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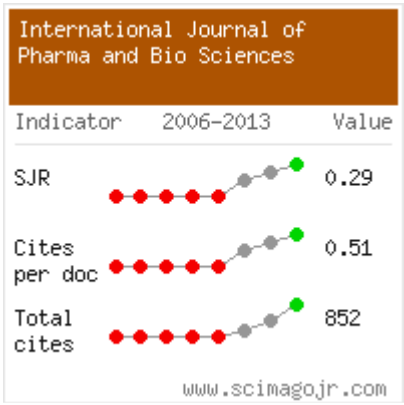

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International Journal of Pharma and Bio Sciences (IJPBS)

Special Issue on

"Engineering and Bio Science"

March 2017

Organised By

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Development of Android Application to Capture Images by Using Wi-Fi Direct

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Abstract---

Background/Objectives: Despite the performance improvements of cameras in a phone, software using cameras are not improved. It is because most of software were developed by using a single smart phone.

Methods/Statistical analysis: This paper proposes an application to take a remote picture by using two smart phones. One is used as a remote camera for capturing image, while the other controls to take a picture while viewing the image transmitted from a remote camera. The system uses the Wi-Fi Direct to send images to other smart phones. The proposed system is designed on the Android.

Findings: To develop the proposed system, we use technologies to control a camera, thread to enhance the performance and Wi-Fi Direct to communicate the image and the commands. One smart phone is used as server and the other is used as client. The server continues to capture a screen shot from a camera and transmits it to other smart phone. The client sequentially receives the transferred image, and displays it on the screen. The task to capture the image and the task to send the image in the server are completely separated. It is more efficient to perform in parallel, rather than performing the two operations in sequence. The two threads are created, and one only captures an image, and the other thread only transmits the captured image. The same problem exists in the client, which for the tasks to receive and display images, they were also carried out in parallel.

Improvements/Applications: To overcome the limitations of the applications to captures the remote images with single smart phone, we proposed the application with two smart phones by using Wi-Fi Direct.

Keywords--- Android, Smart Phone, Camera, Wi-Fi Direct, Image, Thread.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

One of the features most used smartphone takes a photograph with the camera. In particular, the communication through the picture to the development of Internet and SNS is rapidly spreading [1]. As the result, various camera application such as 'Candy camera', 'Photowonder', and 'Camera360' [2] has been released. Most of them are concentrated in the ability to calibrate the picture [3]. Recent trends in the fashion between lovers or friends in the SNS are fashionable the snapshot taking the body using a tripod and camera timer. To take a snapshot by using these methods, it is inconvenient to set the camera timer and use the remote control by using Bluetooth. In order to minimize such inconvenience, this paper proposes a system for taking a snapshot, using the two smart phones. One is used for the purpose of to taking pictures by fixing on a tripod, and the other is used for the purpose of checking picture to be currently taken and of instructing to take a picture.

Smart phone can be used for various purposes to mount a variety of functions. In which the camera is being used in the most diverse and increasingly also being upgraded performance[4, 5].Smart phones without cameras are useless one, and it means that to take pictures on a smartphone is situated in a very important function. Smart phone manufacturers made a lot of effort to improve the performance of the camera and have developed a number of advanced technologies. Despite the rapid performance improvements of such cameras, software using a camera is not greatly improved. Still a lot of people increase their arms or ask others in order to take the picture of their face. This is because most of the software was developed to take picture by using a single smart phone.

Recently a smart phone essentially embeds devices for communicating with another smart phones. A typical device is Bluetooth. But, Bluetooth devices are many limitations in terms of the access distance and the transmission speed[6]. Recently, there is a trend mount Wi-Fi Direct [6, 7]on most smart phone as the device to overcome the limitation of the Bluetooth. Wi-Fi Direct, initially called Wi-Fi P2P, is a Wi-Fi standard enabling devices to easily connect with each other without requiring a wireless access point. One advantage of Wi-Fi Direct is the ability to connect devices even if they are from different manufacturers[7]. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

In this paper, we introduce the development of application that overcomes the limitations of the camera function of the smart phone by using the function of the Wi-Fi Direct. The proposed application is using the two smart phones. One is used as a remote camera for taking remote image, while the other controls to take a picture while viewing the image transmitted from a remote camera. The system uses the Wi-Fi Direct to send images to other smartphones in a smartphone. In order to develop the proposed system, we use technologies to control a camera, thread to enhance the performance and Wi-Fi Direct to send the image and the commands. The proposed system is designed on Android system. It implies that the proposed system has been designed in consideration of the characteristics of the thread and Wi-Fi Direct in the Android.

In Section 2, we introduce the camera technology trends in the smartphone and Wi-Fi Direct technology. In Section 3the development of the proposed application were discussed. Finally, the conclusions were discussed in Chapter 4.

II. RELATED WORKS

A. Camera Applications

Smart phone can be used for various purposes to mount a variety of functions. Specially, the camera is being used in the most diverse and increasingly also being upgraded performance. Smart phones without cameras are useless one, and it means that to take pictures on a smartphone is situated in a very important function. Smartphone camera was generally recognized that it has lack rather than a digital camera in the basic performance. However, the image sensor technology is improved and various camera features are being developed in order to enhance the quality of photos taken with a smartphone camera, and it may give a considerable impact on the digital camera market[3].The camera is a very important factor in the smart phone and it never be even smaller as a criterion in choosing a smartphone. Smart phone manufacturers made a lot of effort to improve the performance of the camera and have developed a number of advanced technologies. In general, smart phones has two cameras, which there is mounted one each on the front and back. Mounted camera looks into a little different depending on the smartphone model, but as considering high-end flagship smartphone criteria, it has 1300 10 000 ~ 1600 million pixels, supporting full HD ~ 4K video recording for

rear camera and 2-megapixel also supporting full HD movie recording for front camera[8, 9].Due to the development of the smart phone camera, also it changes the digital camera market, which births to the result to get easily a good quality camera. Consumers are able to use a lot of camera for better performance and ultimately may lead to the result that the quality of the overall digital image data increases.

Despite the rapid performance improvements of such cameras, software using a camera is not greatly improved. Still a lot of people increase their arms or ask others in order to take their face. This is because most of the software was developed to take picture by using a single smart phone. In order to solve this problem, people use the camera bar or use with a tripod and timer like traditional method. In the case of the former, there is a limitation with respect to the length of the bar. In the case of the latter, it is not easy for people to control the camera, seeing the scene of the camera. To solve the problem, the application for the i-Phone app was released 'Auto Cam Lite' in order to improve the inconvenience of having to use the remote control to place the camera timer using Bluetooth. However, as shown in Figure 1, this application is not only a function to take a look at the role of a smart phone to take the picture, while one of the other smart phone sends the instruction to take a picture by pressing the button. Because of such a disadvantage, it did not attract popular with the public.

Figure 1: "Auto Cam Lite" for i-Phone

B. Wi-Fi Direct

Wi-Fi Direct, initially called Wi-Fi P2P, is a Wi-Fi standard enabling devices to easily connect with each other without requiring a wireless access point. It is useful for everything from internet browsing to file transfer, and to communicate with one or more devices simultaneously at typical Wi-Fi speeds[7]. One advantage of Wi-Fi Direct is the ability to connect devices even if they are from different manufacturers. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

Wi-Fi device helps through more simple and easy connection so that users can take advantage of the output, sharing, synchronization, and display. It is possible to connect directly each other without access to the existing network to mobile phones, cameras, anytime and anywhere by directly connecting a printer, PC, game machine or the like, and sends the content to share applications. It is possible to connect not only one to one but also simultaneous connection of multiple devices and can store the information for one-time connection so that it forms automatically the link when two devices are close. In worldwide, the connection and sharing music, videos, photos and creation of documents are increasing rapidly. For millennial generation to refer to young people between 18-29 years of age in the United States, they are saving an average of 2,400 kinds of music, video and photo files on a digital device. This growth trend is appearing in the same generation of China, Japan and Korea. These generations to come together around a digital camera to view photos of friends and family gathered around a laptop or mobile device also enjoy the movie. Now, using Wi-Fi Direct products they connect with each other to their own devices to share photos, games and videos. Using it, people can be seen comfortably by using the monitor or TV. By applying P2P technology in the Wi-Fi Alliance specifications and certification and testing program, and introducing a new interchange technology combines the unique features. P2P connection technology for consumers will be further expanded. According to a recent survey, US consumers send and receive instant messages, and share the photos with friends and family and it uses a monitor or TV to view your photos as well as mobile devices, in addition to video chatting with the aim of enjoying video games in many places other than home, public transportation, etc. In order to do them all, it showed that they want to connect directly to each other. These results were the same in China, Japan and Korea. In this paper, we develop the application in Android to take a remote picture by using Wi-Fi direct technology.

In the traditional Wi-Fi setup, devices require a gateway to connect to each other, one which we call the Wireless Access Point or WAP, and Wi-Fi Router hub serves as this gateway[10, 11, 12]. The Wi-Fi Direct technology eliminates the need of this separate access point by providing the two devices involved in the connection with their own limited access points. The protocol which is used for this Wi-Fi Direct setup is known as the Wi-Fi Protected Setup (WPS) protocol. WPS standards thus make connecting two devices using

Wi-Fi Direct much easier than connecting two devices using the legacy Wi-Fi connections. Essentially, the Wi-Fi Direct setup includes the use of software within the devices which are to be connected to create Software Access Points or Soft AP. These Soft APs allow the devices to function both as the access point for the Wi-Fi connection, as well as the client which uses this connection. Many of these software or apps are freely available, such as 'SuperBeam', 'Wi-Fi Shoot!' etc. Now that we have a general idea on how Wi-Fi Direct actually works, let us have a look at Wi-Fi Direct, Bluetooth 4.0, and some related factors, and try to understand why Wi-Fi direct is considered to be the better option among these two.

It is clear for new Wi-Fi direct to replace conventional Bluetooth. This is because when using Bluetooth, it requires the additional technologies for controlling Bluetooth device, while it can only use the conventional TCP/IP technology when using Wi-Fi Direct. In addition, Wi-Fi Direct is twice times longerthan Bluetooth for accessing distance and it is 10 times faster than Bluetooth for transmitting speed. Table 1 explains the features of Bluetooth and Wi-Fi Direct.

Table 1: Features of Bluetooth and Wi-Fi Direct

Items	Bluetooth	Wi-Fi Direct
Access Distance	200-300 feets	600 feets
Maximum Speed	25 Mbps	250 Mbps
Security	AES 128 bit encryption	AES 256 bit encryption
Compatibility	Bluetooth devices	Wi-Fi Direct capabilities
Availability	Relatively cheap set means that manufacturers can include Bluetooth in their devices without any excessive hassles	Most new Android devices come with Wi-Fi Direct features

III. DEVELOPMENT OF THE PROPOSED APPLICATION

A Design

The proposed system uses two smart phones. One continuously captures images and then sends it to the other smart phone. The other receives immediately the picture, and displays it screen in order to see the scene. Two start phones run concurrently the proposed application and communicate each by each by using Wi-Fi Direct. Wi-Fi supports TCP/IP. So one of the smart phone is a server and the other is operated as a client. The server-side unit takes to a device for taking images successively and sends to the client-side device. In Android threads are divided into two main types. One is the main thread and the other is a general thread. In the main thread, it is designed for Android user interface. It is the only reason why only the main thread is to allow access to GUI. It implies that conversely any common thread also do not access any components of GUI. For this reason, the main thread can only take a picture in the server-side unit. To reflect this in the design of the system, the main thread continually is to capture an image, and the sub thread sends the taken image to the client unit. The two threads operate in a client device such as the main thread and the sub thread. The sub thread receives continuously the images from the server unit and then sends them to the main thread. The main thread in the client unit receives the images from the sub thread and displays them on the screen so that the user checks his/her snapshot taking the body and moves his/her position. Finally the user gives the instruction to take picture the main thread in the client unit. Then the main thread sends the instruction to the sub thread in the server unit. At the server unit and client unit, the picture is stored permanently.

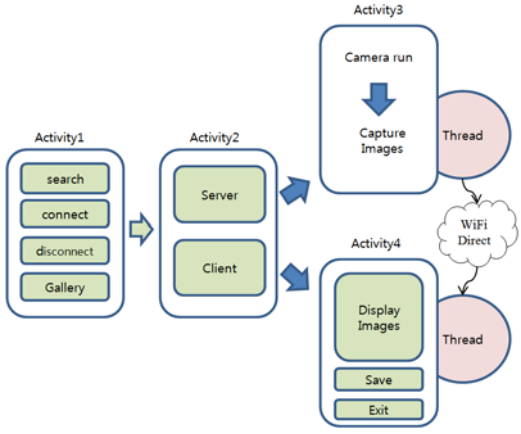

Figure 2: Design of Activities and User Interface

Figure 2 shows the design of the activities with user interfaces. The system consists of four activities. Two smart phones have the same software, so that any one of them can be as the server or the client units. Activity 1 is responsible for the connection of Wi-Fi Direct. It has a function to find devices existing in the range to Wi-Fi Direct for connections. It displays a list of connected devices available through this function and to select the device user wants. When user clicks the connect button for the selected device, it connects this device to the selected devices with TPC / IP and goes to Activity2.In Activity 2, it determines whether this device is in operation as the server or the client. If the device is determined by the server it will run through Activity 3. In Activity 3, it firstly activates the built-in camera, and then waits for request of the image transmission from the client. When it receives the transmission request from the client, it captures the image from camera and transmits the image to the client. If the device is determined by the client it will run through Activity 4. In Activity 4, it awaits a user's instruction and requests the transmission of images to the server. It displays images received from the server to the screen. According to user's command, it determines whether it continues to request the transmission or save the last image or quit the operation.

B. Implementation

The proposed application must first recognize the device to connect with each other before each device connected to each other. At this time, using a frame called "probe" of the data link layer, it is scattered around the devices of the probe request frames to request information relating to the Wi-Fi Direct. The request frame and the response frame use the name as a basic service set (SSID). Devices exchange basic information such as a response frame to the request frame, the device name or a Wi-Fi Direct mode. By selecting the one device of the devices to form a network group, a software wireless connection device is built. The wireless access device is the group owner serving as the start and end of the communication. Therefore, to make the functions of Wi-Fi Direct, it must be negotiated with other Wi-Fi Direct devices and provide the ability to form a group owner. To join the network group, it performs a connection request to the group owner by using the same method to connect to the wireless access device. In order to allow the authorization, group owner is authenticated using approval button of the user, rather than for a password for the authentication operation. These features are called as PBC (Push Button Configuration).Unlike Bluetooth, Wi-Fi device communicates with the client using the IP address. Therefore, if it is determined in the Wi-Fi Direct to the Group owner, it will deploy an IP address to a client like a regular access to their wireless connection. Figure 3 is the algorithm for TCP/IP connection with Wi-Fi Direct, which is developed in the proposed application.

Wi-Fi Direct Setup
1. Create the instance of WifiP2pManager.
2. Initialize Wi-Fi Direct.
3. Register Broadcast Receiver.
4. Search devices with Wi-Fi Direct and select a device.
5. Request the connection through Wi-Fi Direct
6. Create server socket or socket.

Figure 3: Algorithm for TCP/IP Connection with Wi-Fi Direct

The two smartphones are first connected to a TCP / IP using the Wi-Fi Direct previously described. Since two smartphones are connected to a network, one must continue to capture a screen shot from a camera and transmits it to other smart phone as the server. Other smartphone sequentially receives the transferred image, and displays it on the screen. This is the same as real-time relay system in the camera and the image output device are connected wirelessly. If the user commands to save, it stores the image transmitted in the most recently to the external card. Figure 4 represents an algorithm for two smart phones.

Algorithm for the server	**Algorithm for the client**
1. Searches the client device by using WiFi direct.	1. Requests the connect by using WiFi direct.
2. Connects the client by using TCP/IP.	2. Connects the client by using TCP/IP.
3. Receives the command to send images from the client.	3. Requests the image captured by the camera.
4. Captures the image from camera.	4. Receives the transmitted image.
5. Sends the captured image.	5. Display the image on the screen.
6. As receiving the command "quit", exits.	6. If the user commands "save", saves it to the external card.
7. Repeats the step 3.	7. If the user commands "quit", sends the command to the server and exits.
	8. Repeats the step 3.

Figure 4: Algorithms for Server and Client

The task to capture the image and the task to send the image are completely separated in the algorithm for the server. Therefore, it is more efficient to perform in parallel, rather than performing the two operations in sequence. In other words, it is also possible to capture a new image during transmitting the image which was captured just shortly before. To do this, the thread technology of Android is used in this paper. The two threads are created, and one only captures an image, and the other thread only transmits the captured image. The same problem exists in the algorithm for the client. In other words, for the tasks to receive and display images, they can be also carried out in parallel. In this paper, we implemented two threads, one is only to receive the image and the other is to display image on the screen.

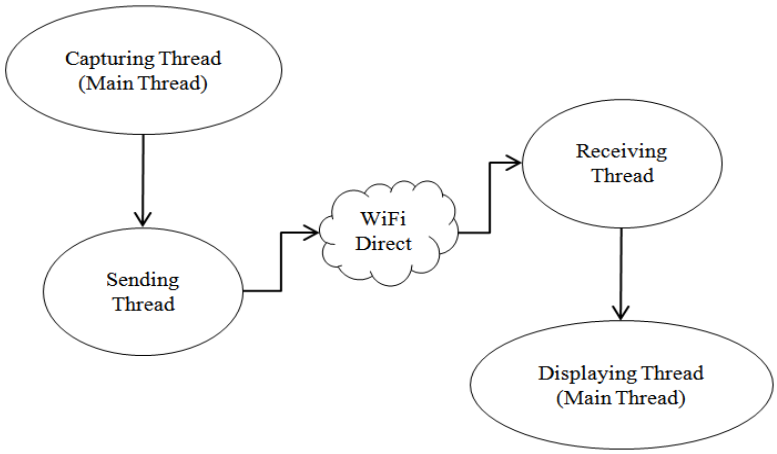

Figure 5: Threads in the Server and the Client

Figure 5 shows those threads in the proposed systems, where the main threads are the thread for user interface in Android. In Android, the main thread only captures the image from the camera and displays the image to the screen. Conversely main thread can never gain access to network resources. The handshake protocol was applied between the sending thread and the receiving thread, which is not shown in Figure 5.

IV. CONCLUSION

In this paper, we proposed the development of the application on the Android which takes a picture by using two smart phones. Because the remote phone sends continuously the scene to the phone, the user can take a picture confirming the scene to be stored. To do this, we used the Wi-Fi Direct network supplied by Android. Smart phone can be used for various purposes to mount a variety of functions. Specially, the camera is being used in the most diverse and increasingly also being upgraded performance. Despite the rapid performance improvements of such cameras, software using a camera is not greatly improved. Still a lot of people increase their arms or ask others in order to take the picture of their face. This is because most of the software was developed to take picture by using a single smart phone. Recently a smart phone essentially embeds devices for communicating with another smart phones. There is a trend mount Wi-Fi Direct on most smart phone as the device to overcome the limitation of the Bluetooth. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

In this paper, we proposed the application that overcomes the limitations of the camera function using the smart phone by using the function of the Wi-Fi Direct. The proposed application is using the two smart phones. One is used as a remote camera for taking remote image, while the other controls to take a picture while viewing the image transmitted from a remote camera. The system uses the Wi-Fi Direct to send images to other smartphones in a smartphone. In order to develop the proposed system, we use technologies to control a camera, thread to enhance the performance and Wi-Fi Direct to send the image and the commands. The proposed system is designed based on Android system. It implies that the proposed system has been designed in consideration of the characteristics of the thread in the Android.

ACKNOWLEDGMENT

This research was financially supported by Hansung University.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Relationship Between Experiences of the Clinical Nursing Practice in Neonate Room and the Consciousness of Biomedical Ethics of Nursing Students

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Abstract---

Background/Objectives: This study was undertaken to determine the relationship between the clinical experience in nursing practice in the neonate room and the consciousness of biomedical ethics of nursing students.

Methods/Statistical analysis: The data, self-reported questionnaires were given to 55 Junior nursing students in nursing college located in Cheonan city in Korea which were gathered during the period of Feb. 22 to 26 2016. The descriptive statistical data was analyzed using $\chi 2$-test, one-way ANOVA, and Tukey Post-Hoc test. It showed a significant difference between the experience of clinical nursing practice in neonate room and the biomedical ethic consciousness.

Findings: The subjects who had longer experience in clinical nursing practice in neonate room were noted more high score on biomedical ethics, artificial abortion ($F=21.365$, $p<.001$), artificial insemination ($F=16.349$, $p<.001$), prenatal diagnosis of fetus ($F=15.681$, $p<.001$), and the right to the life of newborn ($F=58.942$, $p<.001$).

Improvements/Applications: The results obtained from this study are expected to provide a valuable baseline data to develop improve the curriculum in Pediatric Nursing and establish the biomedical ethic consciousness of nursing students.

Keywords--- Clinical Nursing Practice, Neonate Room, Biomedical Ethic.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Nowadays, there are various unknown types of infectious disease spreading rapidly in the world and medical environment is changing according to advances in biomedical technologies. Accordingly, it is required for healthcare team members to be diverse in professional medical skills.

Education in nursing science aims at the improvement of clinical practice as well as nursing knowledge and it is necessary to develop alternative approaches to secure the sufficiency of clinical training for students in variety of clinical environments[1]. The clinical nursing practice can also stimulate the students to build a basis making a decision on ethical and moral judgment.

The issues regarding biomedical ethic include diverse behaviors of patient and medical members[3]. The biomedical ethic education is more important for nursing students who are to be the future leaders of medical society and the change of bio-science and medical technology need to modify a new set of ethical issues which cannot be addressed by traditional ethic[4].

Recently there are serious financial difficulties in society and many neonate care units have closed down due to the decrease in birth rates and problems in management resulting in aggravation of the insufficiency of clinical training[5]. Therefore, the aim of this study was to identify the relationship between the experiences of clinical nursing practice in neonate room and the biomedical ethic consciousness of nursing students that enables to offer the baseline to develop the curriculum in clinical practice in Pediatric Nursing.

II. MATERIALS AND METHODS

This study was carried in a descriptive research in nature to identify the relationship between experiences of the clinical nursing practice in neonate room and the biomedical ethic consciousness of nursing students. The data was collected during the period of Feb. 22 to 26 2016, with 55 Junior nursing students in nursing college located in Cheonan city in Korea.

The tool to measure the biomedical ethic with 49 items developed originally by Kwon (2003)[6]. Out of 28 items, this tool was specially selected related to fetus and newborn that is divided into the following five subcategories: 5 of the rights of fetus, 6 of the artificial abortion, 7 of the artificial insemination, 5 of the prenatal diagnosis of fetus, 5 of the rights of newborn.

The numbers of the subjects were proved substantially to meet the criteria for $\chi 2$-test, one-way ANOVA, and Tukey Post-Hoc test which showed that the minimum number of the subjects required statistical analysis in this study. 55 nursing students were estimated using G*power Program 3.19 at the significance level of .05, test power of .75, and the effect size of .5.

III. STUDY RESULTS

A. General Characteristics and Homogeneity Test

Table 1 indicated that the general characteristics among 55 subjects in this study divided into 3 groups with no experience, 1 and 2 weeks of experiences in clinical nursing practice in neonate room. The result of analyzing general characteristics and homogeneity was not found in terms of gender, type of family, religion, and level of knowledge of biomedical ethics.

Table 1: General Characteristics and Homogeneity Test by 3 groups

Variables	2wks(n=15)	1wk(n=19)	no(n=21)	Total(N=55)	χ^2	*p*
	n(%) or Mean(SD)					
Sex*						
Male	1(6.7)	0(0)	0(0)	1(1.8)	2.284	.27
Female	14(93.3)	19(100)	21(100)	54(98.2)		
sibling*						
older	9(60.0)	12(63.2)	11(12.2)	32(58.2)	4.269	.37
younger	6(40.0)	4(21.1)	9(7.3)	19(34.5)		
no	0(0)	3(15.8)	1(1.5)	4(7.3)		
Religion						
Having a religion.	10(66.7)	9(47.4)	12(57.1)	31(56.4)	1.278	.53
Not having a religion.	5(32.3)	10(52.6)	9(42.9)	24(43.6)		
ethics						
confirm	5(33.3)	7(36.8)	7(33.3)	19(34.5)	.068	.97
confused	10(66.7)	12(63.2)	14(66.7)	36(65.5)		
Known of biomedical ethics*						
Yes	13(86.7)	18(94.7)	21(100.0)	52(94.5)	3.018	.22
no	2(13.3)	1(5.3)	0(0)	3(5.5)		
Thinking about biomedical ethics*						
Yes	12(80.0)	12(63.2)	17(81.0)	41(74.5)	1.873	.40
no	3(29.3)	7(36.8)	4(19.0)	14(25.5)		

B. Comparison of Experiences of the Clinical Nursing Practice in Neonate Room and the Biomedical Ethic Consciousness of Nursing Students in Nursing Department

Table 2 indicated that an analysis of the comparison according to 3 groups in biomedical ethic consciousness. The average of total items of biomedical ethics with no experience, 1and 2-week groups experienced the clinical nursing practice in neonate room were 83.95±6.62, 98.89±5.70, 102.87±3.60, showing a statistically significant difference (F=59.296, p<.001*)*. This means that the subjects who had experienced longer clinical nursing practice in neonate room showed more high score on biomedical ethics. As a result, Significant findings of each items showed artificial abortion (F=21.365, p<.001*)*, artificial insemination (F=16.349, p<.001*)*, prenatal diagnosis of fetus (F=15.681, p<.001*)*, rights of newborn (F=58.942, p<.001*)*, excluding rights of fetus (F=3.177, p=.05).

Table 2: The Comparison of Experiences of the Clinical Nursing Practice in neonate-room, Consciousness of Biomedical Ethics

Variables	2wks (a) (n=15)	1wk (b) (n=19)	no (c) (n=21)	Total (N=55)	F / p
	Mean±SD				
total item	102.87 ±3.60	98.89 ±5.70	83.95 ±6.62	94.27 ±10.00	59.296 <0.001
Right to Life of Fetus	17.07 ±1.80	16.58 ±2.20	15.38 ±2.18	16.25 ±2.18	3.177 .05
Artificial Abortion	28.40±2.38	26.89 ±2.23	22.95 ±3.07	25.80±3.48	21.365 <0.001
Artificial Insemination	21.27 ±1.44	20.42 ±1.54	17.48 ±2.87	19.53 ±2.67	16.349 <0.001
Prenatal Diagnosis of Fetus	17.53±.74	17.11 ±1.20	14.71±2.37	16.31±2.08	15.681 <0.001
Right to Life of Newborn	18.60±.99	17.89 ±1.85	13.43±1.69	16.38 ±2.83	58.942 <0.001

IV. DISCUSSION

The consciousness of biomedical ethics was influenced by being experienced period of the clinical practice in neonate room. The results of this study were similar to the report of correlations between the nursing practice and consciousness of biomedical ethics of nursing students[7] and relationships between nurse's consciousness of biomedical ethics and nursing performance[8]. Therefore, these suggested that nursing majors should be educated continually on a biomedical ethic realm combining theory and practice and offered topics on various areas.[4]

The results of this study recommended the simulation-based educational program should be followed for a significant improvement of the consciousness of biomedical ethics because the nursing students have not a chance to practice in neonate room due to closing neonate rooms with decrease in birth rates.

Finally, this study supports valuable information and baseline data to develop curriculum in Pediatric Nursing considering the importance of the clinical nursing practice in neonate room to establish the consciousness of biomedical ethics of the nursing students. And this study suggests that we should identify the proper curriculum in pediatric nursing practice to improve the consciousness of biomedical ethics of the nursing students. The additional thought placed on the education program of biomedical ethics should be developed to make a proper decision on ethical issues.

ACKNOWLEDGEMENT

This study was supported by the Research Program funded by the Baekseok University.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Dilemma between the Author's Rights and Neighboring Rights in the Era of Music Streaming Service by the Development of IT: Implications and Alternatives

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Abstract---

Background/Objectives: The study analyzed that copyright law has more inclined to protect neighboring rights than authors' rights in realities focusing on music industry in S. Korea and suggested alternatives for improvements.

Methods/Statistical analysis: Literature review was conducted focused on the researches of the change of music market in cultural industry and its influence on the origin of copyright law including the growth of music streaming service by IT and relatively neglected authors' rights; specifically the complexity of the distribution structure of digital music, the imbalanced structure of music industry and unreasonable distribution rate of digital music profits based on the secondary data.

Findings: IFPI predicts that streaming music will overtake downloads in 2017. Similarly, in S. Korea, the sales volume of music industry has increased steadily with annual average of 5.8 percent from 2011 to 2013 and that of online distribution business has been increasing every year. However, the complexity of the distribution structure of digital music and monopoly and oligopoly by a few companies arouse concern about how the rights of music authors could be guaranteed. In reality, while the sales of distribution of music were about 2.6516 trillion Korean won, the sales of creation and production of music were about only 819.8 billion won in 2012 and this presented the serious imbalance in the profits of music compared with the other cultural contents such as game, publishing and so on. Furthermore, recently, music service business operators' combining with distribution business arouses concern about accelerating the disproportionate structure of music profits; they acquire even content production business. This will cause more severely imbalanced structure than the present, especially for authors.

Improvements/Applications: The Copyright Act should be supplemented with more substantial and realistic measures, e.g. of the current distribution rate of music profits to protect practically creators of works, i.e. authors.

Keywords--- Copyright, Copyright Law, Music Copyright, Author's Right, Neighboring Right, Distribution of Music Profits.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Human beings have an inalienable right to invent themselves and their endeavors appear quite often as creating works. Arts such as music, paintings and photographs are the examples. A copyright law in any society is established for protecting the rights; the term "work" by the law means a creative work that expresses human thoughts and emotions. For example, musicians express their rights as composing operas, writing lyrics, recording albums or performing music[1]. This study is started with questioning for whom copyright law is intended in the environment of prevalence of digital media by the development of IT; reconsidering the purpose of establishing the law, so called the world's first copyright law, the Statute of Anne which was enacted in England in 1710. Exercising its power under the newly adopted Constitution to secure the rights of authors and inventors, Congress passed an act almost identical to the Statute of Anne as the first American copyright law in 1790[2].It is generally agreed that copyright law and technological progress have forever been linked and it also appears in the purpose of the Copyright Act in S. Korea; that is to protect the rights of authors and the rights neighboring on them and to promote fair use of works in order to contribute to the improvement and development of culture and related industries[3].But, seemingly, the law has been weighted towards the neighboring rights not the rights of authors now a days; the study analyzed the realities focusing on music area in S. Korea, found their implications and suggested alternatives for improvements.

II. LITERATURE REVIEW

A. Problems

According to IFPI(International Federation of the Phonographic Industry), the global music market achieved a key milestone in 2015 when digital became the primary revenue stream for recorded music, overtaking sales of physical formats for the first time[4]. They reported that digital revenues now account for 45 per cent of total revenues, compared to 39 per cent for physical sales. And a 10.2 per cent rose in digital revenues to US$ 6.7 billion, with a 45.2 per cent increase in streaming revenue more than offsetting the decline in downloads and physical formats. Fig. 1 presents that streaming will overtake downloads in 2017[5].

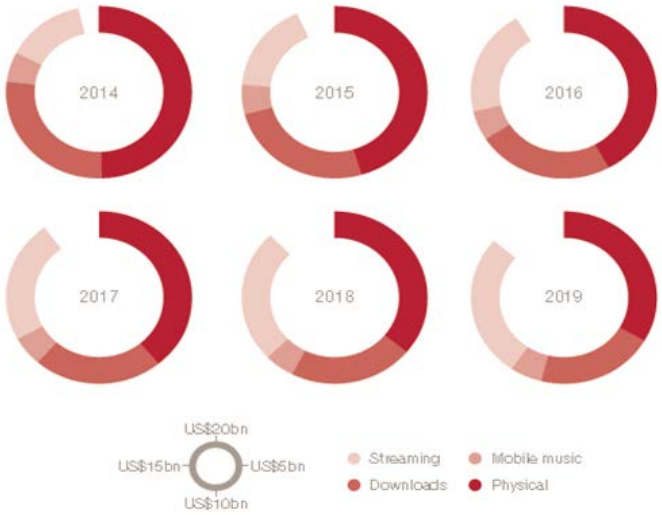

Figure 1: Global Recorded Music Revenue by Source (US $ bn), 2014-2019

This trend is similar in S. Korea, where music industry shows the highest growth rate in cultural content industries and is recognized as a part with great expectations in the future. The sales volume of music industry has increased annually by average of 11.8 percent, with recording 2.7408 trillion Korean won of 2009 and 4.2772 trillion won of 2013(an increase of 7.1 percent compared with the previous year), which increased steadily with annual average of 5.8 percent from 2011 to 2013[6]. And the sales volume of online distribution business has been increasing every year as shown in Figure 2[7].However, as shown in Fig. 3[8], the complexity of the distribution structure of digital music and monopoly and oligopoly by a few companies arouse concern about how the rights of music authors could be guaranteed.

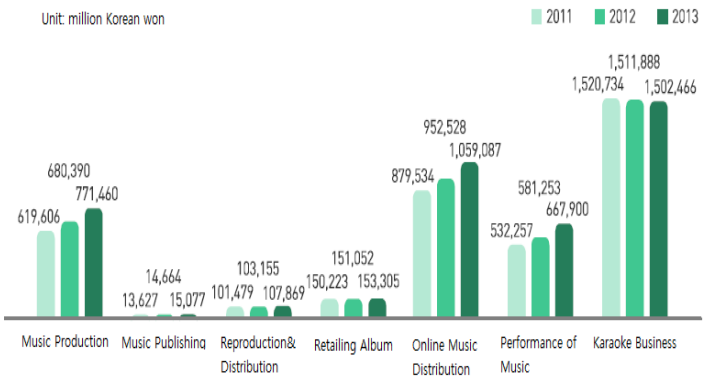

Figure 2: The Trend of Music Industry by Type of Business and Year in S. Korea

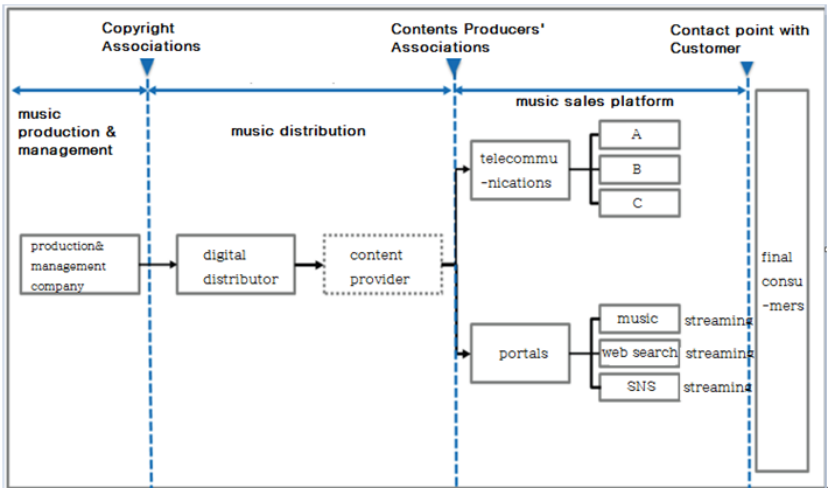

Figure 3: The Distribution Process of Digital Music in S. Korea

In reality, while the sales of distribution of music were about 2.6516 trillion won, the sales of creation and production of music were about only 819.8 billion won in 2012 and this presented the serious imbalance in the profits of music compared with the other cultural content areas such as game, publishing and so on[9]. Fig. 4 shows the differences of the portions of music profits between domestic market and iTunes[10].

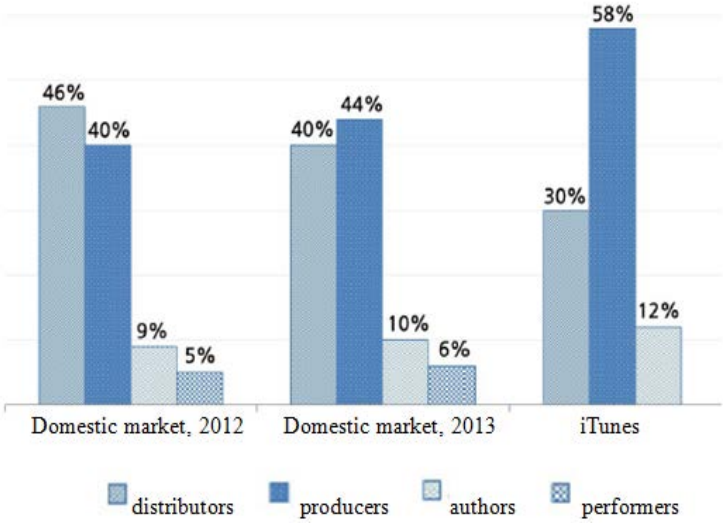

Figure 4: Comparison of the Portions of Music Profits Between Domestic Market and iTunes

B. Implications

Although copyright law, presently, is enacted for not only authors' rights but also neighboring rights, it has been criticized that the Act has been more inclined to protect neighboring rights, which is implying that the latter is more important than the former. With the development and diffusion of Internet based on IT, infringement of copyright is more concerned than before in cultural industry and this seems to be because of a prevalent view that competitively making profits is more important than protecting copyrights in cultural industry[11]. To date, copyright law has broadened its scope of protection for works by virtue of the development of technology since the Statute of Anne. Although the advancement in scientific technology supports actively copyright business, this gives us confusion of the concept of 'authorship' because it causes negative side effects on authorship that are related to the challenges by economic issues from cultural industry[12, 13].

With the background of this, it is assumed that the Act is used for instigating economic profits rather than protecting the expressions of human creative spirits, like thoughts and emotions. And this is proved by Table 1[14]. Furthermore, the recent trend of music service business operators' combining with distribution business arouses concern about accelerating the disproportionate distribution structure of music profits; they acquire even content production business. Then, the structure of music industry will be more severely imbalanced than the present, especially for authors.

Table 1: Distribution Rate of Digital Music Profits

Seller	Producer					
Business Operator	Neighboring Rights		Authors' Rights		Performers' Rights	
40%	44%		10%		6%	
Business Operator	Distributor	Content Producer	Copyright Association	Author	Federation of Performers	Performer
40%	8.80%	35.20%	0.90%	9.10%	1.17%	4.83%
40%	60%					
·	Average commission for distributor, 20%/Commission for copyright association, 9%					
·	Commission for federation of performers, 19.5%					

III. ALTERNATIVES

As mentioned above, there have appeared various unfair practices in the imbalanced structure of music industry. Historically, music copyright issues have always affected the music industry which is connected with the creation and circulation of music. However, currently, music copyright is affected by the development of technology[15].In this context, first of all, it is necessary to compensate defects of the Copyright Act and establish the substantial and realistic measures to protect practically creators of works, i.e. authors. Specifically, the current distribution rate of music profits, which is relatively lower than international standards, should be changed by a way of more reasonable aspect. And the substantial and realistic measures should include protection articles for conclusion off air contracts between business operators and authors against invisible pressure.

Besides that, it is necessary to amend other laws associated with the Act and make up for the weak points of the Act; firstly, Music Industry Promotion Act[16]for the purpose of providing for the matters necessary for the promotion of the music industry and facilitating the growth of related industries; secondly, Artists Welfare Act[17], to protect professional status and rights of artists and to contribute to the development of arts by promoting their creating works by supporting their welfare; and thirdly, Framework Act on the Promotion of Cultural Industries[18], to lay the groundwork for the development of cultural industries and enhance the competitiveness thereof, thereby contributing to the improvement of the quality of national cultural life and development of the national economy, by providing for matters necessary for supporting and fostering cultural industries should be amended not to break the balance of the industry. Furthermore, Monopoly Regulation and Fair Trade Act[19] should include the issues that a big company or conglomerate can't monopolize the music market.

IV. CONCLUSION

The imbalanced structure of music industry that is composed of the low portions of creation and production of music compared with excessively high portions of distribution in music profits should be

changed for the future when IT will govern the way of listening music[20], i.e. streaming. As far as copyright is based on creativity of author's work, it could be a channel for cultural development, but should not be way for economic development of cultural industry. In other words, the legal framework of copyright and copyright law should be basically built on authorship even in the current environment of emphasizing on the power of cultural industry which concentrates economic welfare for the public or the economic reward from author's work via copyright business.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on Diagnosing Security Vulnerability Issues of Big Data and Internet of Things under IT Convergence Environment

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Abstract---

The internet of things (IoT) system shows the characteristics of a smart device by mounting various sensors and communication functions to the system. The data generated in the IoT environment is beyond the range of processing within given cost and time. In this paper, security vulnerability occurring in the IoT and Big data environments is diagnosed. A new security vulnerability may occur in each component in IoT, since a component is connected to security vulnerability. The property of data generated in both the IoT and Bid data environments is related to that of Big data, so security vulnerability issues in these environments are related those of Big data. When these issues are diagnosed based on this relationship, a security measure may be effectively achieved. This paper shows the importance of and necessity for security in this new ICT environment and the factors that can lead to security vulnerabilities.

Keywords--- Security Vulnerability, Security Issues, Internet of Things, Big Data, IT Convergence Environment.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The internet of things is the network of sensor devices, such as sensor electronics, electronic appliances, and others embedded with electronics, software, sensors and network connectivity that enables these devices to collect and exchange data[1]. The IoT network consists of sensors for sensing a particular situation or environment (Sensor Node), a processor for processing the collected information, and a data transmitting and receiving device (Sink Node). In IoT, a seamless communication and information delivery is achieved from a physical component, such as a sensor to user service, so security vulnerabilities specific to each individual component may exist. Anew security vulnerability may occur in each component in IoT, since a component is connected to security vulnerability. Big data is difficult to manage and analyze by conventional methods, since its data format is diverse and unstructured and its distribution speed is fast. The reason for doing research on security issues of both IoT and Bigdata is that it may be more effective in achieving security measures, when the relationship from the attributes of data generated in IoT and to that in Big data is diagnosed. This paper derives and diagnoses security issues of both IoT and Big data in the IT convergence environment.

II. THE STRUCTURE OF IOT NETWORK

The components of IoT, as shown in Figure 1, are humans, things, the Internet, and distributed services. Uniquely identifiable tools and devices are the range of things. The range of things are uniquely identifiable tools and devices. The interlocking process of IoT is connected to sensing - networking - information processing - intelligent relationship - information exchange between things. In order to apply IoT in real life, generic technologies need to be syntagmatically implemented. Generic technologies can be divided into the sensor and network hardware technology, such as controllers and communication chips, the middleware software technology for storing and analyzing the data received from things, and the application software technology that interprets, expresses, and processes data as meaningful results. The sensor network technology is the very basic technology that recognizes, extract data from things, and transmits them to the Internet. The role of human in IoT environment is to implement IoT and utilize the final information. Human doesn't need to be involved on the operational stage, since the operation of things isautomated[2,4].

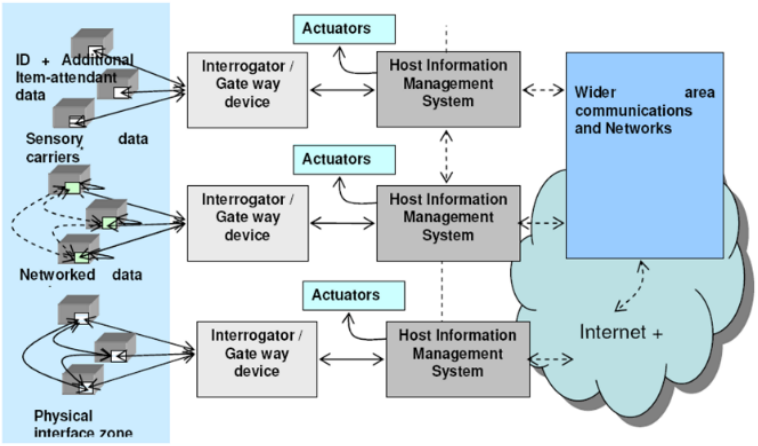

Figure 1: The Structure of IOT Network

Source : 2014 TATA consultancy services

III. SECURITY ASSOCIATION BETWEEN IOT AND BIG DATA

A. Data Collection Process

Things is a simple, an off-the-shelf and a programmable device. IoT means that every thing is connected to the Internet in IoT. Even animals, plants and locations are connected to the Internet as well as all kinds of goods and products. The concept of IoT is same with that of ubiquitous communications – anywhere and any object and assumes a connection to the Internet. In IoT, an infrastructure is created, where information between people and things, and things and things is exchanged and communicated each other, when all things of the world are connected, based on IT, via the Internet. Things are physical objects constituting the natural

environment, such as humans, vehicles, bridges, various electronic devices, eyeglasses, watches, clothing, cultural property, plants and animals. In IoT, the characteristics of smart devices by mounting various sensors and communications capabilities on things in the current application environment of IoT is shown. IoT generates the data beyond the range of data processing within given cost and time in a system, a service, an organization (or company). This feature, as shown in Table 1,shows the generation process of Big data in IoT environment[3,5].

Table 1: Characteristics of Data Generated in IoT

Division	Characteristics
Data collection process	Data collected by the program by hand , not machine
Property of data	Data - much finer than existing data, generated from machinery, sensors , programs, such as click stream, Meter
Data owners	Data from outside organization where the production and management of data is not possible
Data type case	Unstructured data -user data, such as video stream, image, audio, social networks, sensor data, application program data

B. Data Attributes Side

Big data, as shown in Table 2,is structured or unstructured data that is too large, compared to existing data, to collect, store, retrieve, analyze, and visualize by existing methods and tools. It is also data beyond the range of data processing within given cost and time in a system, a service, and an organization. Even though Big data has useful advantages as well as dangerous drawbacks, it will be actively used in marketing. It is information that has comprehensive consumer information, such as gender, ages, hobbies, interests. Analyzing Big data does not simply mean analyzing a large amount of data. System or service itself should have ability of adapting to Big data as well as analyzing ability. Organization that plans, develops, and operates systems or services should have ability to deal with Big data. Big data can't be solved with one solution, and should be solved with a variety of solutions, depending on the requirements and properties of data[6].

Table 2: The Property of Big Data

Producer	Data produced from computer	Data produced by human	Relationship data
	Application server log (website , games, etc.) Sensor data (weather, water , smart grids , etc.) Image , video (traffic , security camera etc.)	Twitter , blogs, email, photos , bulletin board posts , etc.	Facebook , LinkedIn , etc.
Type	Orthopedic	Half-orthopedic	Atypical
	Structured data stored in DB	Web document , metadata , sensor data , process control data , call detail data, etc.	Social data , documents, audio, video , images, etc.

Source : NIA, Securing data resources and quality control measures in the Big data era, 2012.5

IV. SECURITY VULNERABILITIES IN THE IOT AND BIG DATA ENVIRONMENTS

A. Security Vulnerabilities at Terminal Aspects

The IoT terminals holds the vulnerabilities of its own. These are also same with the typical properties of information processing devices - hackers' attacks and malware infections. It can be seen that the attack patterns and threats threatening information security environment of IoT is equivalent to that of PC. Hackers tends to select attack targets that can generate a large amount of damage effect within a short time. Targets used to be devices which are popular and used extensively. Hackers attack or distribute malicious codes by utilizing OS vulnerabilities and protocol vulnerabilities discovered in Smart TVs. IoT devices are small computers and, of course, use OS. By using IoT devices, hackers may do search, use social networks, and install new apps. Like security threats in the traditional database, data security threats in the IoT are serious threats. These can be threatening of spilling the backup of the entire file system with Root privileges, spilling from insiders, and exporting the data by using DB administrator's privileges.

B. Security Vulnerabilities at Data Aspects

IoTmay increase the analytical data, since traffic is increased and security threats are occurred by changes in various smart devices and the Internet environments. Data volume of IoT environment is based on size of the data. MIME data, such as mail data or web log data is correspondent to several PB, however, Twitter

network data is less than several tens of GB. The analysis and processing of data is a significant concern. There is a difficulty in handling the attributes of data, as shown in Table 3, since the properties of data, not the size of data, is important. The *velocity* means the speed of data processing. It is a function that returns the result of processing after processing a number of user requests in real time, if necessary. The various data is analyzed in the traditional enterprise data and stored in ERP, SCM, MES, CRM, or etc. It is the operating data generated from within the enterprise.

Table 3: The Attributes of Big Data Security Quality

Division	Attributes
Confidentiality	Only the Big data owner or a person who is authorized from the owner, and a person who receive authorization from the relevant legal regulations can access to information
Integrity	Ensuring that the creation, modification and deletion of Big data information by an unauthorized party is prevented.
Availability	The user is given permission to use big data information services at any time.
Certification	Accessing to inside big data information assets from outside, it should be authenticated
Repudiation	Prevent to deny the action of the information systems usage

V. CONCLUSION

In order to cope with security vulnerability in IoT and Big data environments, it is important to encrypt and authenticate messages sent between the nodes for establishing a secure wireless sensor network environment. An encryption algorithm and the key management protocol are necessary for encryption. The protection of privacy is also necessary in large data processing created at the same time on different channels. In order to meet the constraints and requirements of the security sensor network, a technique including a light-weight, and password authentication technology suitable for environmental sensors, light key management techniques, the privacy protection technology preventing side-channel attack, and techniques must be used. The lightweight intrusion detection mechanism functions need to be appliedto secure detecting node connected to the network. It is necessary to grasp the identification number of the terminal authentication techniques and systems for sensors unmanaged by humans. The increased traffic and security threats caused by changes in various smart devices and Internet environments, quality control programs procedures need to be institutionally and procedurally organized.

ACKNOWLEDGMENT

"Funding for this paper was provided by Namseoul University"

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Comparison Analysis of the Structure of Meaning Generation in <Dangun Myth> and <Leafie, A Hen Into the Wild>

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Abstract---

Background/Objectives: Myth suggests the ideal type pursued in overall national and periodic background of universality, morality, and society. This study aims to figure out if the most well-known animations, <Dangun Myth>, and the most successful animation, <Leafie, A Hen Into the Wild>, have any similarities or differences.

Methods/Statistical analysis: The framework of literary analysis is based on the legible premise of structural semiotics for the world of meaning made in the boundary of cultural space. Greimas set the category of the actor as three paired binominal opposing relation and analyzed the structure of meaning generation after he modeled every descriptive structure. Thus, this study aims to analyze meaning that focuses on desire of narratives and subjects through actantial model and semiotic square.

Findings: As a result of analysis, subject is anti-social and system reformist, but it shows passive structure caused by suffering effort and sacrifice. About relation between subject and object, it is nearly passive form. It rather operated as reward for accidentally received endurance than acts as a subject, and the relationship strongly shows one-sided relationship toward the object from the subject instead of being interactive. The sender and receiver rather acted for their desire as they gave themselves targets and hoped to complement their weaknesses than being affected by external factors. Helper has common with the sender and receiver since they both disappear from subject due to death or leaving after they play a role to give birth. In aspect of sociality, though opposite relation is anti-social and system reformist, it appeared to be subordinate to the power, and positive relation appeared to be mother-son relationship. About paradoxical relation, while subject is not able to adapt new world and stays at the its boundary, object rather overcomes suppression of existing society with father's name, in other words, it appeared to be the structure that seizes power after the blood relationship is admitted.

Improvements/Applications: Myth still has affected to our emotion as it has been melted over overall society. I hope the animation becomes friendlier to the public as it creates more various meanings based on this narrative structure.

Keywords--- Subject, Object, Meaning, Desire, Relation.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Myth exists anywhere in the world in form of a birth myth, a historical myth, a folk tale, and so on. Especially, most countries have their birth myth, and it suggests the ideal type pursued in overall national and periodic background of universality, morality, and society. “Truths are perceived by people as the fact of culture and therefore they functions in accordance with laws of myth. Researches of mythology from the point of view of culture provide close relation with other sciences,“ such as ideology, philosophy, aesthetics and religion[1]. Like this, as myth has operated to various areas, it always exists nearby us, and it consciously or unconsciously affects a lot to our life from children culture to adult culture. Thus, we may find out various structure of meaning generation if we compare and analyze which structure of meaning generation the most popular <Dangun Myth> has and which structure it is applied in now. This meaning generation structure is possible through figuring out the object about subject and relation of object that main character wants to save, which is shown as an axis that reflects main character's desire. Desire is clearly exposed more in relation between sender and receiver, and opponent. In various relations with main character, desire shows meaning generation structure in various aspects, and this desire also speaks for the desire of the era. Therefore, we may find out the meaning if we analyze how meaning generation structure of <Dangun Myth> to the modern animation, <Leafie, A Hen Into the Wild>. The framework of literary analysis is based on the legible premise of structural semiotics for the world of meaning made in the boundary of cultural space. Greimas set the category of the actor as three paired binominal opposing relation and analyzed the structure of meaning generation after he modeled every descriptive structure. Thus, this study aims to analyze meaning that focuses on desire of narratives and subjects through Greimas'sactantial model and semiotic square. For selection of subject of study, the animation with many audiences had to be chosen among recent animation films played at theaters. As a result, <Leafie, A Hen Into the Wild> was selected. Thus, this study aims to analogize conclusion through analysis of the most popular <Dangun Myth> and <Leafie, A Hen Into the Wild> based on Greimas theory.

II. LITERATURE REVIEW

A. Greimasactantial Model

The actant means people or objects that independently complete or endure an action. Teniyer (?) defined "actant means existences or objects that participate in the process with figurant in the most passive type regardless of qualification or type [2]. The concept of the actant is represented in animation by character. This effectiveness of the actant concept covers not only animation's human, animal, plant, object, and mixed figure but also human, animal, impersonated objects, or imaginary concept[2]. We may figure out ideological meaning of naturally hidden concept if we interpret "the meaning" according to the myth[3].

Subject and Object

The subject of animation means existence that is able to carry out the action and the character that gives directions for behavioral principle. According Greimas, main agent appears as an actant, and essence of the actant depends on the function that it is imprinted. Conversational subject originated by conversational linguistics may possess various behavior positions inside of speech flow, and it sustains its identity during conversation is in progress through corresponding action process. The subject is distinguished into 'sujetspragmatiques' and 'sujetscognitig', and this is explained by behavior speech flow and state speech flow. The object is only defined to relation with main agent. Among a number of subjects that a conversation includes, the object is only connected by a subject, and it is the object only when it is targeted[4]. The subject is an existence that is looking for object and desire that the subject wants, and relation between the subject and the object is explained with the relation with this desire. Therefore, relation between the subject and the object are bonded, both are connected in the relation of mutual premise.

Sender and Receiver

While propp belongs to sender's behavior area, receiver is subject-main character in general. This main character is assigned mission to solve lacking situation or to recover damage[2]. Relation between sender and receiver has causative structure, which someone asks someone to do something. Greimas defines causative verbal sense (to order) and awarding verbal sense (to give) contract relation. Greimas calls sender manager

of the value system appearing in conversation. In other words, sender who controls is regarded as the first sender, and sender who judges regulation and reward and punishment is regarded as the final sender. Therefore, sender is considered as high ranked dominant relationship compared to receiver. Sender and receiver are associated with abstract ideology as they explain about desire in value system occurred at this process[5]. In process to guide subject to the way of explore, receiver and the subject are in concordance. Main character is defined as the subject at relation with desire's subject, and it becomes the receiver at relation with sender. Sender evaluates receiver, and it has structure to grant constant value on the object that it wants as the subject.

Helper and Opponent

Regarding subject and object, two kinds of functions are: First, it is the function that helps conversation as it behaves at desire's direction. Second, on the contrary, it is the function that faces desire's realization or object's conversation and makes obstacles. This bundle of two functions may be considered as two actants under name of helper and opponent respectively[6].

B. Actantactantial Model

This actantial model is the tool that enables to look at various structure from one sentence to whole text. Especially, when we look at structure of character at animation, we can figure out the meaning easily. Thus, character structure analysis becomes easy when this model is used. Also, related structure of characters that appears in the literary work may be illustrated easily. Therefore, we can understand the direction of progress easily and figure out its function and meaning from the character in literary work. Actantial model that is classified with 6 technicians develops the conversation depending on direction of the arrow, and it allows object exploration of the subject. Greimas was influenced by Propp, Vladmir, and 31 functions that Propp says classify basic story framework into evil deed and connected accident, and these functions are considered as deep structure of folktale. [7]As Greimas modified and complemented illustration of Propp's 31 functions, he sorted many pairs of functions, which can be paired. As Greimas modified and complemented illustration of Propp's 31 functions, he sorted many pairs of functions, which can be paired. Greimas's unique hypothesis was shifted from functions' area to actant's area, and it composed actant's model from play state list of actant and Propp's unchangeable list[2]. It set the category of the actor as three paired binominal opposing relation and modeled every narrative structure, and object about the subject represents axis of main character's desire. Relation between sender and receiver is to let main character do behavior and to accept it as axis of sender. Also, on the contrary to helper that helps the subject's desire, this relationship is analyzed as opponents' relation[8]. We categorized the characters at the literary work into three opposite clauses - Receiver, Subject - Object, Helper - Opponent, the final illustration through observing narrative body in the relations are as followings.

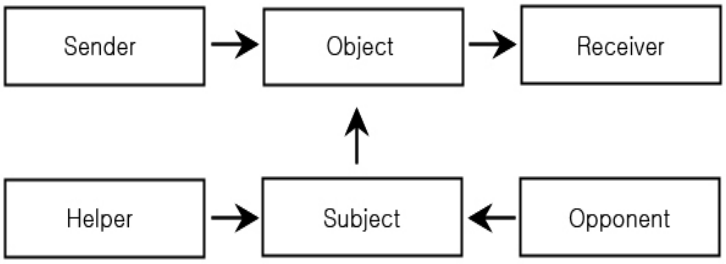

Figure 1: Greimasactantial Model

III. GREIMAS SEMIOTIC SQUARE

As shown in <figure 1>, At Greima's structural semantics, the basic structure was suggested. Semiotic square can be considered as a kind of devised mimic of logical segment of semantic category[9]. Semantic square model figures out ordering relation of animation character, and it allows todefine the kinds or the ranges that have characteristics like opposite relation, contradictory relationship, and implicate relation.

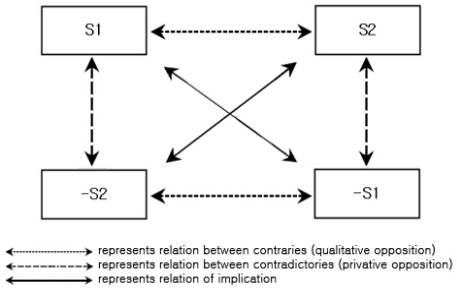

Figure 2: Greimas Semiotic Square

A. Affirmation and Denial

As shown in <figure 2>, Basically, every development is the result of mixture of two processes called affirmation and denial. Every semantic composition has those two. In other words, texts representing choice, judgment, and expression are expressed within category of affirmation and denial.

B. Contrary Clause and Contradict Clause

As shown in <figure 2>, Being contrary is interpreted to offsetting or contrary action according to the context, and this represents both actions that are resisting and being countered each other. Contradiction means two propositions are not able to be the truth at the same time. In other word, contrary concept of "beautiful" is ugly. However, it is not ugly unless it is beautiful, and it is not beautiful unless it is ugly. This relation is contrary clause and contradict clause.

C. Semiologic Square Model

As shown in <figure 2>, Recognition of rational attributes of basic structure is denying S1 and suggesting S1 at the same time, and the manipulation of contradiction is followed by new premise manipulation that highlights new S2. Thus, syntactic manipulation simply has directivity, and it is systemized in logical series. This structure explains new premise manipulation associating with contradict manipulation and S1 that denies and suggests S1 at the same time in order to highlight new S2. Therefore, semiologic square model forms relation between 4 factors: opposite relation between S_1- S_2 and -S_1- -S_2, contradict relation between S_1- S_2 and -S_1 -S_2, and complementary relation between S_1- S_2 and -S_1-S_2[10].

IV. PROPOSED WORK

A. Greimasactantial Model Analysis

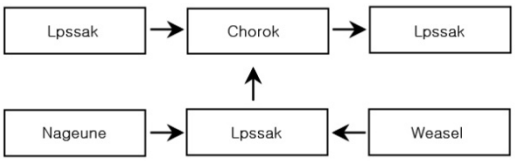

Figure 3: Greimasactantial Model <Leafie, A Hen Into the Wild>

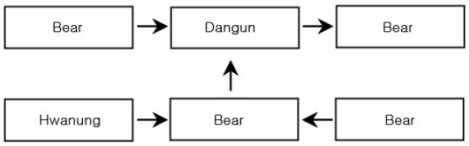

Figure 4: Greimasactantial Model <Dangun Myth>

Subject - Object

As shown in <figure 3>, At <Leafie, A Hen Into the Wild>, main subject character is Lpssak. Lpssak lived in chicken far and always wanted to escape to outside of this world. Lpsak pretended to be culled chicken as it did not eat for days, and it was abandoned at a puddle of mountain and finally escaped. Escaped Lpssak had

hope to see the birth of chick and incubated an abandoned duck's egg, and Lpssak raised a baby mallard duck. The object that becomes a desire's axis and related by the subject, Lpssak, is Chorok (baby mallard duck).

As shown in <figure 4>, At <Dangun Myth>, the character that realizes desire is the bear. The bear had desire to get out of its environment in order to become a human, and prayed for 100 days in dark cave with eating mugwort and garlic, and the bear was finally reborn as a woman named Woongnyo. Hwanung and Woongnyo had relationship, and Dagun was born. The object that had relationship with Woongnyo of axis of desire is Dangun

The appeared subject in <Dangun Myth> and <Leafie, A Hen Into the Wild> escaped from where the subject was to the new world, and it forms axis of desire, which is related to self-starvation with endurance and trouble. Also, ultimately, what to realize in the new world is becoming parents through incubating egg or getting pregnant by someone who is not husband. Relationship between the subject and object is nearly passive form. It acts as reward caused by accidently gotten endurance instead of acting as the subject. Relationship between the subject and object is not also both sided and is toward the object.

Sender - Receiver

As shown in <figure 3,4>, The subject of fairy tale or novel has sender and receiver that always desire something, but sender and receiver in <Dangun Myth> and <Leafie, A Hen Into the Wild> are not appeared clearly. Since it is inside of the subject, both sender and receiver are the subject. The subject actively creates its desire, and the effort for desire operates as hopeful clue. The earnest hope appears one-sided precondition in form to give reward to enduring one by accidental relation. At the situation in <Leafie, A Hen Into the Wild>, it is limited to the subject that has desire to escape from peaceful and sufficient chicken farm. Thus, the subject plays a role to grant itself a goal and to hope in order to act for its desire.

Helper - Opponent

As shown in <figure 3>, Helper and opponent at <Leafie, A Hen Into the Wild> are found in bonded relation with the subject, and Nageune is parents of abandoned egg, which helps Lpssak in the stage to adapt to the new world. For opponent, a weasel appeared as an opponent. Nageune, the helper died while it was protecting Lpssak and eggs from the opponent (one-eyed weasel). As shown in <figure 4>, At <Dangun Myth>, the helper is Hwanung. When the bear prayed to become a human, the helper (Hwanung) gave the bear a numinous bundle of mugwort and garlic and told not to see sunshine with eating the mugwort and garlic for 100 days in order to become a human. However, the bear that became a women could not find where to marry to and prayed to get pregnant under the holdy tree, and Hwanung changed to a human and married to Woongnyo, and the son is Dangun. Hwanwoong (the helper) is in the form to test subject and to give reward for that. As a result of long endurance, the helper as a holy existence showed up and then disappeared after realized the subject's dream, which is not mutual relationship with the subject. The helpers at <Dangun Myth> and <Leafie, A Hen Into the Wild> died or left after they gave a birth of a baby.

B. Semiologic Square Model Analysis

Semiologic Square macroscopically and concretely enables given text to be analyzed in various aspects.

We can see the viewpoint of text is switched depending which dual analysis is used in which aspect of the character. In this aspect, the result of analysis of <Dangun Myth> and <Leafie, A Hen Into the Wild> is as following.

Sociality

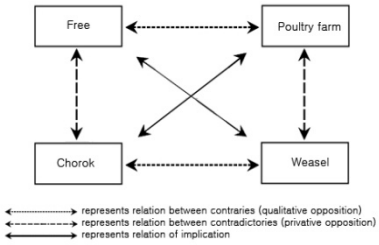

Figure 5: Greimas Semiotic Square Sociality<Leafie, A Hen into the Wild>

As shown in <figure 5>, About opposite relation between S1 and S2 in aspect of sociality, the desire to go out to the new world by itself is appeared by Lpssak, the anti-social hen that always want to escape from given spatial system. Opposite relation between -S1 and -S2 is conflict between weasel and Chorok. This relation is appeared power relation that is appeared in society. About contradictory relation between S1 and -S1, it is dominated society by power relation represented by sacrifice of NageuneLpssak by weasel. Contradictory relation between S2 and -S2 is represented by chicken farm and environment that Chorok lives with hen. In other words, the two places are contradictory relation. About complementary/inclusion relation between S1 and -S2, Lpssak and Chorok are lacked characters that are isolated from social system, but they also have cooperative positive relation. Relationship between S2 and -S1 is the element that symbolizes suppression and power of existing society, and the chicken farm represents suppressed space, and weasel represents dangerous existence.

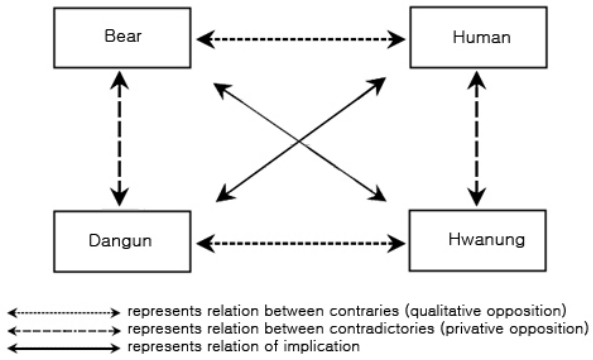

Figure 6: Greimas Semiotic Square Sociality<Dangun Myth>

As shown in <figure 6>, About opposite relation between S1 and S2 In aspect of sociality at <Dangun Myth>, desire to live as a social human is appeared by anti social bear that wants to escape from given spatial system. Opposite relation between -S1 and -S2 are represented by relation between Hwanung and Dangun. Power relation in society appears this relationship. Extreme power relation refers contradictory relation between S1 and -S1 to dominated society, which is mutual subordinate relationship. Dangun who is son of the bear and Hwanung represent contradictory relation between S2 and -S2. It is contradictory relation about differences caused by different environment. About complementary/inclusion relation between S1 and -S2, though Dangun is not social systematic character, he is permitted as Hwanwung's son. The relation between S2 and -S1 is the factor that represents suppression and power of existing society, which is subordinated relationship that is permitted by the authority.

Desire

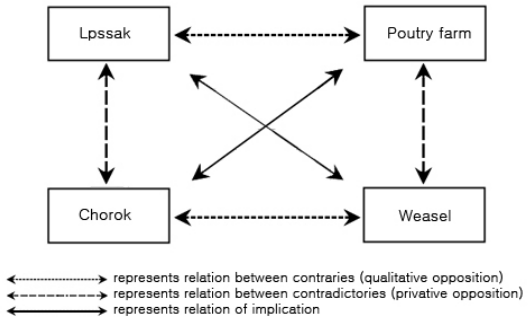

Figure 7: Greimas Semiotic Square Desire<Leafie, A Hen into the Wild>

As shown in <figure 7>, About opposite relation between S1 and S2 at <Leafie, A Hen Into the Wild> in aspect of desire, It started with the environment that takes her unhatched eggs away.Lpssak operates compensation mentality for its eggs, and chicken farm is at opposite side of the desire. Relation between -S1 and -S2 is about Chrok and weasel. It represents opposite relation that caused Nageune and Lpssak's death. Contradictory relation between S1 and -S1 is represented by weasel's behavior that it stopped attacking to

save its babies. Contradictory relation between S2 and -S2 is weasel has to hunt other's babies to raise its babies. Complementary/inclusion relation between S1 and -S2 is Chorok overcame its different appearance that is unlike its mother, Lpssak. Lpssak has to admit to send Chorock from its world to another world. Relation between S2 and -S1 is represented by power system that unable hens to hatch their eggs in chicken farm.

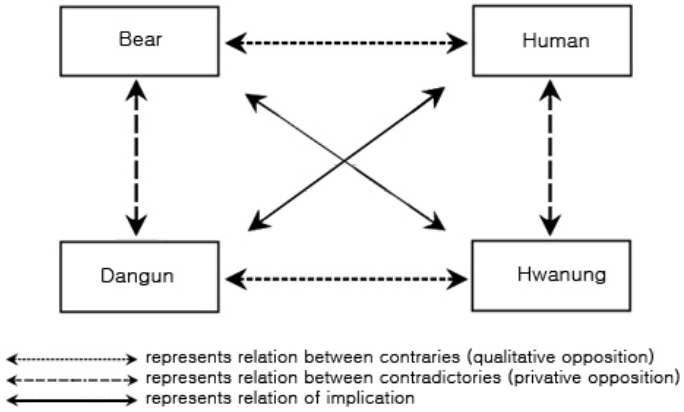

Figure 8: Greimas Semiotic Square Desire<Dangun Myth>

As shown in <figure 8>, Opposite relation between S1 and S2 at <Dangun Myth> in aspect of desire, different human's environment that doesn't accept the bear, Woongnyu represents opposite relation. Opposite relation between -S1 and -S2 is Hwanung and Dangun. Even though Dangun was succeeded the power by Hwanung, but there is nothing about father's love. Contradictory relation between S2 and -S2 is that people do not admit the bear that became a human, but they admit the son of Hwanung and Woongnyu as the king. Complementary/inclusion relation between S1 and -S2 is represented by mother and child relation of Dangun and the bear. Relation between S2 and -S1 is relation as a powerful man who influences existing social system.

V. CONCLUSION

This study aims to do macroscopic/microscopic analysis of characters appeared in <Dangun Myth> and <Leafie, A Hen into the Wild> in various aspects. How the viewpoint changes by deployment sequence by dual confrontation. As a result of the analysis through syntactic level, we can figure out mutual reaction about whether it is positive or not. As a result of Greimasactantial model, though the subject is anti-social and systemic reformist, it is passive structure caused by endurance, effort and sacrifice. The subject commonly forms axis of desire to escape from current situation to the new world, and the process to realize is along with self-endurance and sacrifice. About relation between the subject and the object, it is nearly passive form. It is appeared to operate as reward for accidently given endurance, and relation between the subject and the object are not mutual, but the subject is toward the object. Sender and receiver are rather influenced by the subject itself than influenced by external factor. The subject gives itself goals and hopes to complement its weakness for its desire. Helper has common with the sender and receiver since they both disappear from subject due to death or leaving after they play a role to give birth. As a result of analysis of Greimas semiotic square, it is analyzed in sociality and desire. About common thing in sociality, opposite relation is anti-social and system reformist, and power subordinated, and positive relation is appeared in mother and child relationship, and contradictory relation admits rather father's name than mother's sacrifice. In other words, about contradictory relation, while subject is not able to adapt new world and stays at the its boundary, object rather overcomes suppression of existing society with father's name, in other words, it appeared to be the structure that seizes power after the blood relationship is admitted.

In aspect of desire, opposite relation is appeared the relation that doesn't allow giving a birth in existing society, and positive relation is mother-child relationship like sociality, and contradictory relation represents structural common that is sacrificing for child. <Leafie, A Hen into the Wild> is successful animation in domestic. this animation was not advantaged by production's name, but it is succeed because of its strong story[11]. We established hypothesis that the most well-known birth myth, <Dangun Myth> has a lot of similar

structure according to analysis in Greimas's semiotics According to comparison analysis, character's behavior in <Leafie, A Hen Into the Wild>, social reformist factors and new alternatives are suggested, but it is composed by power system that exists in the society, and contradictory relation exists about sacrifice and endurance in the system.

ACKNOWLEDGMENT

This paper is supported by YEWON ARTS University, Korea.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Application of Association Rule Mining in Marketing, Biomedical, Business, Census and Text Data

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Abstract---

In the recent times, there has been phenomenal growth in the area of data mining. The profiles hidden in data are extracted using expert methods and techniques in the data mining. Mining is an iterative process in a sequence. One of the most important techniques of data mining is association rule mining. The frequency of the recurring patterns in the database is discovered by using the data mining technique. There are numerous sources of databases such as large database, distributed database, medical database, relational database, spatial database, which are mined by the data mining techniques. The association rule plays an important role in decision making. A lot of research has been done in the area of association rule mining. In the present paper, the numerous areas in which the association rules are applied for effective decision making are studied. The correlation among the various transactions is discovered by the association rule mining that are then used to make decisions in various fields like - market basket analysis, medical diagnosis, bio-medical literature, protein sequences, census data, logistic regression, fraud detection in web, CRM of credit card business etc.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

There are numerous techniques or methods available to condense a specific data from large database. The futuristic trends and behavior can be anticipated by data mining. There are two divisions of data mining - descriptive mining and prescriptive mining [3]. The prior existing data are identified and summarized in the descriptive mining, whereas in prescriptive mining, historical data is used to make predictions. For decision making, we use association rule mining. It finds applications in areas such as - healthcare, finance, telecommunication, business, education etc. the main purpose in many applications is to find finding pattern in data. The pattern reveals combinations of events that occur at the same time[1].

In business, it is very important that one finds the pattern in data that in turn helps to make the right decisions[2]. There are numerous algorithms available to find the association rule. The complexity and performance of mining algorithms depends on the area of research as the algorithm deals with huge database. In this paper, we have largely focused on the predictive use of the association rule mining in different fields. The background of association rule mining is described in the II section. The construction and measures of association rule mining is detailed in section III. Section IV explains the application of association rule mining in different fields and the conclusion and future work are explained in section V.

II. ASSOCIATION RULE MINING

Association mining rule specifies that there are certain correlations among the data in a database. The rules showcase the conditions wherein items occur frequently together in a given dataset. This kind of information is provided in the form of "if-then" statements[10]. The association rules are probabilistic in nature. The degree of uncertainty about the rule is expressed by two numbers besides the antecedent and the consequent. Two fundamental parameters are evaluated in majority of the association mining rules - support and confidence.

Support: The number of transactions that include all items in the antecedent and consequent parts of the rule is called as support[9]. They are defined as the parts of record that come together X and Y to the total number of records in the dataset.

Confidence: The ratio of the number of transactions that include all items in the consequent as well as the antecedent (namely, the support) to the number of transactions that include all items in the antecedent is termed as the confidence[4]. It is calculated as the percentage of transactions that contain X and Y to the total number of records that contain X, where if the percentage exceeds of confidence threshold.

Lift: The ratio of confidence to expected confidence is termed as the lift [5]. Lift is a value that gives us information about the increase in probability of the "then" (consequent) given the "if" (antecedent) part.

For instance, let us consider that in an association rule, 40% of transactions that contain bread also has butter. 5% of all transactions contain both of the items. In this, 40% is termed as the confidence; it implies that 40% of the transactions that contain bread also contain butter. The 5% is termed as the support; it implies that only 5% of the transactions contain purchasing of both items. Apriori algorithm plays a key role in association rule mining [12]. It is a well-known association rule learning algorithm for finding frequent items over transactional data sources. Two passes are run in the Apriori algorithm. The first pass is run in order to find the number of occurrences to find the large 1-itemsets. The second pass, k, has two stages. First one is the large itemsets Lk-1 found in the (k-1)th pass that used to generate the candidate itemsetsCk by the Apriori function. Next, the database is scanned and the support of candidates in Ck is counted [20]. Basic principles of the Apriori algorithm are demonstrated as follows,

1) To find the set of frequent 1-itemsets. Then Lk is completed through scan the data and accumulates the count of each item to see the minimum support in a new set called Lk.
2) It uses Lk to find Ck+1 is a two-step process that first generates Ck+1 based on Lk and secondly prunes Ck+1 by getting rid of those Ck+1 itemsets using the Apriori method.
3) It is to find Lk+1: we do this by finding the support count for all the itemsets in Ck+1 and getting rid of those that are below the minsup.
4) It continues step 2 and 3 until no new frequent (k+1) itemset are found.

The above algorithm is to use k-itemsets to explore (k+1) itemsets and Lk denotes a set of frequent k-itemsets and Ck denotes a set of candidate k-itemsets. The major problem of the Apriori algorithm is that it makes multiple passes over the chosen data. The proposed technology of GARW algorithm was to reduce the number of data passes in the area of TM [17]. The execution time is reduced as compared to the Apriori

algorithm as multiple scanning is not done. Another issue with Apriori algorithm is that the complication of the candidate sets generation is high as the algorithm has to handle extremely large candidate sets and the frequent pattern matching with a lot of candidates by searching through the transactions becomes very expensive [10]. To overcome the problem, there is no need to generate any combinations of candidate sets in the entire mining operation [6]. Moreover, the pruning method of Apriori downward closure property does not guarantee an effective pruning method of candidates; meanwhile the number of frequent itemsets grows up very quickly. In this case, frequent closed itemsets are complete to extract all frequent closed itemsets with no duplications, saving both space and time in computing itemset closures in their work [1].

The various techniques to generate strong association rules among huge number of rules are as given below:

- Scalable association rules
- Mining level crossing rules
- ARM on multiple data base
- Sampling algorithm
- Parallel ARM
- Non parallel ARM
- Spatial ARM
- Negative association rules
- Constraint based ARM
- Fuzzy association rules
- Ontology based ARM

III. CONSTRUCTION OF ARM

Association rules are created by analyzing data for frequent if/then patterns and using the criteria support and confidence to identify the most important relationships. In data mining, association rules are useful for analyzing and predicting customer behavior [7].

Association rules are if/then statements that help uncover relationships between seemingly unrelated data in a relational database or other information repository. An example of an association rule would be "If a customer buys a loaf of bread, he is 85% likely to also purchase butter." An antecedent is an item found in the data [11]. A consequent is an item that is found in combination with the antecedent.

a. Types of Association Rule Mining

1. Positive Association Rule
2. Negative Association Rule
3. Constraint Based Association Rule

b. Measures

Categories of Measures

1. Objective Measures
   a) Based on probability
   b) Based on the form of the rules
      - Peculiarity
      - Surprisingness
      - Conciseness
        - Non redundant rules
        - Minimum description length
2. Subjective Measures
   a) Surprisingness
   b) Novelty
3. Semantic Measures
   a) Utility
   b) Actionability

Role of Measures

The measures are used in the following three ways:

1. They are helped to classify each pattern as either interesting or uninteresting.
2. The measures are used to determine one pattern is more interesting than another.
3. Also the measure helps to rank the interesting or useful patterns.

IV. APPLICATIONS OF ASSOCIATION RULE MINING

Owing to numerous benefits of association rule mining, if finds application in varied fields. The association rule mining is predominantly used to elicit important data from huge database[7].

Some of the application areas in which association rule mining finds its application are:

- CRM
- Medical diagnosis
- Census data
- Market basket analysis
- Protein sequences
- Text applications

CRM of Credit Cards

Of late, in the banking sector, CRM i.e., Customer Relationship Management, has become very important. CRM is nothing but a system adopted by the banks to recognize the preference of the customers and tailor the services according to their usage so that the bond between the credit card clients and the bank becomes strong [16]. By monitoring the pattern of usage of the customers, the bank is able to find out their likes and dislikes. This in turn increases the bond between the credit card clients and the bank [11]. By using the association rule methods, the marketing people can be aware of the clients' interests and likes and that helps the bank to provide better service to the clients. The basic logic behind is to find out changes from two databases and to generate rules from each database to perform the rule matching.

Medical Diagnosis

Even in the medical field, association rule mining is applied. It majorly assists the doctors to treat their patients. The rules aid in the discovery of the probability of illness in a disease [18]. A common issue with reliable diagnostic rules is that it is very difficult to find a reliable method to ensure the accuracy of the induced hypotheses. This leads to a situation where in the hypotheses are too unreliable to be used in medical applications. Always a proper explanation is required for any illness and thus, the diagnosis becomes difficult as it involves unreliable diagnosis tests and noise in the tests [8].

Based on the association rules and the learning techniques, a technique has been proposed, which aids in the identification of the probability of the illness. By addition of the symptoms for a given disease and by defining new relations between these symptoms, the interface can be upgraded [17]. For instance, for the accurate diagnosis of the disease, a doctor needs to know all the data related to the disease for an accurate diagnosis.

Census Data

Census data is yet another field in which association rule mining find application. The good public policy gets the support from the mining rules that in turn aids in the business development. Census generates colossal statistical data [15]. The data are generally related to population and economic aspects that can be used in improving public services such as funds, health, education, transport etc.In the business, the rules can be used in the construction of malls, factories, production of certain items and also in the banking sector. Further, for the proper functioning of the democracy, it is very essential to have a good public policy and the data mining techniques applied to census data can help in that aspect [6]. On the other hand, it is not undemanding and requires tough methodological study, which is still in the preliminary stages.

Market Basket Analysis

The bar code scanners that are used extensively used in the supermarkets are classic example of the usage of association rule mining is market basket analysis [9]. The database of supermarkets is very huge and so are

the transactional records. The supermarket owners want to improve their sales by giving better service to the existing customers and at the same time also entice new customers. The huge records carry the list of all items bought by customers. Individual record will have data about the transaction of a single customer [20]. The shop owners are interested to know if a particular product has been purchased repeatedly, which would help them to market themselves better in the market and hence bring more profit to them.For instance, if in a shop database, there has a 500,000 point-of-sale transactions, of which 9,000 include both items Milk and Cornflakes and 4000 of these include item Cornflakes, the association rule "If Milk and Cornflakes are purchased then Cornflakes is purchased on the same trip" has a support of 0.8% (= 800 *100/100,000) and a confidence of 44% (=800*100/2,000). Hence, we understand that support is the probability that a randomly selected transaction from the database will contain all items in the antecedent and the consequent, whereas the confidence is the conditional probability that a randomly selected transaction will include all the items in the consequent given that the transaction includes all the items in the antecedent [19]. In the present world, all items are packed with a barcode, and the software used to scan the barcodes produce large amount of data that was identified by the business people as a tool for marketing. The association rules were discovered by the commercial organizations to look for the repeated patterns so that sales could be boosted.

The customers' buying pattern can be analyzed using the association rule mining that helps to discover the frequently occurring itemsets in a store. The sales and the promotional activities can be boosted if the frequently bought items are promoted [8]. Market basket can be defined as collection of items purchased by a customer in a single transaction (e.g. supermarket, web) Association rules are used for pattern discovery, each rule has form: X->Y. For example: “80% of customers who purchase 4% milk will also purchase cornflakes.” Support shows the frequency of the patterns in the rule; it is the percentage of transactions that contain both X and Y, i.e. Support = Probability (X and Y)

Support = (# of transactions involving X and Y) / (total number of transactions).

Confidence is the strength of implication of a rule; it is the percentage of transactions that contain Y if they contain X, i.e. Confidence = Probability (Y if X) = P (Y/X)

Confidence = (# of transactions involving X and Y) / (total number of transactions that have X).

Protein Sequences

The fundamental constituents of cellular machinery of any organism are proteins. In order to determine the DNA sequencesby inference of proteins, many tools are available. Basically, proteins are the sequences which are made up of almost 20 types of amino acids.Every protein has a three dimensional structure, depending upon the sequence of amino acids [14]. A slight change in sequence may change the functioning of protein that creates a lot of anxiety. Latest study reveals that the amino acid patterns are not random and therefore association rules can be generated for them that aids in learning more about the structure of the proteins [6]. Knowledge of these association rules or constraints is highly desirable for synthesis of artificial proteins.

Text Applications

The process of extracting useful information from the collection of text data is termed as text Mining (TM). The TM has been often regarded as a sub field of DM (Data Mining). But, the TM is to extract semantic logic from text and DM discovers novel insights about it [17].The various applications discovers similar to document classification, document clustering, information extraction and summarization are frequently used in the current field of text data analysis. The huge amount of textual documents becomes more and more intensive research by the growth of the web technologies and the local data repositories in the fields of digital library, technical documentation and the online blog maintains [13].

V. CONCLUSION

ARM finds numerous applications in the data mining. We have surveyed the list of existing association rule mining methods. It is all about to find some kind of pattern or relationship among various datasets. The outcome is association rules, and it is an iterative refinement process. We have given the research direction for Association rule mining techniques in which we have said about how to increase the efficiency and effectiveness of the Association rule mining and to get the interesting rules. Further work can be done on the crime pattern mining to detect the pattern of the crime.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on Dementia Patients Monitoring System Design Using Bluetooth Low Energy Beacon

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Abstract---

Background/Objectives: BLE(Bluetooth Low Energy) Beacon is a technology for indoor positioning. Design a system to monitor the movement of dementia patients in the indoor and outdoor use BLE Beacon.

Methods/Statistical analysis: The proposed system is a system for monitoring the movement of dementia patients to receive signals that BLEBeacon dementia patients possessed by BLEBeacon scanner consisting of a sensor network nodes are installed in the form of particular indoor and outdoor areas.

Findings: Using the current GPS and the wireless mobile communication network, there is a device for tracking in real time the position of the dementia patients. This equipment, called Wandering Detector has the advantage that nearly all of the location tracking is possible by using the wireless mobile communication network. But disadvantages of this equipment is that expensive, inconvenient portable size and must be charged every eight hours. However, the proposed system uses a lightweight and cheap BLE Beacon the size of a small badge and is economical to use at least half year continuous use in the coin battery.

Improvements/Applications: When the disappearance of dementia patients in possession of the BLE Beacon can be used for location tracking of patients with dementia BLEBeaconscanner equipped vehicles or drones.

Keywords--- Bluetooth, BLE, Beacon, Sensor Network, Dementia Patients Care Monitoring System.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Based on the 2015 population aged 65 years or more in proportion South Korea has entered a rapidly aging society, aged society 13.1% in 2030 is expected to be 24.3% of the super-aged society[1].As well as entering the aging society of the elderly also the prevalence of dementia is expected to continue to increase by about 2-fold increase every 20 years[2].The disappearance of an accident caused by dementia patients and cognitive impairment due to dementia symptoms resulting wandering is increasing every year and the consequent suffering and social costs of patients and guardians is increasing. Various studies to solve and prevent wandering incidents consequent disappearance of those dementia patients are being conducted. Current progress is that previous studies of look RFID (Radio Frequency Identification) for use by patients in and out situation monitoring and guardians to inform the system, Bluetooth and NFC (Near Filed Communication) for use by guardians and wards between a certain distance the system falls to contact the guardians of self-discovery around by generating an alarm via an NFC tag, and a typical example is a system for monitoring dementia patients of the room using a BLE Beacon[3-6].

Previous studies for the monitoring and management of dementia patients are mostly studies using GPS, RFID, NFC, BLE Beacon. However, GPS is difficult to use where the GPS radio wave can't reach, such as indoors, the problem with the RFID read range and price, NFC has a problem of a recognition distance. Also studies using the beacon was most research on the location in the room and the distance measurement[7-9].This purpose of this paper is to use the BLE Beacon and WSN(Wireless Sensor Network) to offer real-time monitoring systems for the indoor and outdoor location-based dementia patients and preventing the disappearance of dementia patients through it.

II. SYSTEM ANALYSIS AND DESIGN

A. System Analysis

Figure 1 shows a conceptual diagram of expresses the whole system proposed in this study.

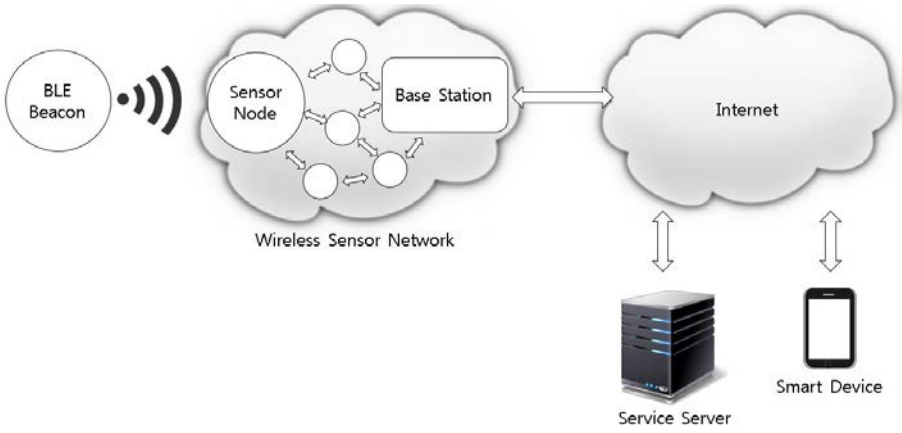

Figure 1: System Overview

BLE Beacon that dementia patients have possession and to periodically broadcast a unique identification number of the BLE Beacon signal of the UUID of dementia patients, the signal to the receiving Sensor Node that includes a BLE Beacon Scanner installed in a specific place. Then BLE Beacon signals that the Sensor Node is received via the close around the Sensor Node is transmitted to the Service Server through the Base Station, the Service Server determines whether the current dementia patients are deviated a safe area, or has entered the dangerous region. Service Server will send a warning message to guardian's smart device as smart phone or tablet.

B. Design of the Sensor Node

Figure 2 shows a structural diagram of a Sensor Node that received signal of the BLE Beacon transmission to another Sensor Node, or Base Station.

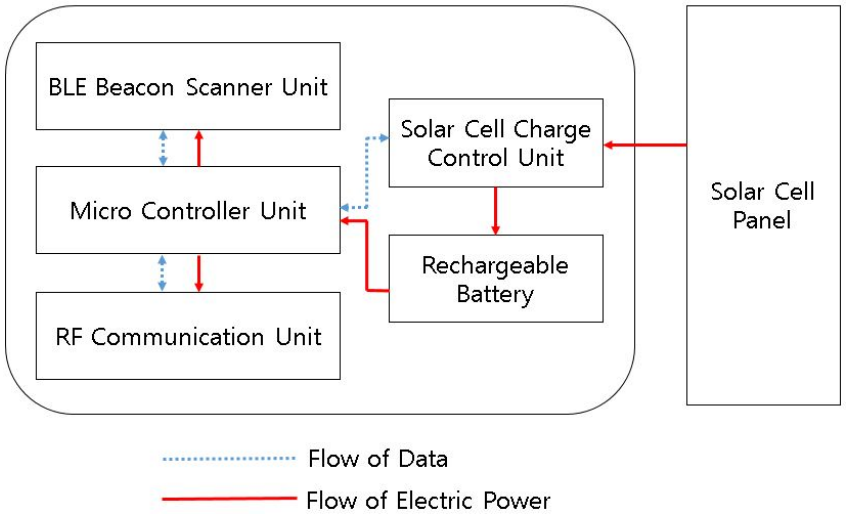

Figure 2: Structural Diagram of Sensor Node

Sensor Node consists of BLE Beacon Scanner Unit for receives the signal of BLE Beacon, RF Communication Unit for communication with close other nodes or base stations, Micro Controller Unit for the control of all units in Sensor Node, Solar Cell and a Solar Charge Control Unit, and a Rechargeable Battery for supplying power to the Sensor Node itself.

C. Design of Base Station

Figure 3 shows the structure of a Base Station for transmitting data collected by the Sensor Nodes to the Service Server over the internet.

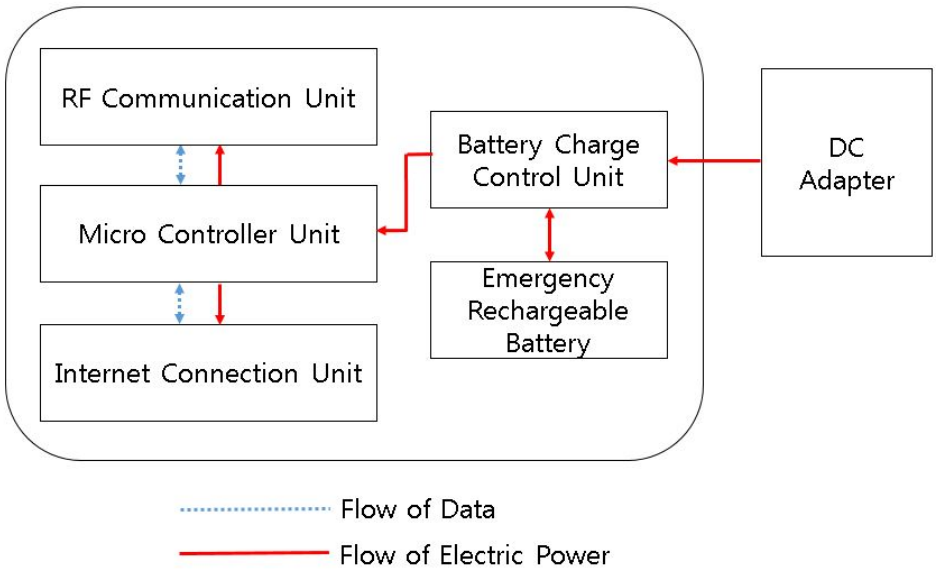

Figure 3: Structural Diagram of Base Station

Base Station consists of RF Communication Unit for communicating with the Sensor Nodes, Internet Connection Unit using an Ethernet or Wi-Fi for communicating with the Service Server over the internet, Micro Controller Unit for controlling all the units of Base Station, and Emergency Battery and Battery Charge Control Unit for a well supply of Base Station in case of emergency such as a power outage.

D. Design of Service Server

Figure 4 shows a structural diagram for the Service Server for analyzes the received information collected by each of the Base Stations that they service to the web or smart device.

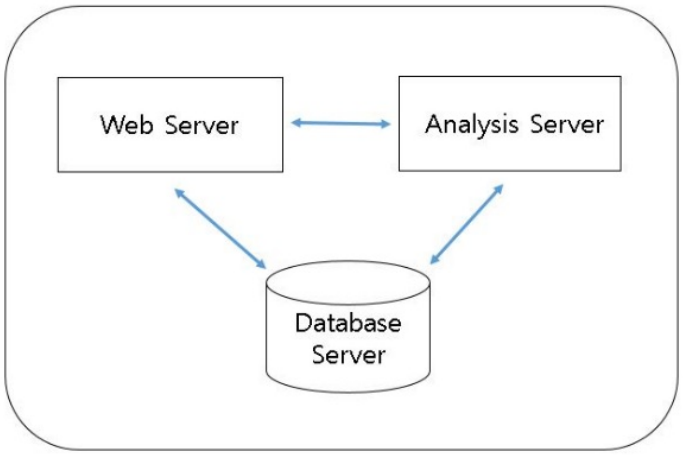

Figure 4: Structural Diagram of Service Server

Service Server consists of web server to handle the user's basic web service request, Analysis Server for processing the analysis of the collected data and perform communication between the Base Station and the smart device using the REST ful API, Database Server for storage of collected data or processed data.

III. ELECTRONIC PARTS THAT CAN BE CONSIDERED WHEN IMPLEMENTING THIS SYSTEM

A. BLE Beacon

BLE Beacon has the advantage that can be used in at least a few months up to several years in a coin battery technology which can broadcast a signal up to 100 meters with low power consumption and low price. Figure 5 shows important to the structure of the three elements of a broadcasting data format of BLEBeacon is a unique identifier of the UUID (Universally Unique Identifier) and Major and Minor for service or area separated.

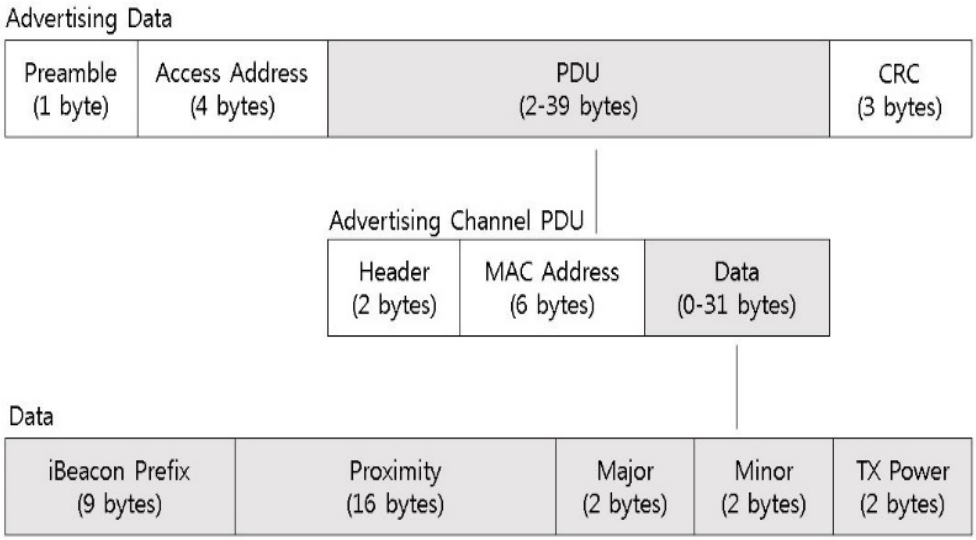

Figure 5: BLE Beacon Data Format

BLE Beacon can be used to strength RSSI (Received Signal Strength Indicator) of the radio waves, and broadcast signal periodically without the need for the traditional Bluetooth pairing between devices wherein the signal to calculate the distance between BLEBeacon and receiving equipment. Figure 6 shows the various beacons.

Figure 6: Bluetooth Beacons

B. Bluetooth Module

In order to read the information in the BLE Beacon, Bluetooth module it shall support the version 4.0 or later. Figure 7 shows that the thing is a cheap price HM-10 Bluetooth module that is mostly used.

Figure 7: Bluetooth Module(HM-10)

HM-10 Bluetooth module must be changed to a master mode in order to receive a BLE Beacon signal.To change the Bluetooth module in master mode after connecting the Bluetooth module with FTDI cable using serial communication program such as Hercules, you need to enter several commands.

C. Arduino Board

Arduino board is one of the leading open hardware platform. The Arduino UNO R3 version is most commonly used in the Arduino board. Arduino UNO R3 version used in this project to the controller is equipped with an AT mega 328 MPU which has 13 digital input and output ports and 6 analog input port. Because of a programming language based on C ++ development with C programming language, if the user experience an easy to use.

D. RF Communication Module

RF (Radio Frequency) communication module, there are modules using different frequencies, such as the data received to the wireless module 433Mhz, 915MHz, 2.4GHz. Figure 9 shows the RF wireless module using a frequency of 433MHz of the HC-11 in figure 8.

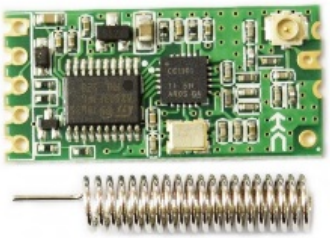

Figure 8: RF Communication Module

RF module used in communications module of the sensor nodes in this study can easily implement the N-to-N communication is easy to use and supports serial communication is easy to build a network of sensors form a mesh network.

E. Ethernet &Wi-Fi Module

In this study, Ethernet and Wi-Fi module is a communication module used for the base station's Internet connection. Figure 9 shows the Ethernet and Wi-Fi module.

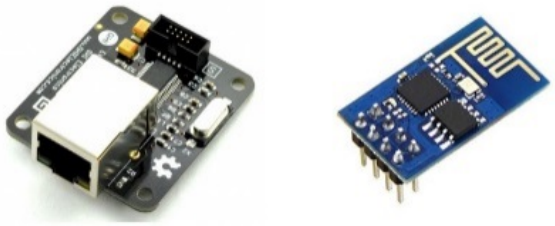

Figure 9: Ethernet and Wi-Fi Module

IV. CONCLUSION

This paper proposed a tracking and monitoring system for wireless sensor networks using BLE Beacon to prevent the disappearance of an accident caused by dementia patients wandering. This system can use a wireless sensor network nodes that are installed on places within the residence area of dementia patients by receiving the signal of the BLE Beacon, which is in possession dementia patients identify the location of dementia patients in real time. And if the dementia patients is caused unexpected situations such as outside their area of residence, give them to smart devices such as smartphones protector can prevent wandering and disappearance of dementia patients. The current system that uses GPS and wireless mobile communication network exists, but the price of the equipment is expensive and leasing fee is raised and the additional costs generated during the loss. In addition to charge the equipment every 8 hours, but dementia patients may occur when a failure to obsolete charging. However, the system proposed in this study can be used continuously up to a minimum of six months to several years as a small coin battery using inexpensive BLE Beacon. In addition, if connected to the temperature sensor and acceleration sensor, etc. on GPIO (General Purpose Input Output) port of the BLE Beacon will be able to more closely monitor the environment and the amount of activity of such dementia patients.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Chunk Replacement Design for QoS Control in CCN

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Abstract---

Objectives--- Content Centric Networks (CCN) is one of the future internet technologies. The Quality of Service (QoS) is also important issue in CCN. However, the current CCN chunk replacement method is not suitable for QoS. Therefore, this paper propose a new chunk replacement design to support QoS efficiently.

Methods/Statistical Analysis--- The proposed method manages the average of packet arrival time in CCN node and classifying packet separately for QoS service in CCN. This paper also simulates the proposed new chunk replacement design in congested topology.

Findings--- This paper proposes chunk replacement mechanism on the CCN. Even if the chunk request time of flow number 1 and flow number 2 is same, the throughput on request node can be different. If the transmission rate of flow is faster than other flows, the flow can occupy the total current bandwidth. Therefore, the other flows cannot use current bandwidth sufficiently. In the simulation, the proposed method set the same start time of each flow and changed the transmission rate of each flow so that the proposed method can check the throughput of each flow. The most of the previous method still have the problem of different throughput. In this paper, the consumer node is using the proposed Chunk replacement algorithm. The flow that arrives later is using the same bandwidth compared to other flows in the limited network circumstance. Therefore, the throughput is not different according to the transmission rate. The proposed method will be also an efficient method for QoS.

Improvements/Applications--- To demonstrate Chuck replacement algorithm, topology is composed of linked 6 nodes with 3 consumer nodes and 3 producer nodes to prove its performance.

Keywords--- CCN, Cache, Future Internet, Congestion, Queue Management.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The data transmission rate is gradually increasing due to development of high-bandwidth networks. One of the reasons is the use of devices such as a remote planes, smart watches is increasing and requires high-speed networking. There is a decrease in the transfer rate due to the interference between the flows as the data transmission rate increases.[1,2] It also causes the CCN fairness decrease between flows in the intermediate node. This paper evaluates the fairness issue at the CCN, which is one of the next-generation technologies that is emerging as the future Internet. It supports to provide the required content to the users in wired and wireless networks. The basic unit to transmit in CCN is Interest packet and Data the packet as a pair. The user requires Data packet by sending Interest packet. It is an automatically adjusted flow balance[3] mechanism. Because of this, end-to-end flow control is not required[4]. CCN is working on the basis of hop by hop[3,5] method, unlike the previous end-to-end method. Once user sends Interest packet, Data packet will be sent to consumer passed by intermediate cache of CCN node. The each CCN node can save the content in cache. Therefore, it can send the content instead of the producer. CCN needs forwarding strategy in this mechanism. If some node is down because of overflow or blackout, the other node will be alternative, so it has the flexibility[6]. This is because the consumer can receive the Data packet from the alternative a node with changing PIT(Pending Information Table) path. If the data size is bigger, Data packet can be handled by the unit chunk even though it sends Interest and Data packet as a pair[3]. There are various studies related to the data chunk and fairness control in CCN. The research about reduction of the receiving time of data from the consumer by adjusting the index of data chunk in the intermediate routers[2], and the research that suggested a routing scheme based on selective cache caching or pre-allowable range based on the acceptable range for the medium cached[6]. In addition, there is a study for improving throughput through the flow control in order to improve fairness[7,8,9]. This paper proposes the Chunk replacement mechanism of the intermediate CCN router in order to increase data transmission rate in each consumer and fairness. This paper is organized as follows: Section 2 describes the structure of CCN which is composed of CS(Content Store), PIT(Pending Information Table), FIB(Forwarding Information Base), Interest packet and Data packet as a pair. Section 3 defines what is Chunk replacement mechanism. Section 4 describes performance evaluation with complex topology. Finally, Section 5 describes the conclusion of this paper.

II. THE STRUCTURE OF CCN

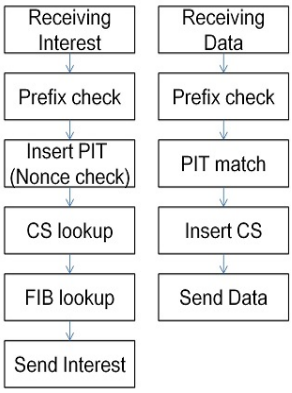

Figure 1: Receiving Interest and Data Packet on CCN Node

Content Centric Network(CCN) is a new mechanism for Future Internet such as ICN, NDN.CCN node is composed of CS(Content Store), PIT(Pending Information Table), and FIB(Forwarding Information Base). Cache(CS) is the repository, that stores Data packet that the user requested by sending Interest packet. PIT table is matching table to transmit the Data packet to the requested user. FIB table decides the direction to forward Interest packet.

As shown in Fig. 1, once Interest packet is received by CCN node, the CCN node checks prefix and then does duplicate data check by confirming Nonce record. If it is not duplicate data, it will search for the data in the cache and if it exists, Data packet will be sent to the consumer after that the related record will be deleted from the PIT table. If there is no related data in the cache, the information of the Interest packet will be saved in PIT table. Forwarding strategy to transmit the Interest packet will be decided through FIB table. If the Data

packet is received from CCN node, CCN node will check whether the information from Data packet matches to Interest record in PIT table after checking the prefix.

If it matches, the information will be saved in the cache, after that the Data packet will be sent to consumer node.

III. CHUNK REPLACEMENT DESIGN

When the network is unstable and congested, the classification of a fast flow and slow flow rate is needed for fairness between the flows.

The slow flow packet affects transmission rate of fast flow packet in the bottleneck bandwidth of the high-speed network. The transmission rate of fast flow packet is higher than that of slow flow packet that is stored in the CS of bottlenecks per time unit. That is why, the packet loss rate of fast flow is higher than the one of slow flow when congestion occurs in bottleneck CCN node. If the proposed emthod separate the flow by checking transmission rate and handle them separately in CCN node, the total throughput can be increased based on QoS by reducing delay in CCN node.

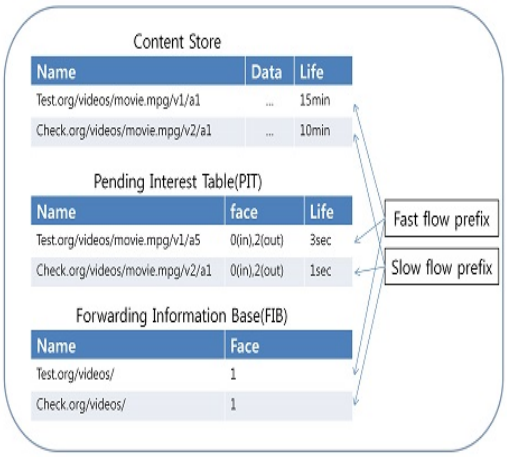

Figure 2: Classifying Packet Separately on CCN Node

The proposed algorithm checks the arrival time of Data packet after reading prefix of the packet in CCN node in order to classify between fast flow and slow flow. The proportion of transmission between the slow flow packet and fast flow packet is set to 1:1.

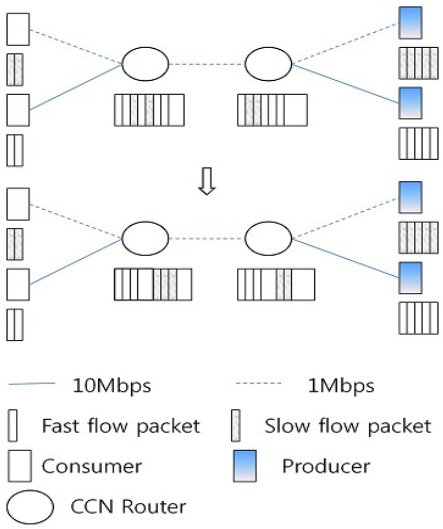

Figure 3: The Usage of Chunk Data

When the packet arrives in the intermediate CCN node, the node will check whether the arrived packet is fast flow packet or slow flow packet by inspecting packet arrival time per time unit. If the arrived packet is fast flow packet, it will be assigned to the front of the table. If the arrived packet is slow flow packet, it will be assigned to the back of the table. If the number of the packet in the table is full, fast flow packet will go out first.

Fig. 2 shows a table field in the CCN node. CS which represents cache in CCN node is composed of data prefix and lifetime. PIT table is composed of Nonce for duplicate packet check, In and Out Face that is Interest path, and prefix, lifetime. FIB table is composed of prefix name and Face. It decides the forward direction for the packet. The standard of classifying between fast flow prefix and slow flow prefix is the arrival time of the packet.

Fig. 3 shows the sequence of stacked chunks of in the bottleneck interval. When the consumer sends Interest packet for Chunk to the producer, the intermediate node will store the information of Interest packet. The CCN node will classify the slow flow and fast flow packets packet when they are saved in the node. One of the reasons is to reduce searching time in PIT table. Data packet size is more than the Interest packet size, therefore, it may cause the congested environment. Furthermore, the data throughput between fast flow and slow flow is similar because they are congested in bottleneck CCN node. The proposed method to solve fairness is that classifying packets in the tables of CCN node. The slow flow and fast flow will be divided in the table. Chunk processing is processing to control the ratio of the fast flow and slow flow. It will maintain the fairness, by this improved throughput, based on QoS.

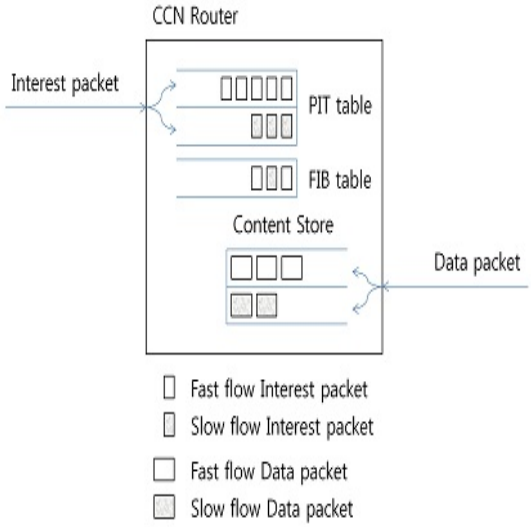

Figure 4: Chunk classification in CCN router

Fig. 4 shows how the Chuck is managed in the CCN Router. If the Interest packet arrived on CCN Router, fast flow packet in the PIT table will be separated from the slow flow packet. When the Data packet is received from the producer, the CCN node will store in CS table by classifying fast flow packet and slow flow packet.

Algorithm. 1 and 2 describe the proposed technique. When the Interest packet is received in CCN Router, the node will check whether it is in PIT table or not. If it is not, the CCN node will check the Interest packet arrival time(*it*) and the average value of arrival time(*avgIt*). If the*it* is left the side of *avgiT*, the packet will be a fast flow packet so it will be assigned the front of PIT table. If the *it* is not, the packet will be assigned the right side of PIT table.

If the Data packet is received in the CCN node, the CCN node will check the Data packet arrival time(*dt*) and the average value of arrival time(*avgDt*). If the dt value is the left side of *avgDt*, the Data packet will be assigned the left side of CS table. If it is not, it will be assigned the right side of CS table. The separate processing of the packets in the CCN node will improve the total throughput and the fairness of the receiving Consumer.

Algorithm 1 For Interest packet

Ensure: Incoming packet is not dummy packet
If *it< avgIt* then
Push Interest packet to the front of PIT
End if
If *it> avgIt* then
  Push Interest packet to the back of PIT
End if

Algorithm 1 For Data packet

Ensure: Incoming packet is not dummy packet
If *dt< avgDt* then
Push Data packet to the front of CS
End if
If *dt> avgDt* then
  Push Data packet to the back of CS
End if
Ensure: Outgoing packet is not dummy packet
If fast flow packet then
Pop Data packet from the front of CS
End if
If slow flow packet then
  Pop Data packet from the back of CS
End if

IV. PERFORMANCE EVALUATION

To demonstrate Chuck replacement algorithm, ndn SIM 2.0[5] based on NS-3[10] is used. The topology is composed of linked 6 nodes with 3 consumer nodes and 3 producer nodes. The consumer nodes will send the Interest packet at the same time to compare the reception time of the Data packets for Interest. Table. 1 shows the configuration for the simulation. Consumer requests the movie streaming data to the producer. Cache algorithm was used LRU[11]. The RED method was used, the minimum threshold is 50 packets, and the maximum threshold value was set to 80 packets. The one of Consumer1 (C1) and Consumer2 (C2) was set to 1Mbps.

Table 1 Configuration for simulation

Parameter	Value
Request chunk size per second	100 pieces
Simulation time	100 seconds
Payload size	1040 byte
Bandwidth	10 Mbps
Bottleneck bandwidth	1Mbps
Cache size	1000 packets
The minimum threshold of RED	50 packets
The maximum threshold of RED	80 packets
Transmission rate of C1	10 Mbps
Transmission rate of C2	1Mbps
Link delay	20 ms

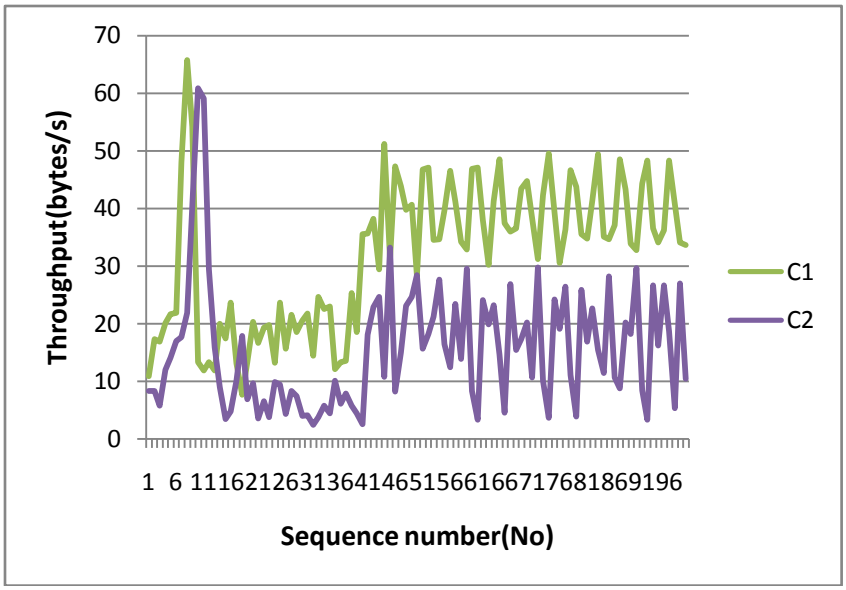

Figure 5: Result for the Previous Method

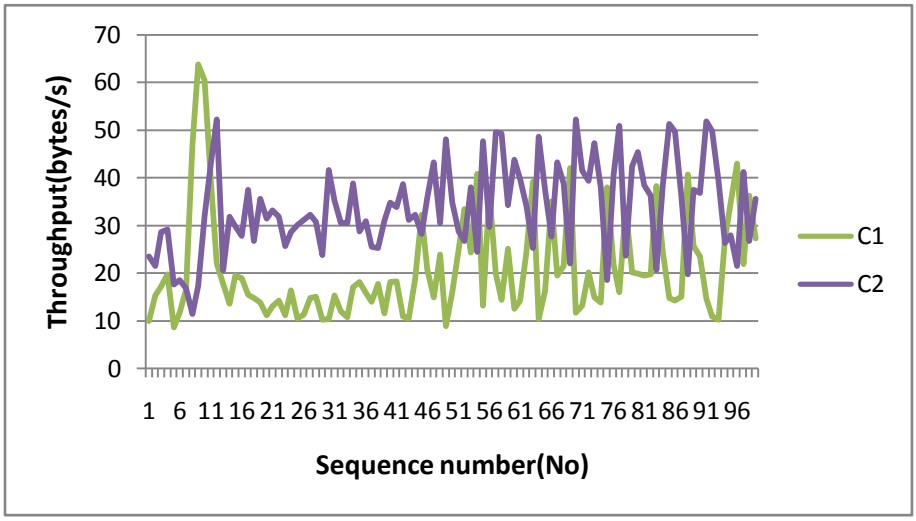

Figure 6: Result for the Proposed Method

Fig. 5 graph illustrates the Data packet throughput requested by the Consumer1, Consumer2 using conventional methods. The chunk request time of C1 and C2 are the same but throughput was different. The throughput of C1 and C2 did not make a significant difference. Fig. 6 graph illustrates the throughput for each Consumer using the proposed Chunk replacement algorithm. The flow that arrives in the network later is using the less bandwidth in the limited network circumstance. The proposed method will be an efficient method in this case. It will improve the throughput of each flow without affecting QoS policy. C1, C2 of Fig. 6 is similar throughput.

V. CONCLUSION

In this paper, a Chunk replacement mechanism is proposed to increase the transmission rate of each consumer and fairness in the CCN router. By keeping the transfer rate on the basis of QoS and making efficient use of the network to improve the fairness, the throughput of each flow was increased using Chunk replacement mechanism. The simulation results show the improved throughput and fairness based on QoS. The following study will investigate the proposed method in various scenarios and traffic usage patterns to make satisfactory progress of the communication network by controlling the content size studies.

ACKNOWLEDGMENT

This work was in part supported by Ministry of Science, ICT and Future Planning project of KISTI (Automated SaaS compatibility support technology development between heterogeneous cloud, N-16-NM-CA04-S01)

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0975-6299

Inter-Collaboration Design between ISP CERTs and Security Center for Effective Response of Large-Scale Cyber Attacks

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Abstract---

Background/Objectives--- Recently, cyber-threats have been increased every day with most of the information is transmitted by internet. Many institutions perform appropriate countermeasure against cyber crisis. However, they have been considered a partial solution to the problem.

Methods/Statistical Analysis--- Cyber-attacks classified as well-known attack and unknown attack. While in the latter case there's a limit as new cyber-attacks that misuse the system and application vulnerability, the responses of well-known attacks are possible because the solution for them already exists. We describe the proposed process and effect of inter-collaboration system. Our design consists of three processes (global threat management, network control and RBL (Real-time Blocking List)).

Findings--- The current response for large-scale cyber-attacks is inadequate. Many institutions that provide main service and resource to the user are suffered by cyber-attacks. We propose the effective response method against their cyber threats. Our proposed mechanisms reduce the cyber threats through inter-collaboration design between ISP CERTs and security monitoring and response. While they perform the security monitoring for the only own circuit, the institution use the various networks such as main network and backup network etc. Among their network, ISP CERTs can exist or can't exist and security center can exist or can't exist too by the security service policy of ISP. Therefore, while institution reduces the cyber threat through them, the circuit that they don't exist significantly increases the security threat. And the institution not only hasn't the trust for the circuit but also increase in cyber threat because ISP optionally provides the security service. Therefore, we design the inter-collaboration mechanisms of them that rapidly and exactly response the cyber-attacks.

Improvements/Applications--- We implement the inter-collaboration system based on the global threat management, global network control, RBL(Real-time Blocking List).

Keywords--- Cyber-Attacks, Inter-Collaboration, ISP CERTs, Security Monitoring & Response, Hacking.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

These days, internet has become the method used by many people. We carry out the task such as education, research, education and interest, etc. based on the own privacy information through the internet. However, cyber-attacks have been increased as their privacy information is transmitted by the internet. Internet always is not only exposed from cyber-attacks but also bring the critical damage from them. Currently, ISP CERTs and Security Center is working on countermeasures against cyber threats. But, they are situation that doesn't suitably answer to users not even already well-known attacks.

In this paper, we propose the effective response method against them. Especially, we propose inter-collaboration design between ISP CERTs and Security Center to defend cyber threats. Our design is systematic approach that promptly and correctly response cyber-attacks based on their role. It defines their role and has productive results to prevent the critical damage that cyber-attacks frequently occur. Also, our proposed mechanisms reduce the cyber threats through inter-collaboration design between ISP CERTs and security monitoring and response. While they perform the security monitoring for the only own circuit, the institution use the various networks such as main network and backup network etc. And the institution not only hasn't the trust for the circuit but also increase in cyber threat because ISP optionally provides the security service. Therefore, we design the inter-collaboration mechanisms of them that rapidly and exactly response the cyber-attacks.

II. RELATED WORK

Recently, many studies such as Big data, IoT, and Session[1-7]have been introduced the response technique for new cyber-attacks. Many people and institutions perform appropriate countermeasure for the cyber crisis through their studies. However, they always are being damaged by well-known cyber-attacks though have the various security devices and defensive measure. They have been considered a partial solution to the problem. We focus on not only the security techniques but also the overall security system based on inter-collaboration.

III. PROPOSED MECHANISM

A. Proposed Concept

In this section, we explain why proposed design is necessary. In left side of figure 1 show the security monitoring state for the arbitrary institutions and right side present proposed design based on inter-collaboration. Most of research and education institutions carry out large data transmission and collaboration task using the various networks. In their network, one use as main network and the others use as sub or backup networks. Among their network, ISP CERTs can exist or can't exist and security center can exist or can't exist too by the security service policy of ISP. Therefore, while institution reduces the cyber threat through them, the circuit that they don't exist significantly increases the security threat. The institution not only easily is exposed by always cyber-attacks but also bring the problem to build the security policy and the appliances. We propose the inter-collaboration between ISP CERTs and security center to solve these problems. Our concept reduces the cyber threat level for the institution through the proposed design. As right side of this figure1, the rapid and correct detection, analysis and response not only are possible but only can carry out the network control in case of the large scale attack through Inter-collaboration.

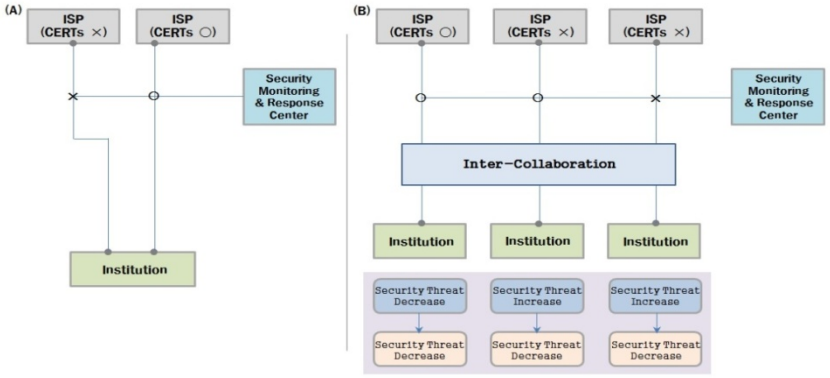

Figure 1: Security Threat State of Institution

B. Proposed Model

In this section, we introduce the excellence of proposed model through existing and our model comparison. The upper of figure 2 shows current security architecture. It consists of the circuit, monitoring and institution and the circuit is IX set (Internet eXchange IX = {IX_1, IX_2, ⋯, IX_i}) Monitoring field guards the threat traffic in ISP CERTs and security center. They mainly carry out the monitoring for assigned circuit to them. Institution provides the service and resource to the users and constructs the security system to protect own area. The root cause that many institutions don't response the well-known cyber-attacks is the security countermeasure. First of all, DDoS attack absolutely performs the response in the institution though the security organization exists.

While institution uses multi-network such as main and backup network, etc. ISP CERTs and security center don't realize the current situation because they monitors only own assigned circuit. Also, security organization doesn't exist for the all circuits. Ether only ISP CERTs exist or only security center exist as their security and service policy in the IX. In the worst case, no one carry out the monitoring for the circuit. Therefore, when large-scale cyber-attack occurs institution doesn't response the threat traffic received in the various and a lot of IP. After of all, they has the problem that don't provide the user with their service though security device and manual exists.

We propose inter-collaboration model to solve this problem as the bottom of figure 1. Inter-collaboration stores and shares detected threat traffic in the each circuit. It carries out early response and the network control through shared information and notice the result to the institution. Institution sets the traffic threshold and different route through noticed result and share the task based on role. They not only can block the threat attack but also normally can provide main service to the user.

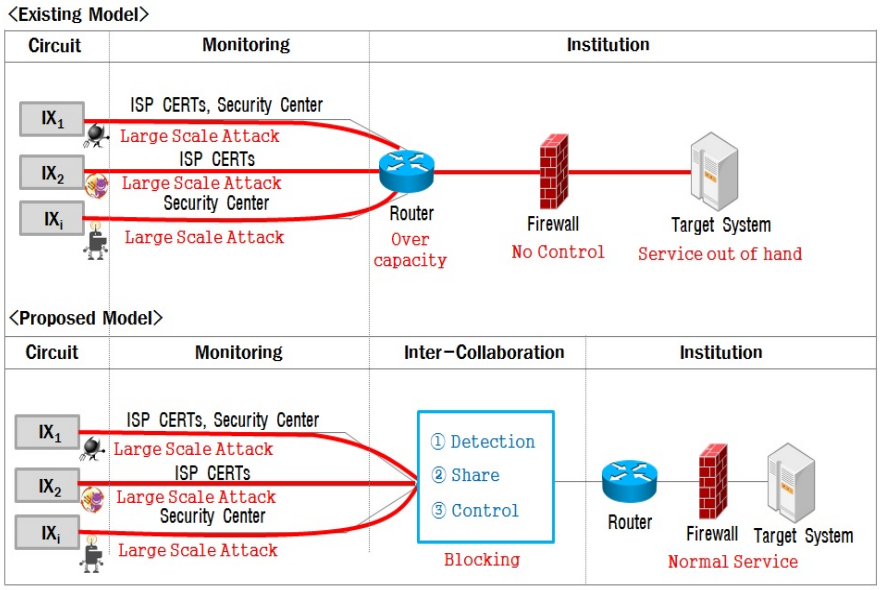

Figure 2: Existing and Proposed Model Comparison

C. Proposed Framework

We introduce inter-collaboration design to response as figure 3. Our design consists of global threat management, global network control, RBL, global inter-viewer and DB.

1) Global Threat Management: it classifies detected cyber-attacks (well-known and unknown) them to promptly response well-known attacks and raise detected accuracy. In the case of well-known attack, it receives and shares the detected attacks through their traffic threshold and detection pattern. The other way, unknown attacks perform the analysis sharing to verify false positive.
2) Global Network Control: it prevents the continuous damage and spread against cyber-attacks. It analysis the traffic of IP and determine the circuit blocking to perform the network control.
3) RBL (Real-time Blocking List): RBL denies IP and notices the result to the user when infected

system sends the spam mail to the target system. User can't access different circuits if is registered by RBL. Therefore, RBL must certainly be necessary for the inter-collaboration must quickly respond. We construct the RBL registration, measure and report to can carry out the quick response.

4) Global Inter-Viewer: it provides the intuitive screen for the real presentation of each module. Also, it enables one to extract and search the statistical data.
5) DB: it stores them after encrypts each the module information because security data is sensitive information.

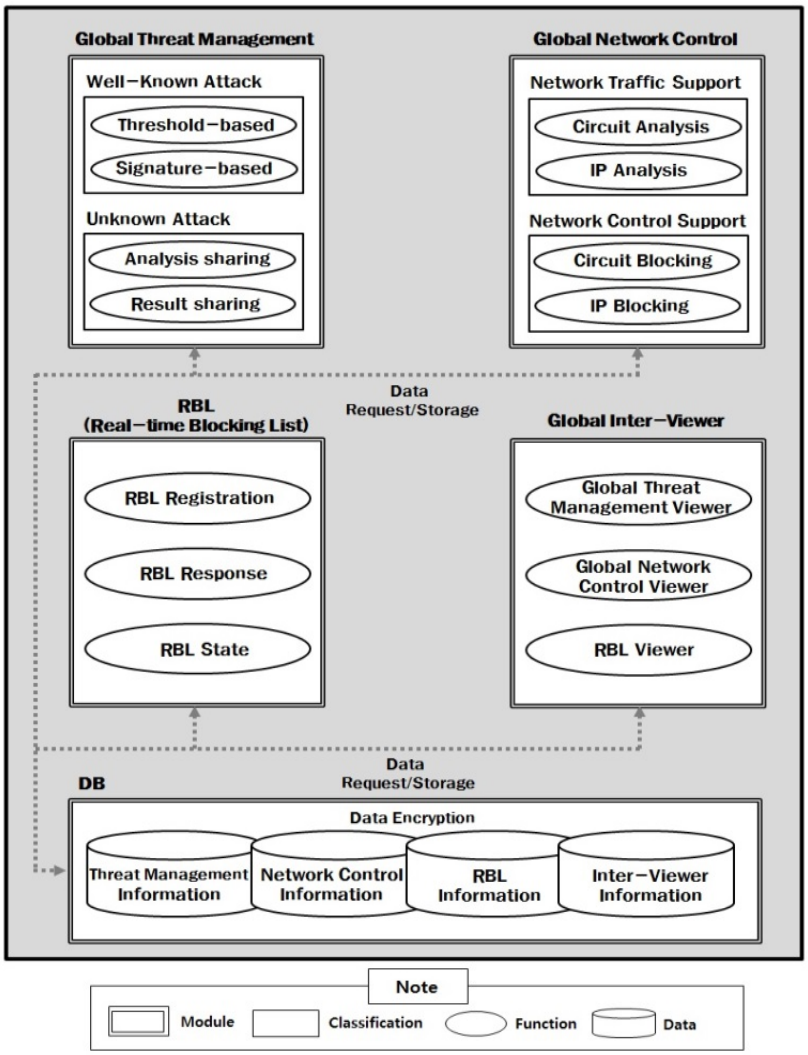

Figure 3: Inter-Collaboration Framework Against Cyber Threats

IV. PROCESS OF INTER-COLLABORATION

A. Process of Global Threat Management

In this section, we describe the proposed process and effect of inter-collaboration system. Our design consists of three processes (global threat management, global network control and RBL (Real-time Blocking List).As the figure 4, global threat **management** is inter-collaboration between ISP CERTs and security center to promptly response the cyber-attacks.

Step 1~8: ISP CERTs and security center register the threat traffic through proposed system when cyber-attack is detected. Inter-collaboration system classifies the cyber-attacks as unknown attack and well-known attack. Well-known attack divides by the signature-based and the threshold-based. The signature- based means cyber-attacks such as warm virus and web vulnerability etc. and threshold-based means large scale

attacks alike DDoS attacks. Inter-collaboration system promptly notifies the technical solution to the institution through already analyzed data, if cyber-attack type is well-known. Otherwise, cyber-attack type is unknown, our system find the technical solution through the analysis sharing and notifies it to the institution because the analyzed data don't exist.

Step 9~13: The institution returns the result after it response the cyber-attacks based on the technical solution from them. Our system performs the verification based the received result and notifies it to ISP CERTs and security center.

Step 14~21: They check the response result and re-notifies for the reconfirmation to the inter-collaboration system if they don't satisfies the response result. Inter-collaboration system verifies the reconfirmation and it determines whether it carries out by myself or notifies the reconfirmation to the institution again. Received ISP and security center checks the re-response result and notifies to them.

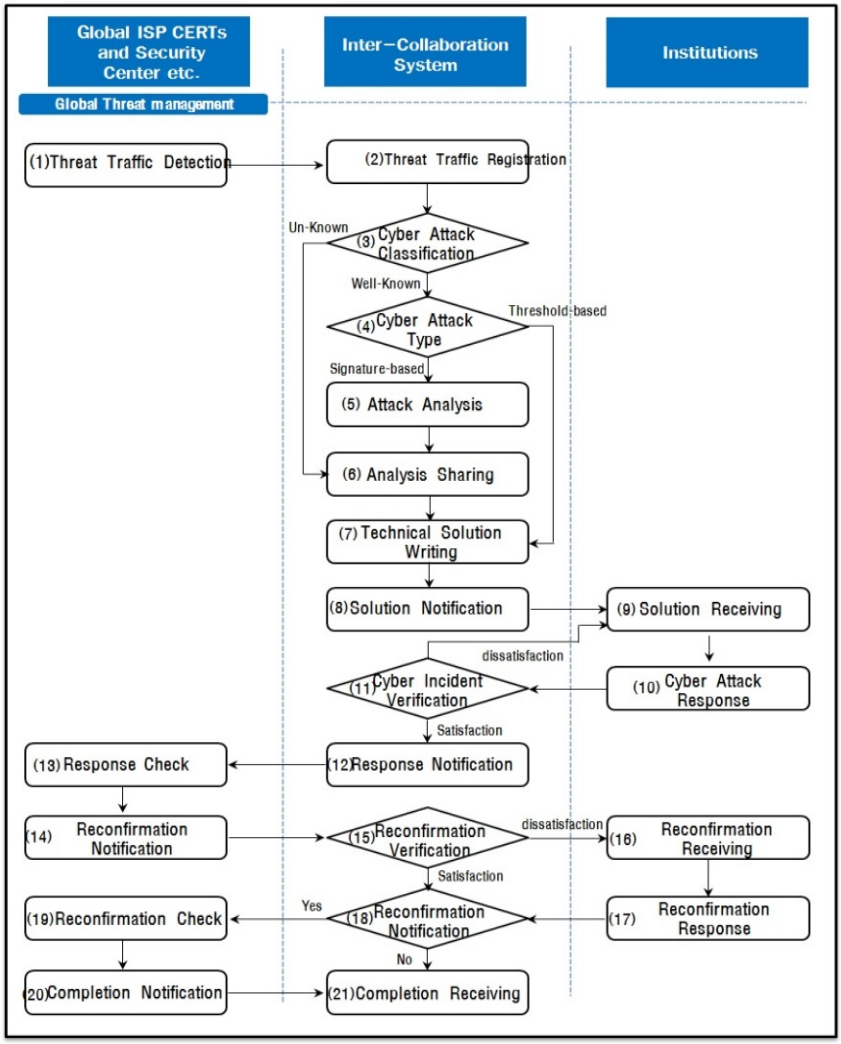

Figure 4: Process of Global Threat Management

B. Process of Global Network Control

As the figure 5, global network control performs the circuit supporting for the prevention of spread of damage during the certain period against the large scale cyber-attacks.

Step 1~6: ISP CERTs and security center detects critical cyber-attacks in the networks and registers the inter-collaboration system. It classify as the large scale cyber-attacks and very large scale cyber-attacks. The large scale attack notifies the countermeasure through already standardization solution to the institution.

Otherwise, Very large scale attack notifies the shared information to the institution after it comes up with the critical level of cyber-attacks through the analysis sharing.

Step 7~13: Inter-collaboration system establishes the network control IP, control period and circuit name etc. And notifies ISP CERTs and security center after verifies the received response. They check the network control supporting and return the completion notification to our system.

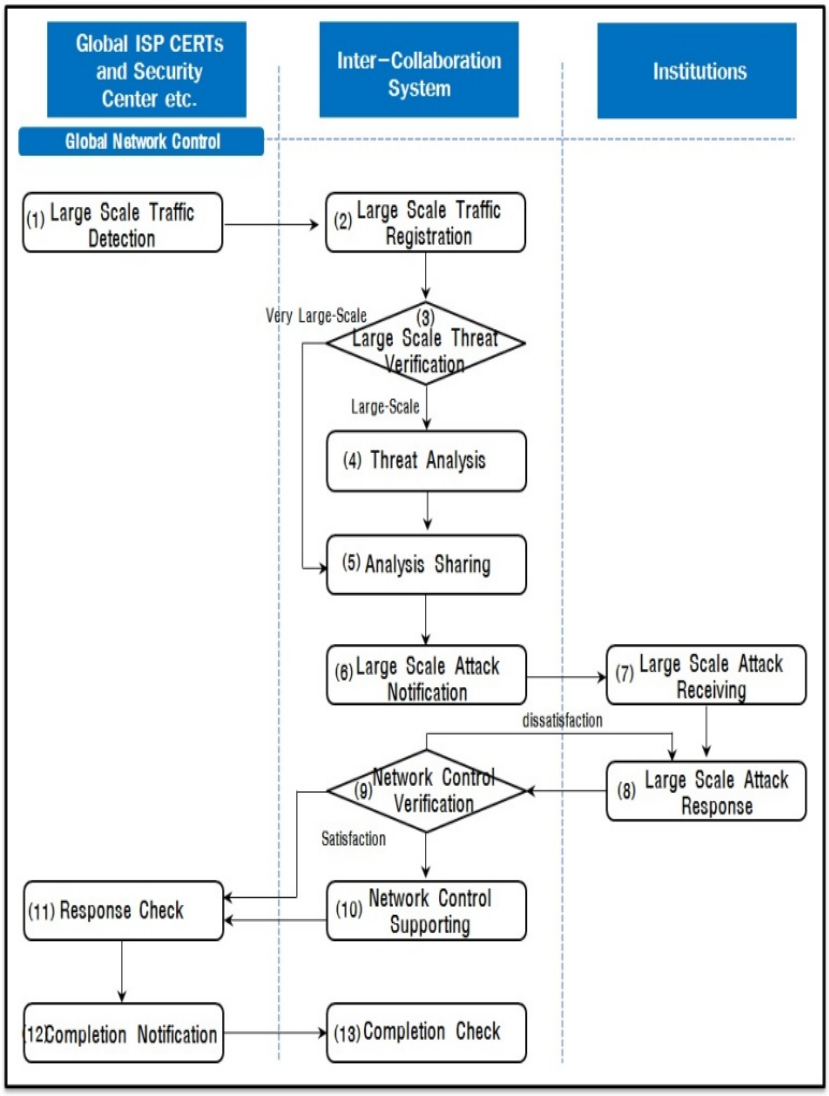

Figure 5: Process Global Network Control

C. RBL(Real-time Blocking List) Process

As the figure 6, RBL(Real-time Blocking List) blocks the IP for the this system if arbitrary system is infected by the virus and the infected system transfers the spam mail from domestic and foreign networks. Blocked IP must promptly carry out the removal action because it can't connect another circuit. Therefore, our inter-collaboration system shows the process for RBL response and removal as follows.

Step 1~7: Inter-collaboration system notifies RBL to the institution if RBL is registered by ISP CERTs and security center. Received institution returns the result to inter-collaboration system after it examines the infected system. It verifies this result and returns it to ISP CERTs and security center.

Step 9~12: ISP CERTs and security notifies RBL removal to the institution after they check RBL response result.

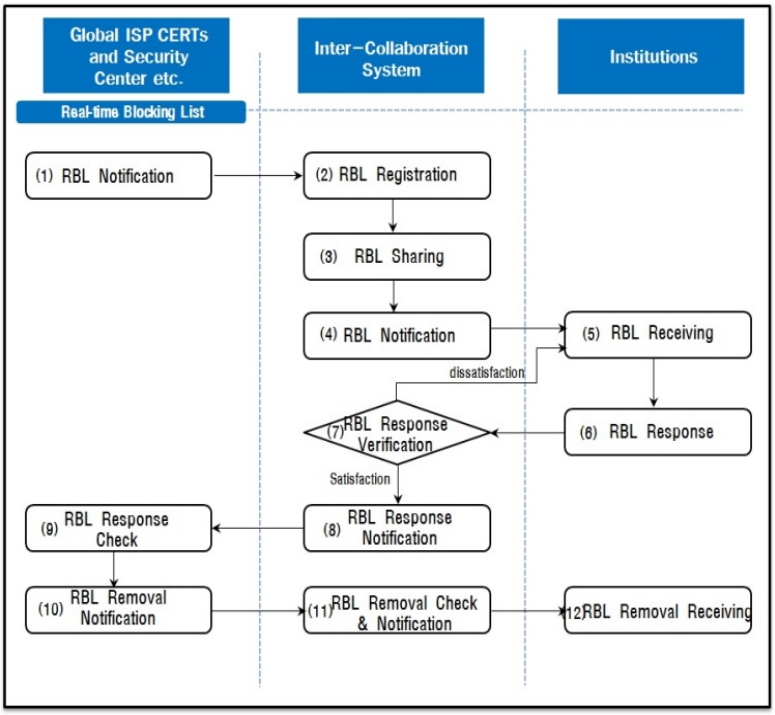

Figure 6: RBL Process

D. Implementation

We implement the inter-collaboration system based on global threat management, global network control and RBL process. Our OS is Linux and it use JSP, HTML, Java script, CSS programming language. Also, development program applies ORACL 10, Apache Tomcat 6.0 and jquery 2.1 versions. Firstly, we constructed ORACL DBMS environment after built Apache Tomcat server. Secondly, we constructed actually DBMS using the SQL dump files. Finally, we uploaded developed web page, script files and style sheet etc. to the server. Figure 7 shows one part of our system and we blinded the related items for the security.

Figure 7: Partial Screen of Inter-Collaboration System

V. CONCLUSION

We proposed inter-collaboration design between ISP CERTs and security center for effective response of well-known cyber-attacks. Also, we presented the false positive and inter-collaboration response for the unknown attack through our system. As a result, proposed system provided the users and institutions with the prompt and correct response for cyber threats.

ACKNOWLEDGEMENT

This research was support by “Building and Services of Advanced KREONET Based on Software” Program funded by the Ministry of Science, ICT & Future Planning(K-16-L01-C02)

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Case Study on the Establishment of Cloud Management System in Data Centers: Focusing on G-Cloud Application Case

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Abstract---

Objectives: According to the enforcement of the Cloud Computing Development and User Protection Act, a new paradigm called as Cloud Computing is coming to the fore among public and private domestic enterprises. Now we are facing a necessity to combine all the cloud systems in Korean government to operate seamlessly in a harmony.

Methods: Through the case study of CMS(Cloud Management System) in data center, this paper explores the concept of G-Cloud and G-CMS.

Findings: After defining the Cloud Computing and G-Cloud of Korean government, this paper intends to examine the outlook for growth in the industry with the architecture of G-CMS by reflecting on the case of G-CMS establishment.

Improvements/Applications: G-Cloud was the first implemented base on a UNIX server. G-CMS is the only platform in the world that can control RHEV(Red Hat Enterprise Virtualization), IBM Power VM, and HP Integrity VM.

Keywords--- Cloud Computing, G-Cloud (Government Cloud), G-CMS (Government Cloud Management System).

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

On September 28, 2015, the Cloud Computing Development and User Protection Act (the Cloud Development Act) was enforced. As[1] the one and only act in the world that regards Cloud, it's requires public institutes such as the branches of the central government, the local governments, state-owned firms, and schools to spearhead the introduction of Cloud. Thus the market for Cloud will grow around the public market.

Cloud Computing (Cloud) has evolved from its original method that requires inconvenient installation of ICT resources, to a new method that charges users for their service. As the central infrastructure to accomplish the key values of Government 3.0 - openness, sharing, communication and cooperation - Cloud is expected to promote information sharing across institutions.

Meanwhile, on November 10, 2015, the Ministry of Science, ICT and Future Planning pronounced the K-ICT Cloud Promotion Plan in a bid to establish an infrastructural foundation for Government 3.0 and fast-track the innovation of the national and social ICT infrastructure. As[2] elaborated in Figure 1, the plan will step up the utilization rate of Cloud to 30% (about a tenfold of the current rate) by 2018, giving a boost to nationwide innovation.

At the same time, the private market will be fueled with a 2 trillion won worth revenue generated in the Cloud market. The public sector will also benefit from budget saving by 320 million dollar for three years from 2016 to 2018 and operational innovation.

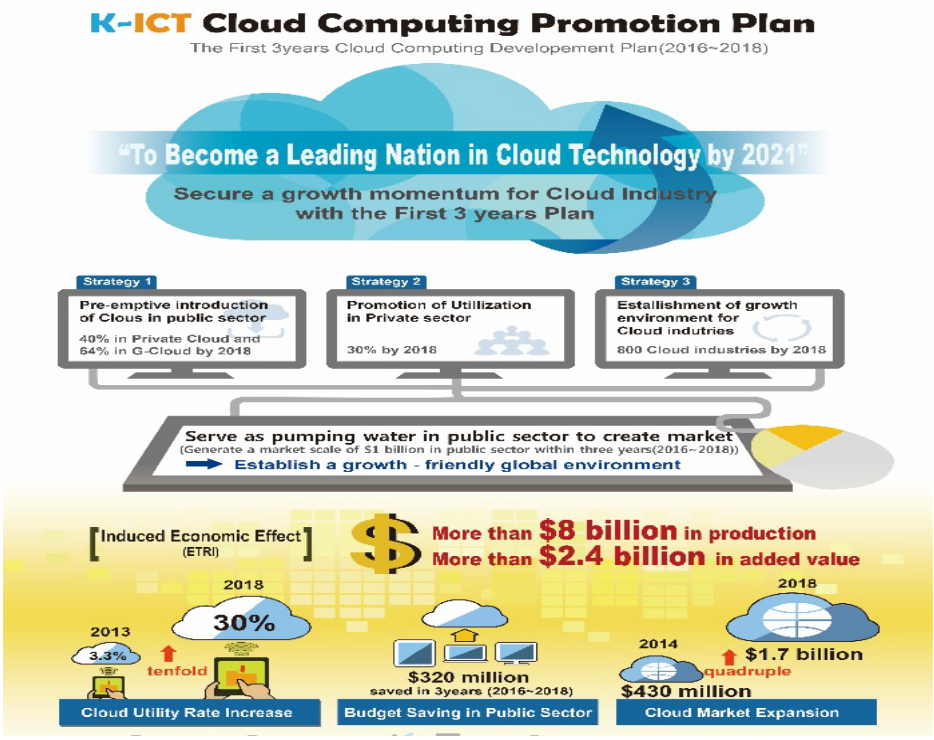

Figure 1: A Blueprint of K-ICT Cloud Promotion Plan

II. THE CONCEPT OF CLOUD COMPUTING

A. The Technological Trend of Cloud

According to Gartner, the market research agency, the annual average growth rate of cloud computing is over 35%. Furthermore, as the market for Private Cloud enters a maturing stage, the demand to utilize the flexibility of Public Clouding is projected to increase.

Table 1 demonstrates the latest technological trend from 2011 to 2015 selected by Gartner[3].

Table 1: Gartner's Top 10 Strategic Technology

	2011	2012	2013	2014	2015
1	Video	Media tablets and beyond	Mobile devices battle	Mobile device diversity/management	Computing everywhere
2	Mobile App and Media Tablet	Mobile-centric applications/interfaces	Mobile Application and HTML5	Mobile App and Applications	Content-rich systems
3	Social communications and collaboration	IoT	IoT	IoT	IoT
4	Context-aware computing	Contextual/social user experience	**Hybrid IT & Cloud Computing**	**Hybrid Cloud & IT as a service broker**	Risk-based security/self-protection
5	**Cloud computing**	**Cloud computing**	**Personal Cloud**	**Era of the Personal Cloud**	**Cloud / Client Computing**
6	Next generation analytics	Next generation analytics	Actionable analytics	**Cloud / Client architecture**	Advanced pervasive/invisible analytics
7	Social analysis	Big data	Strategic big data	Software-defined anything	Software-defined applications and infrastructure
8	Storage class memory	In-memory computing	In-memory computing	Smart machines	Smart machines
9	Fabric-based computing and infrastructure	Extreme low-energy servers	Integrated ecosystem	Web-scale IT	Web-scale IT
10	Ubiquitous computing	App stores and marketplaces	Enterprise app stores	3D Printing	3D Printing

B. The Definition of Cloud Computing

Different organizations and institutions define Cloud Computing differently[4].

1) Gartner: A form of computing that utilizes internet technologies to offer highly expansive resources to a wide range of clients.
2) Wikipedia: An internet-based computing technology or a web-based software service that basically keeps its programs in utility data servers on internet and loads the data into computers or smart phones on demand.
3) Google : The technology that enables the utilization of ample computing resources, a task that cannot be performed by a computer alone, by connecting hundreds or thousands of user-oriented and task-oriented computers

Sorted by service type, Cloud is composed of IaaS, PaaS and SaaS. If sorted by service operation mode, it is composed of Public Cloud, Private Cloud and Hybrid Cloud.

The main definition of each type and operation mode is as explained below[5]:

Table 2: Service Types and Operation Modes of Cloud

Category		Main Definition
Service Type	IaaS(Infrastructure as a Service)	• A type of service that rents or provides hardware resources such as server or storage
	PaaS(Platform as a Service)	• A type of service that rents or provides platform necessary for developing software
	SaaS(Software as a Service)	• A type of service that rents or provides the software that users demand
Service Operation Mode	Public Cloud	• A form of service opened for the public to use its many services
	Private Cloud	• A form of service that establishes a cloud service environment exclusively for the insiders of an enterprise or an institute
	Hybrid Cloud	• A combined form of Public Cloud and Private Cloud • Imposes selective privacy policies on specific data or service that should be kept in privacy.

III. AN OVERVIEW OF G-CLOUD

G-Cloud(Government Cloud) is an electronic government Cloud Service established and run by the National Computing and Information Service(NCIS). Before the introduction of G-Cloud, each government branch had to establish information resources according to each task.

This, in turn, widened the gap in the utilization of software and hardware resources among tasks and systems. Thus, the government resources were exploited inefficiently and rarely shared across organizations. Also, the huge number of computing equipment filing into NCIS brought about the overall depletion of infrastructure such as the upper surface area of computing rooms, electricity, and heating and air-conditioning equipment.

In [6]order to overcome these inefficiency, G-Cloud was created in response to the demand for sharing and speedy distribution of various resources, as well as cost-saving.

IV. AN OVERVIEW OF G-CMS

A. An Introduction of G-CMS

G-CMS is a G-Cloud management system, created with POLESTAR XEUS, a domestic cloud management solution by Nkia, co., ltd. POLESTAR XEUS is a service operation tool that provides a wide range of convenient functions for users and control and management functions for Cloud managers[7].

Covering almost all of the current heterogeneous solutions, G-CMS is the only platform in the world that can control RHEV(Red Hat Enterprise Virtualization), IBM Power VM, and HP Integrity VM. It has proven its excellence by acquiring GS (Good Software) Certificate, 2012 and National Software Presidential Award, 2013.

B. Main Functions and Expected Utility of G-CMS

The main functions of G-CMS are as follows:

Table 3: Main Functions of G-CMS

Item	Function
User Portal	• User Log-in page • Dashboard information each for users and managers • My Page information
Manager Portal	
Management of Resource Provisioning	• Creating new HP/IBM virtual machine • Altering spec of virtual machine • Retrieving resources from CPU, memory or storage (Deleting virtual machine, retrieving disk, etc.)
Connecting with G-CMS	• Altering constituting information of virtual server • Automatic updating of agent • Consistency of garnered data
Management for Resources	• Management of resources status dashboard controlled respectively according to net, government branch, resources pool, and physical server. • Management of IP, storage and events • Management of service catalog and template
Management of Usability	• Online Migration management of virtual machine • HA(High Availability) management function • Automatic backup management function

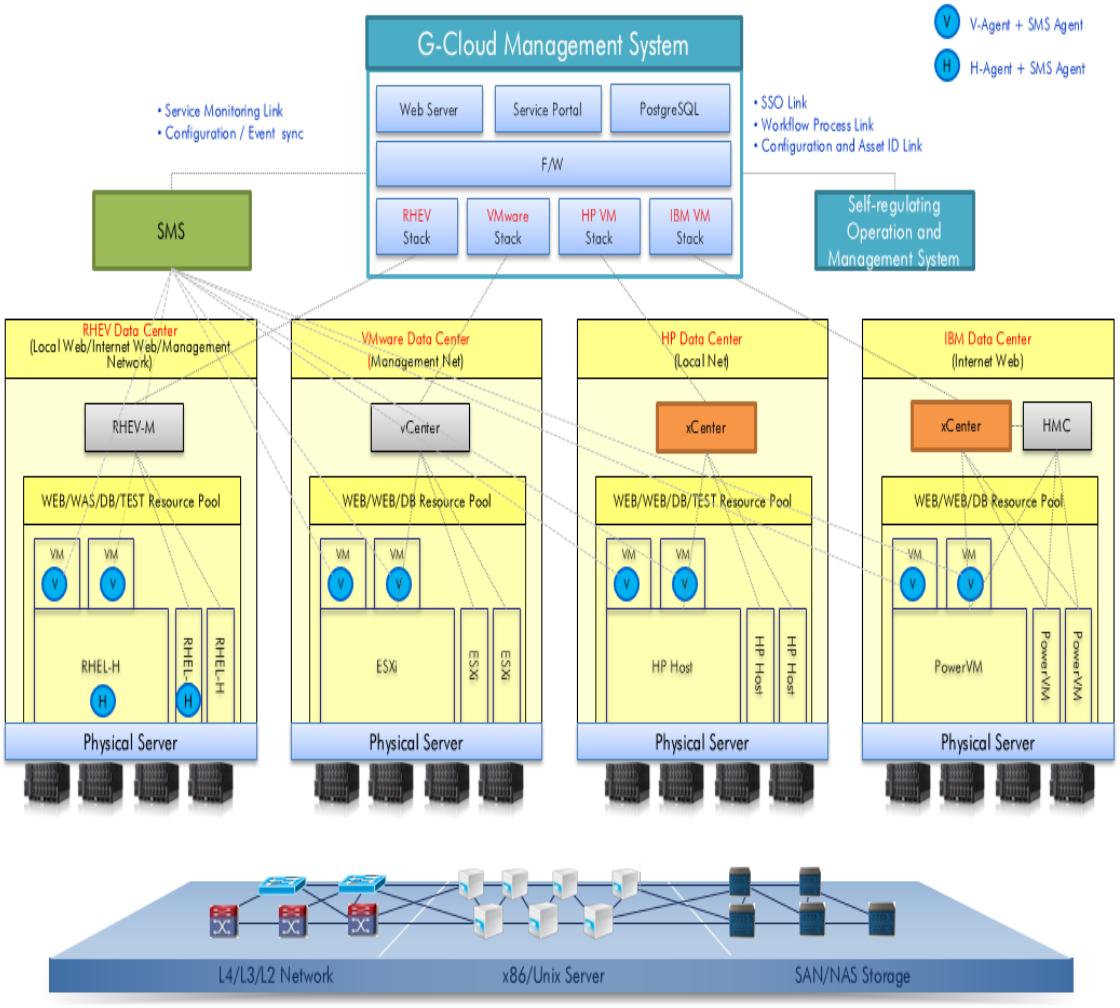

Figure 2: G-CMS Architecture

As Shown in Figure 2, G-CMS allows more than 120 physical servers including IBM Unix, HP Unix to be managed via Cloud. It also provides an environment in which users and managers can more conveniently perform management operations such as altering virtual server qualification and adding storage. It also provides a holistic view of a situation by presenting summarized resource status data on dashboard. Thus, NCIS has been able to fully exploit the resources rapidly, while at the same time cutting down the cost. The table below shows the effectiveness of the system by comparing the previous environment with the Cloud environment[8].

In this paper, G-CMS was introduced with the concept of its architecture.

Table 4: The Comparison between the Former Environment and Cloud

Category	Former Environment	Cloud Environment	Note
Resource Allocation Period	A week	An hour	7 times
Usability	HA composition	HA composition	Same
Performance	1Gbps	10Gbps	10 times
Expandability	Difficult	Accessible	-
Complexity	Normal	High	-

V. CONCLUSION

G-Cloud was the first implemented base on a UNIX server. The expected utility of constructing G-Cloud is as follows: First, it expands the service that can be shared and used by government agencies and institutions. Second, it facilitates the operation of a world-class smart government and the informatization of low-carbon green growth. Third, by promptly reacting to the demands for globalization projects of each government branches, such as various requirements and service demands from client organizations, it can increase satisfaction in terms of nationwide administration service and client organizations.

Thus, G-CMS can be seen as the first system to comprehensively manage heterogeneous Unix virtualization systems. This helped domestic enterprises to acquire a world-class technological dominance in the field of Cloud management system. The integrated management can also save costs by managing heterogeneous virtualization systems in data centers.

ACKNOWLEDGMENT

This research was financially supported by Hansung University.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES
IJPBS

ISSN
0975-6299

Evaluation of Usefulness for Quality Control Phantom of Computed Tomography Produced by Using Fused Deposition Modeling 3D Printing Technology

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Abstract---

Background/Objectives: The purpose of this study was to evaluate of usefulness for developed computed tomography (CT) phantom using fused deposition modeling (FDM) 3-dimensional (3D) printing technology with the same quality performance as American association of physicists in medicine (AAPM) CT performance phantom.

Methods/Statistical analysis: The phantom by using modeler program was the 180 mm in diameter, 50 mm height cylinder shape and constructed by making 30.6 mm in diameter round holes in the middle of inside of the cylinder and 4 spots on surrounding. To measure slice thickness and spatial resolution, we designed the cylinder shaped sub phantom to let it locate inside the round hole.

Findings: This study was showed the CT phantom with the same quality performance as AAPM CT performance phantom using FDM 3D printing technology. The results of CT number of and noise were passing the criterion with 3.10 HU and 2.66 HU. The uniformity of CT number was a difference within ±5 HU between the centers. The study of spatial resolution was suited because the 1.0 mm thick wall of the cylinder with 5.0 mm, 3.0 mm, and 2.0 mm in grid size was distinguishable. In terms of the measuring slice thickness, the result was passing meeting the criterion; it came to 4.5 mm and 9.1 mm from 5.0 mm and 10.0 mm with deviation of ±1 mm. The comparing with AAPM CT performance phantom all categories were suitable for the AAPM CT evaluation criterion.

Improvements/Applications: We could expect that developed CT phantom was cheaper up to 80% than AAPM phantom so the small-medium size the hospitals can easily equip the high quality medical image technology devices.

Keywords--- Computed Tomography, Phantom, Fused Deposition Modeling, 3D Printing Technology, Quality Control, American Association of Physicists in Medicine.

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Special Issue on"Engineering and Bio Science"

I. INTRODUCTION

It was possible for the computed tomography (CT) scanner to scan rapidly CT images and reconstruct them. It is used to examine the medical imaging of diseases on the nervous system, the respiratory system, the digestive system, the urinary system, the muscular skeletal system, the cardiac condition and the blood vessel condition[1,2].In many aspects of medication, CT scanners are highly used with the radiographic method furthermore error images from the CT scanner could cause the diagnostic errors. Also in this case, it is apprehended that the repetitive radiographic inspections will increase medical radiation exposure to the patients. Therefore, it is strongly recommended that the quality control (QC) in CT scanner should be performed frequently, which means it can help to minimize the CT imaging errors and the radiation quantity from CT test[3,4]. Initial QC in CT scanner was also implemented to target self-made phantom and patients. A few years after, the quantitative analysis of the quality control of the match of Hounsfield (HU), image noise, spatial resolution, sensitivity profile, etc. were performed[5-7]. Currently the QC phantom in CT scanner named American association of physicists in medicine (AAPM) CT performance phantom that AAPM invented is widely in use[8]. In Korea as well, AAPM CT performance phantom is used as the standard of the QC phantom with CT in accordance with regulations about setup and operation of special medical equipment[2].AAPM CT performance phantom is composed of 5 blocks; CT number calibration block, spatial resolution block, contrast resolution block, beam alignment block and noise measurement block[8].But CT performance phantom designed by AAPM had some problem. It was heavy because filled with water in the phantom. So the phantom must setting on the CT scanner table. The results of this method caused in homogeneity of image by supporter of the phantom on the table edge of CT scanner. Several solid phantoms were developed for this problem. One of the most familiar solid quality assurance CT phantom was proposed based on the works of Good enough and collaborators using a tissue-equivalent epoxy resin developed by White[9]. The phantom was made from solid-cast materials, elimination material absorption of water and leaks associated with water bath phantom, as well as problems related to varied water sources. But these phantoms were the high cost equipment so generally it is hard for the small and medium-sized hospitals to be fully equipped. Recently, the application of 3D printing technology to medical field has been gradually increasing with the commercializing 3D printer[10].

In this study was to evaluate of usefulness for developed solid CT phantom using fused deposition modeling (FDM) 3D printing technology with the same quality performance as AAPM CT performance phantom.

II. MATERIALS AND METHODS

A. Equipment and Materials

In this study is used 4-channel MDCT(MX8000-IDT, Philips, USA) scanner. The phantom is produced by 3D printer (Fortus 360mc/400mc, Stratasys, USA), modeler (CADian 3D Ver. 2.0), and slicer program (CreatorK Ver.9.6.0). To compare phantom, CT evaluation phantom, AAPM CT performance phantom is used like Fig. 1.

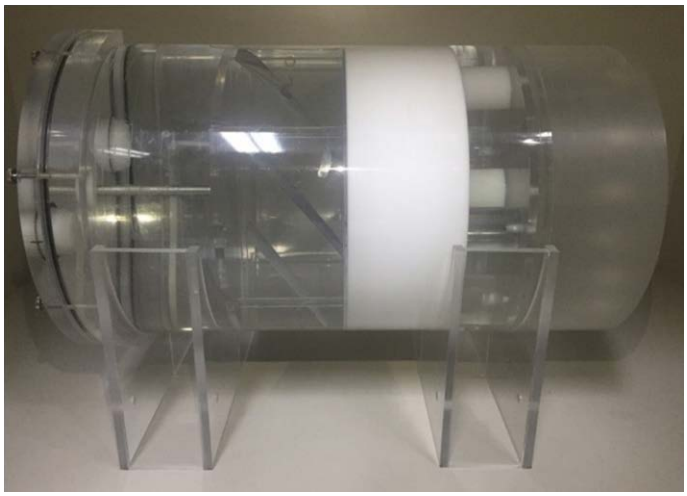

Figure 1: AAPM CT Performance Phantom

B. 3D Modeling

The production of phantom by FDM 3D printing technology followed the procedure like Fig. 2.

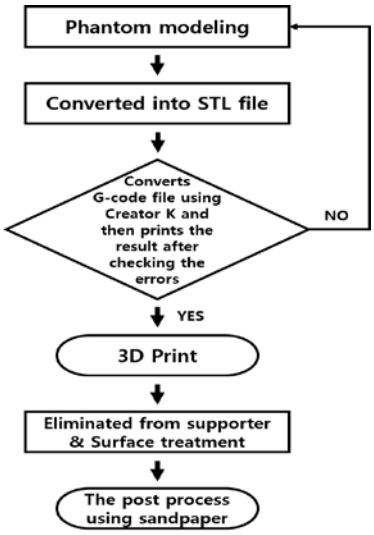

Figure 2: The Flow Chart of 3D Printing by Manufacturing Phantom

First, it is converted into stereo lithography (STL) file through modeling with modeler program. The proposed CT performance phantoms were consisting of the main phantom and sub-phantom by solid type. The main phantom is designed the 180 mm in diameter and 50 mm height cylinder shape and constructed by making 30.6 mm in diameter round holes in the middle of inside of the cylinder and 4 spots on surrounding (Fig. 3). And then we designed the cylinder shaped sub-phantom to let it locate inside the round hole, which could measure slice thickness and spatial resolution.

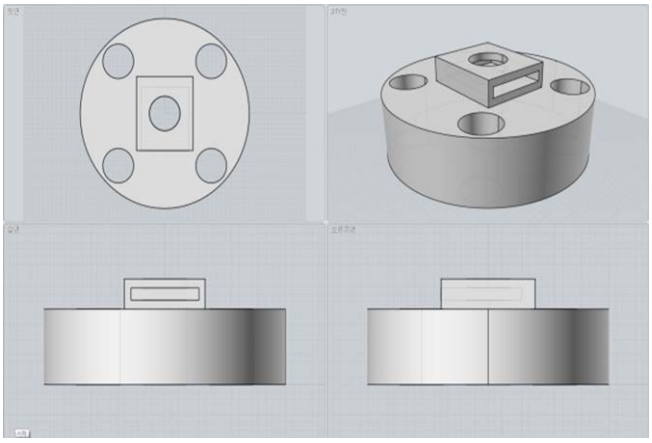

Figure 3: Phantom Modeling by Modeler Program

Secondly, we converted STL file into G-code file using Creator K, the control program of 3D printer, and then printed the result after checking the errors. In this study, the main phantom is made with acrylonitrile poly butadiene styrene (ABS) and the cylinder shaped phantom uses poly lactic acid (PLA). Thirdly, the produced phantom is done with the surface after being eliminated from supporter. Finally, to obtain research completeness we implement the post process using sandpaper.

C. Performance Test

The condition of performance evaluation resulted from investigation X-ray applying 120 kVp, 250 mAs, 10 mm thickness, 50 cm scan field of view (FOV)and 25 cm display FOV, standard reconstruction algorithm. Additionally in terms of slice thickness measure, a 5 mm thickness is fulfilled. To measure a water attenuation coefficient and an image noise, we checked out X-ray to the filling syringe of distilled water in the middle of

our proposed CT phantom and on 4 circle spots of outside surrounding. For checking the degree of image uniformity, we put the same quality of material cylinder into each circle of the main phantom and then investigate X-ray. And CT number is measured respectively after locating the square shape the region of interest (ROI) on the direction of 12 o'clock, 9 o'clock and 3 o'clock which is the spot about two-thirds distance of the surrounding from the middle at the main phantom. To survey spatial resolution, we checked out X-ray putting the sub-phantom of 9 cylinders in total into the middle of the main phantom. These phantoms are consisted by 5 mm, 3 mm, 2 mm in grid size and each 1 mm, 0.75 mm, 0.5 mm in the wall thickness of grid. Also for the clear distinction of wall thickness, window width (WW, 300~400 HU), window level (WL, -200~-100 HU) is adjusted on spatial resolution. Slice thickness is measured with 5 mm, and 10 mm slice thickness by investigated X-ray through put the manufactured the cylinder of sub-phantom as the same thickness as slice thickness in the middle of the main phantom. Also for the clear distinction of wall thickness, WW (1900~2000 HU), WL (0~100 HU) is adjusted on spatial resolution.

III. RESULTS

A. Results of 3D Printing

We successfully manufactured our proposed CT phantom by using 3D printer and equipped at the CT scanner table-edge like Fig. 4.

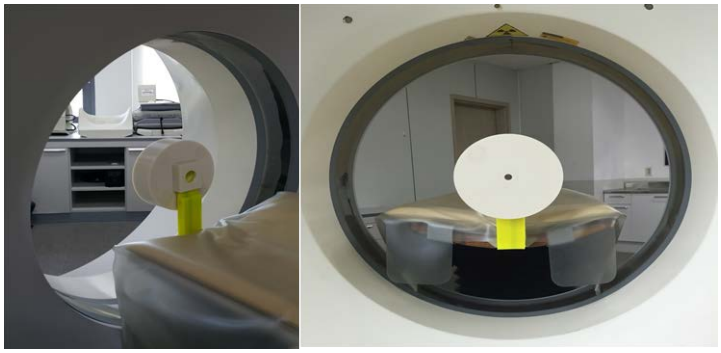

Figure 4: Proposed CT Phantom by 3D Printing Technology Equipped at the CT Scanner Table-Edge

The cylinders of sub-phantom and the main phantom are made using the 3D printing technology like Fig. 5. The cylinders of sub-phantom in each hole can evaluate the quality of image about spatial resolution and slice thickness.

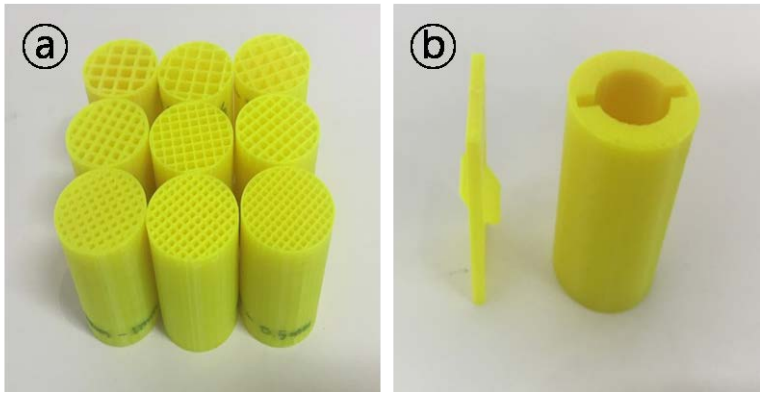

Figure 5: Proposed CT Sub-Phantom by 3D Printing Technology (a) Sub-Phantom for Spatial Resolution (b) Sub-Phantom for Slice Thickness

B. Results of Evaluating Images

The 4-channel MDCT is tested by AAPM CT performance phantom and gets through in all categories. So it was proper in this study. As Table 1, the suitability of the developed CT phantom meets acceptance criterion of AAPM CT performance phantom.

Table 1: AAPM CT Evaluation Criterion and the Measured Value of AAPM CT Performance Phantom and Proposed Phantom

Categories	Criterion	AAPM CT Phantom	Proposed CT Phantom	Result
Water attenuation coefficient	0 ± 7 HU	- 5.7 HU	3.10 HU	Pass
Noise	Below 7 HU	5.7 HU	2.66 HU	Pass
Image uniformity	±5 HU	Mean -2.2 HU	Mean 1.7 HU	Pass
Spatial resolution	1.0 mm	Below 7.5 mm	Below 1.0 mm	Pass
Contrast resolution	6.4 mm	Below 6.4 mm	-	N/A
5 mm thickness	±1 mm	4.8 mm	4.6 mm	Pass
10 mm thickness	±1 mm	9.2 mm	9.1 mm	Pass
Artificial substances	None	None	None	Pass

As the Fig. 6, the measurements of water attenuation coefficient and image noise are checked investigating the average and the standard deviation of CT number in the interested region. The result 3.10 HU and 2.66 HU is accepted. As the result of the degree of image uniformity the CT numbers of the direction of 12 o'clock, 9 o'clock and 3 o'clock were -111.98 HU, -115.37 HU, -110.62 HU and the center CT number in the main phantom was -112.23 HU by a difference within ±5 HU between the center and the peripherals, which means the test passes. The study of spatial resolution suited because the 1mm thick wall of the cylinder with 5 mm, 3 mm, and 2 mm in grid size were distinguishable with the naked eyes. In terms of the measuring slice thickness, the result passes meeting the criterion; it came to 4.5 mm and 9.06 mm from 5 mm and 10 mm with deviation of ±1 mm.

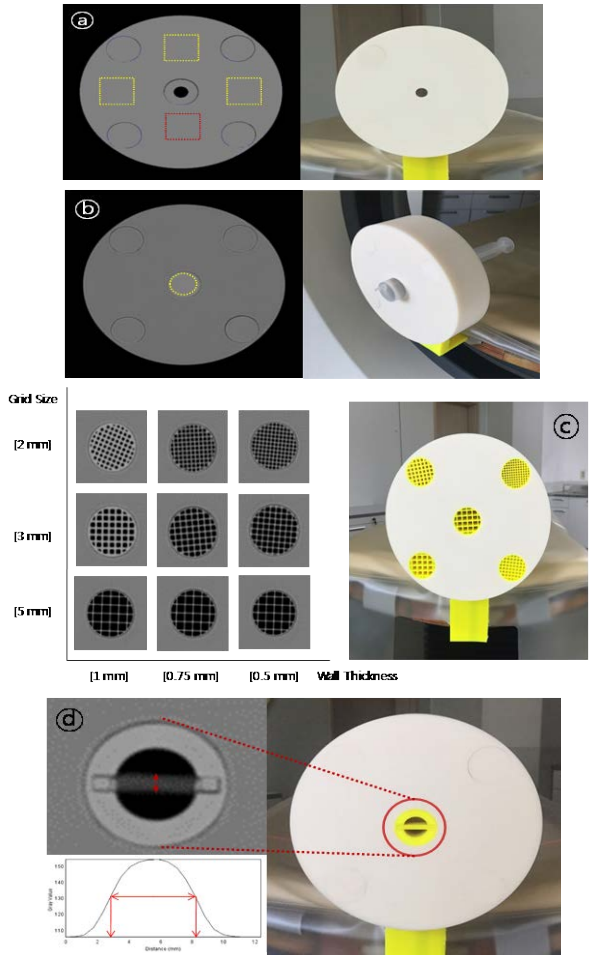

Figure 6: CT Phantom Produced by 3D Printer (a) CT Image for Uniformity of CT Number and Phantom Appearance (b) CT Image for Water Attenuation Coefficient with Image noise and Phantomappearance (c) CT Image for Spatial Resolution and Phantom Appearance (d) CT Image for Slice Thickness with Sensitivity Profile and Phantom Appearance

IV. DISCUSSION

The purpose of this study was to evaluate of usefulness for developed CT phantom using 3D printing technology. After the introduction of the commercial CT scanner in the early 1970s, the scientific community started to evaluate the capabilities and limitations of that new image modality. However, the previously known image quality evaluation techniques were not adapted to the geometric characteristics of the CT scanners neither to their physical and architectonic properties, such as voltage and current range and gantry geometry. This situation resulted in proposals for geometric apparatus intending to quantify the main image properties of the CT images, such as spatial resolution and contrast resolution, image noise, slice thickness, and also some kind of artifacts[11]. The McCullough and colleagues, proposed have contributed to the AAPM task force on CT phantoms, and their progresses were adopted on the first guide for QC and dosimetry in CT published by AAPM[3,4]. The AAPM CT performance phantom included many interesting inserts for evaluation of the CT scanners in terms of its image quality. The ACR phantom is also endorsed by the American College of Radiology for CT accreditation in the United States. This phantom was used by the physics group to establish baseline values for all scanners under the group's responsibility. For CT number accuracy, the ACR recommends that scans are performed between 120 and 130 kVp, and gives CT number ranges which are based on the average values obtained from multiple scanner models[12]. Recently, CT scanners have been gradually developing with detectors and scanning technology. So various CT scanners required develop more practical methods for evaluation image quality in CT scanners. For example, such as the Catphan (The Phantom Laboratory, Salem, NY) or ACR Accreditation Phantom (model 464,Gammex, Middleton, WI) are typically used by physicists to monitor image quality on variousscanners[13].We suggested that 3D printing technology applied for manufacture of the CT performance phantom. The greatest advantage that 3D printing technology provides is the freedom to produce custom-made equipment[14]. Another important benefit offered by 3D printing is the ability to produce items cheaply[10]. Traditional manufacturing methods remain less expensive for large-scale production. However, the cost of 3D printing is becoming more and more competitive for small production runs[15]. Therefore, the results of this expects that our proposed CT phantom was cheaper up to 80% than AAPM phantom, so the small-medium size the university hospitals and the general hospitals can easily equip the high quality medical image technology. Also, because lightweight and compact by 3D printing technology than conventional AAPM phantom, the phantom can equipped at the CT scanner table-edge. As a result, it was decreased beam-hardening artifact by the supporter of CT phantom. Comparing with AAPM phantom, all categories of CT number, image noise, the degree of uniformity, spatial resolution and slice thickness were suitable for the AAPM CT evaluation criterion. These findings were applicable to CT performance phantom by using ABS and PLA with FDM 3D printing technology. On the other hand, this study showed the limit to fail on developing the sub-phantom for measuring contrast resolution. But future studies will keep on the study about it.

V. CONCLUSION

The 3D printing technology has become a useful in the medicine field[16,17]. Especially, we confirmed that 3D printing technology can utilize the radiation field.The results of this study demonstrated that recommends the low price evaluation phantom with the same quality performance as AAPM CT performance phantom using FDM 3D printing technology. Future work will focus on the various the design of the CT performance phantom.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

An Improved Dynamic Reconfiguration System of Component Based Software Systems with the Consideration of QOS Parameters Prediction

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Abstract---

The component based software development is recognized as the direction in which the software industry. Dynamic reconfiguration is the process of alternating the functionality or characteristics of running software dynamically by alternating the modules or components of the software. One of the most complex processes is dynamic reconfiguration and it cannot be executed successfully where the entire component will be beneath the execution and immediate change would impact the results. During this reconfiguration process the real software is affected and it is required to be preserved for the excellent results. In the preceding research work, the WoS prediction Model (QoS-PM) is proposed for the excellent dynamic reconfiguration system. On the other hand, these approaches only consider the throughput and elapsed time metrics at the time of validation. To overcome these trouble in the proposed research work, by performing the dynamic reconfiguration with the aim of attaining excellent performance by developing the following methodologies. The QoS aware Dynamic Reconfiguration System (QoS-DRS) is introduced in the proposed research framework and this method is proposed for assuring the efficient and the development of component based system. The QoS metrics are the units for calculating the QoS attributes of a software component. The quantification of the QoS attributes of software components is one of the significant aims of the new QoS framework. Therefore, there is a requirement for standardized metrics to differentiate the QoS attributes of various software components. The different types of QoS metrics like dependability, security, adaptability, maintainability and portability is to accomplished optimal and the excellent reconfiguration in the proposed research work. The entire experimental evaluation of the proposed research methodology is applied in the java simulation environment from which it is conferment that the proposed research methodologies direct to give the excellent result compared to the existing methodologies.

Keywords--- Component System, QoS Metrics, Dynamic Reconfiguration, Improved Reconfiguration System.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The software systems are created by Component based software development by using the proper off the shelf software components [1]. The assembling complete systems concepts out of prefabricated parts are common in science and engineering branches like manufacturing. This concept is direct to create the prompt and economical products. This process is only possible because of the standardized components. This standardized components are used to manufacturer's functional and nonfunctional like quality necessities [2]. And the standardized component also used to create the manufacturer task in simple process based on the functional and non-functional attributes.

Now days, the component based methodologies are used by the software developer and it does not get the benefits from the same luxury. The Commercial off the Shelf (COTS) components are specified only with the functional attributes in their interfaces [3]. Basically, there is no solid concept of quality is linked with components. Therefore, there is no need the contrast the performance characteristics among the many number of components with the same functionality by the system developer. During the software development process, this process is leads to restrict the developer selections while to choose the component with functionality. Therefore, the framework is required to permit the objective measurements of components Quality of Service (QoS) attributes [4].

The initial step of these directions is the creation of a Quality of Service catalog for software components [5]. This catalog has the QoS attributes of software components details with the suitable metrics, evaluation approaches and the attributes interrelationship. On the other hand, the gap is very large among the dynamic reconfiguration and its applicability because of a better understanding of the QoS assurance capacity of the preceding methodologies and it is not accomplished [6]. The dynamic reconfiguration is mainly cause the impaired QoS of a RUSR, or unpredictable faults in the concluding systems. Suppose it is apply with the improper methodologies or the improper time point [7].

The QoS aware Dynamic Reconfiguration System (QoS-DRS) is used to assuring the efficient and excellent development of component based system. This methodologies is proposed in this proposed research framework. In the software component, the QoS attributes are measured by using the QoS metric and this metrics are known as units. The significant aim of the proposed QoS framework is the quantification of the QoS attributes of software components. Therefore, the QoS attributes are compared among the various software components by using the standardized metrics. The name of the QoS metrics is dependability, security, adaptability, maintainability and portability and so on. This metrics are used to get the optimal and good reconfiguration.

The entire concept of the proposed research work is explained in the following sub sections. The different research works is explained in detail in section 2 and also explain the aim of to achieve the efficient dynamic reconfiguration.

The proposed research methodology is explained in section 3 and also explains the performance of the dynamic reconfiguration with the proper examples and diagrams. The experimental comparison is explained in section 4. At last, the proposed research methodology results are explained in section 5.

II. RELATED WORK

The concept of QoS aim is too associated with the networking field. A number of structural designs are introduced for QoS guarantees for distributed multimedia systems. The Quality of Service Architecture (QoS-A) is used to specify and accomplish the significant performance properties of media applications through the asynchronous transfer mode (ATM) networks is introduced. In QoS-A, as an alternative of considering the QoS in the end-system and the separate network, a novel integrated methodologies and it is incorporates with the QoS interfaces, control and management mechanisms through the entire structural design of the layers is used. This structural design is based on the concept of flow, service contract and flow management. The QoS requirements are formalized by using the service contract of the user and the service commitment of the service contributor is also possible. The network resource requirements are also enabled and important concept is being taken because of a service contract violations. In the service contract the QoS is observed and organized by using the flow management.

The Quality Objects (QuO) framework [9] gives the QoS to share the software applications composed of objects. The aim of QuO is to link the gap among the socket-level QoS and the distributed object level QoS. This process is emphasized on specification, measurement, control and adaptation to alter in Quality of

Service, the QuO is established the CORBA functional IDL with a QoS description language (QDL). The QDL is a collection of quality description languages for explaining the QoS contracts among the customers and objects, the system resources and mechanisms for calculating and giving the QoS and suitable characteristics on the customer and object. The Aspect Oriented Programming paradigm is utilized in [10] and this is used to give the support for incorporating the non-functional properties of components individually from the functional properties.

In [11], the new QoS Modeling Language (QML) is a QoS specification Language is introduced. The extension of UML is QML. There are three types of abstraction mechanisms is available for QoS specification namely contract type and contract and profile. A contract type represents a particular QoS attributes like reliability or performance and the dimensions are described and it is used to describe the specific QoS attribute. A contract is described as an example of a contract type and it is represented a specific QoS specification.

Both the base framework and the reconfiguration framework was measured performance in opposition to the similar workload in [12]. In [13], the similar type of reports can be identified with both the evaluated the reconfiguration overhead that was proposed by the top-up of reconfiguration layer on the base system. On the other hand, how the overhead is affected the QoS of a RSUR and it is checked whether it is eliminated in safely.

In [14], the estimation while it was safe to execute evolution, what evolutionary steps were needed and how to execute the evolution operation to ensure the suitability of dynamic reconfiguration methodologies are used. In [15], the survey and the result is conducted with the more number of factors like coexistence, performance characteristics prediction, dynamic state transfer, dynamic change impact analysis and servicing continuity should be the principal criteria. In particular, the probable impacts of dynamic change were recommended to be the significant feature. In [16], the comprehensive analysis results, the impact of QoS preceding dynamic methodologies were quantitatively differentiated in opposition to the proposed reconfiguration benchmark DEDSS on the reconfiguration platform DyanQoS.

III. EFFICIENT DYNAMIC RECONFIGURATION SYSTEM WITH QOS ASSURANCE LEVEL

The software systems are created by component based software development by using the proper off the shelf software components. The assembling complete systems concepts out of prefabricated parts are common in science and engineering branches like manufacturing. This concept is direct to create the prompt and economical products. This process is only possible because of the standardized components. This standardized components are used to manufacturer's functional and nonfunctional like quality necessities [2]. And the standardized component also used to create the manufacturer task in simple process based on the functional and non-functional attributes.

Now days, the component based methodologies are used by the software developer and it does not get the benefits from the same luxury. The Commercial off the Shelf (COTS) components are specified only with the functional attributes in their interfaces. Basically, there is no solid concept of quality is linked with components. Therefore, there is no need the contrast the performance characteristics among the many number of components with the same functionality by the system developer. During the software development process, this process is leads to restrict the developer selections while to choose the component with functionality. Therefore, the framework is required to permit the objective measurements of components Quality of Service (QoS) attributes. The initial step of these directions is the creation of a Quality of Service catalog for software components [5]. This catalog has the QoS attributes of software components details with the suitable metrics, evaluation approaches and the attributes interrelationship.

A. Qos Attributes Considered

The abstract component model is described with the associated reconfiguration concepts. The dependent concepts are proposed with respect to QoS characteristics and key troubles, with related work reviewed based on the every QoS characteristics. The QoS characteristics configuration is in line with their power, which means: 1) compared to the preceding characteristics the QoS characteristics are very stronger and 2) the QoS characteristics are supported, the preceding QoS characteristics must be supported in advance. Moreover, the common work is categorized by the group of different methodologies, and the variation is very important trivial with respect to QoS characteristics description. In this research work, the QoS attributes are considered for the dynamic reconfiguration efficiency.

1) Dependability: It is a measure of confidence that the component is free from errors.
2) Security: It is a measure of the ability of the component to resist an intrusion.
3) Adaptability: It is a measure of the ability of the component to endure changes in resources and user requirements.
4) Maintainability: It is a measure of the ease with which a software system can be organized.

Based in this QoS metrics software CPU saturation level is evaluated for the dynamic reconfiguration process.

B. Qos Factors Considered

Even as the logical continuity is very important to eliminate the disturbance to ongoing transactions, it is not enough to confirm the QoS physically. The unintentional blocking trouble is explained in detail. The reason for unintentional blocking is from the preservation of the systems critical state. It means the states among the previous components and their replacements. There are two types of two factors are available namely time to transfer state and the state size.

Time to transfer state: the time to transfer state is represented as ts, the system is switched from version vold to version vnew, and the time tc. The entire transaction of version vold is committed. In this case the ts <= tc. The preceding stateful systems are reached state transfer at tc. The foundation is that while the components are no longer used by any transactions of version vold, state transfer is secured with respect to the application consistency. Or else, the early transfer of sate may eliminate some of the components and the outcome is transaction failure. On the other hand, a specific components state could be presented for transfer at any time ta: ts <= ta <= tc. For the reason that, the data is being processes and the component is possible and it is invoked in the entire period from ts to tc. Therefore, the alternate component is waiting for the state among the ts and tc. On the other hand, the state is delayed for transfer at tc owing to the necessities of consistency preservation. The state transfer at tc is secure but it is conservative and the unintentional blocking is caused. Finally, it does not predict while to serialize a stateful component like unintentional blocking does not happened. Because of the structural design of the concerns and the functional concerns should be individual, and hence the inner functionality of a component and the data processes should not inspected by the reconfiguration framework.

State size: the state size is different from component to component, state transfer by a duplicate of state variables and it is required the CPU time and threads to wait. It means the unintentional blocking. Moreover, the group of state sharing and the timing control access the reconfiguration to have the stateless equivalent property as described below.

A stateful system can be regarded as stateless and it is equivalent for reconfiguration. Suppose the state transfer does not incur unintentional blocking of workflow. Another method is the unintentional blocking is reconfiguration overhead, and it is physically decrease the QoS considerably. While the reconfiguration processes concurrently with ongoing transaction on the similar physical machine, it can remove the ongoing transactions owing to the temporary occupation of resources like CPUs, memory, or network bandwidth.

A reconfiguration gives the QoS assurances suppose the running systems is QoS is physically organized by the reconfiguration not lower than a predetermined baseline in the period of reconfiguration. The QoS assurance is given, a reconfiguration must have the complete control through the unintentional blocking and reconfiguration overheads. Hence, the resource availability for ongoing transaction is organization is possible, and it is ensure the resource availability with assurance.

The following constraints are required to the process of state sharing [17]:

1) The backward compatibility of the state format is given by the replacing component for the alternate component.
2) The shared state is accessed and this process must be mutually exclusive.
3) The application logic allowed the state sharing.
4) The alternating components reside on the same physical machine.

The distributed state is accesses by using the mutual exclusion and the atomicity of the state are undated and also the non corruption of state. On the other hand, the new component using the sate and it is contributing to the overall QoS of the system. It means the QoS is maintained for the period of the reconfiguration. The state distribution is application dependent is the third constraint.

The identifier generators or number of counter is very simple and the instance of components where the application logic allowed likes state sharing. Even though, the component state migration is the major trouble, the new state sharing is suitable to sharing the environments, where the component can be shared as long as the alternating components reside on the similar physical machine. The aforementioned can be easily fulfilled by more number of domain applications. At the second time, the state sharing is possible for the entire stateful components. The state sharing is accomplished instantaneously by redirecting a single reference, state sharing is access the entire version of vnew components to standby the second time point and it is able to skip the unintentional blocking troubles.

Controllability of Overheads

The controllability of reconfiguration overhead is concentrated and the reconfiguration is divided into the main three sequential segments and it is the combination of the various reconfiguration operations by CPU intensiveness.

1) The load operations are performed by the installation segment and the new components is initialized with the state sharing methods and also the new connectors are set.
2) The transformation segment alternates the workflow from version vold to version vnew and traces ongoing transactions of version vold to completion.
3) At last, the removal segment finalizes and the old components are collected and the old connectors are removed.

In the transformation phase operation, the workflow is switching versions levels to reassigning the flags in RAM and hence the virtually instantaneous can be treated. The ongoing transactions is traced to completion involves a wait operation. On the other hand, by using the thread synchronization, the reconfiguration threads yields its CPU through the wait operation and it is processes for the period of predefined regulations, like the completion of a sub transaction at a component. The wait operation is asynchronous and the little CPU time is consumed. Beneath the classification, overhead of this segment can be removed and this segment is protected as immediately. On the other hand, both the installation phase and the removal phase are included in CPU-intensive operations.

The controllability of overheads is accomplished over the thread prioritization and scheduling is consideration of present CPU usage. While the CPU is non- saturated, the better results to controllability is to create use of free CPU time to execute the CPU-intensive operations. Therefore, the preemptive scheduling should be assigned to both installation and removal phase to ensure that the intensive operations can only use free CPU time for execution and yield the CPU once the applications transaction is ready to execute.

While the CPU is saturated, the reconfiguration thread should be applied the similar priority as for the ongoing transaction in both installation and removal phases. Subsequently, the intensive operations have a selection to execute. To limit the resource competition from CPU-intensive operations, the reconfiguration threads CPU usage should be limited in these segments through the time-slicing scheduling. A reconfiguration thread is scheduled for execution in the runnable time slot and balanced in the sleeping time slot. For example, consider the runnable time slot is 300 ms, the reconfiguration thread will acquire the 30 percent chance to participate for CPU usage in a 1s time slice. Beneath the controlled competition, the CPU usage is assured at a particular level for ongoing transactions and therefore the QoS can be organized at or aforementioned an appropriate baseline.

The transformation phase operations can be created logically instantaneous, as explained in this sections. Once the reconfiguration thread is included in the transformation phase, it cannot be interrupted. In this phase the operations must be completed in one run. Or else, the feature of logical instantaneousness would be broken down and unintentional blocking could happen. To protect this feature, the reconfiguration thread priority should be increased for the transformation phase.

IV. EXPERIMENTAL RESULTS

The proposed research methodologies process completion evaluation is described in this section. And this process is completed in the java simulation environment with respect to predict their fault detection capability. The entire work is implemented and simulated beneath the different configuration parameters to know their performance measure values. The differentiation process is done among the preceding research work and the proposed research work. The QoS prediction Model (QoS-PM) is the preceding research work

and the QoS aware Dynamic Reconfiguration System (QoS-DRS) is the proposed research work. The performance measure for evaluating the enhancement of the proposed research approaches like "Sensitivity, Specificity, Precision and Delay". The comparison results of this performance metrics are demonstrated and the explained in the following sub sections.

Sensitivity

Another name of sensitivity is true positive rate, recall or probability of detection in some fields. The sensitivity measures are the proportion of positive and it is identified. For instance, the sick people percentage is identified accurately using some conditions. Sensitivity means the ability of the test to correctly identify the patients of the conditions. For instance, of a medical test used to identify the disease, among the diseases the sensitivity of the test is the proportion of the people with the test positive for the disease. Arithmetically, the calculation of the sensitivity can be expresses as follows:

$$\text{Sensitivity} = \frac{\text{Number of true positives}}{\text{Number of true positives} + \text{Number of false negatives}}$$

In figure 1 illustrate the graphical representation of the sensitivity measurement values of the proposed research methodologies.

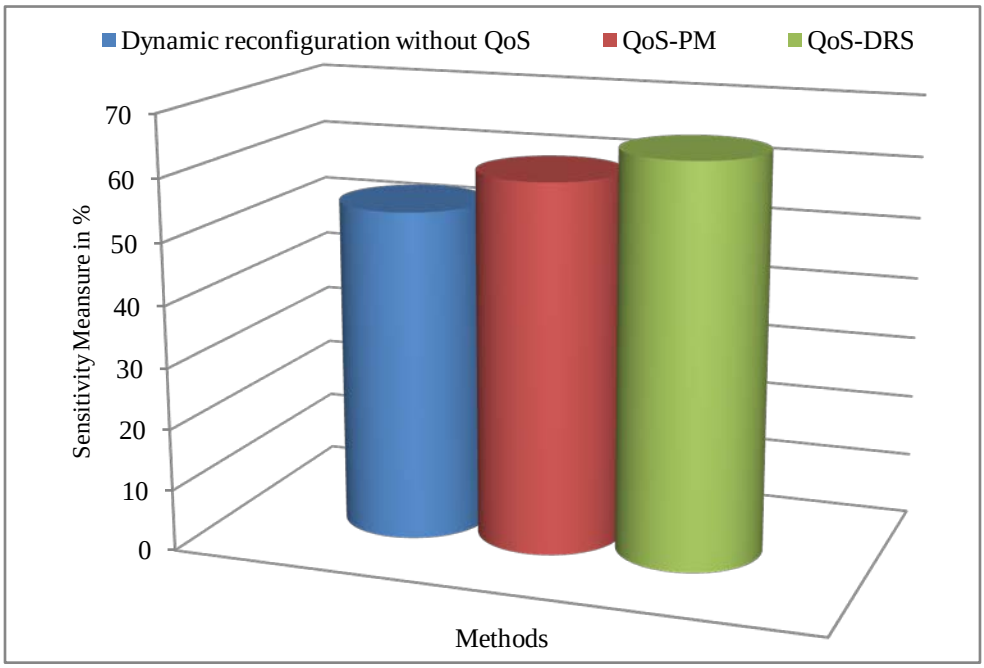

Figure 1: Sensitivity Measure

The comparison of sensitivity measure of the proposed research methodologies are illustrated in figure 1. From this figure the result of the proposed research methodology is confirmed that, the reconfiguration components are predicted accurately in the software efficiently with the enhanced performance.

Specificity

Another name of specificity is true negative rate. It is used to measure the proportion of negatives that are correctly identified. For example, the healthy people percentage is accurately identified and it is not for the conditions. The ability of the test is related to the specificity to identify the patients accurately without any conditions. The proportion of healthy patients known not to have the disease is called as specificity, and the test negative for it. The calculation of the specificity can be expresses as follows:

$$\text{Specificity} = \frac{\text{number of true negatives}}{\text{numbre of true negatives} + \text{number of false positives}}$$

The Specificity measurement values are illustrated in figure 2 of the proposed research methodology in the graphical representation.

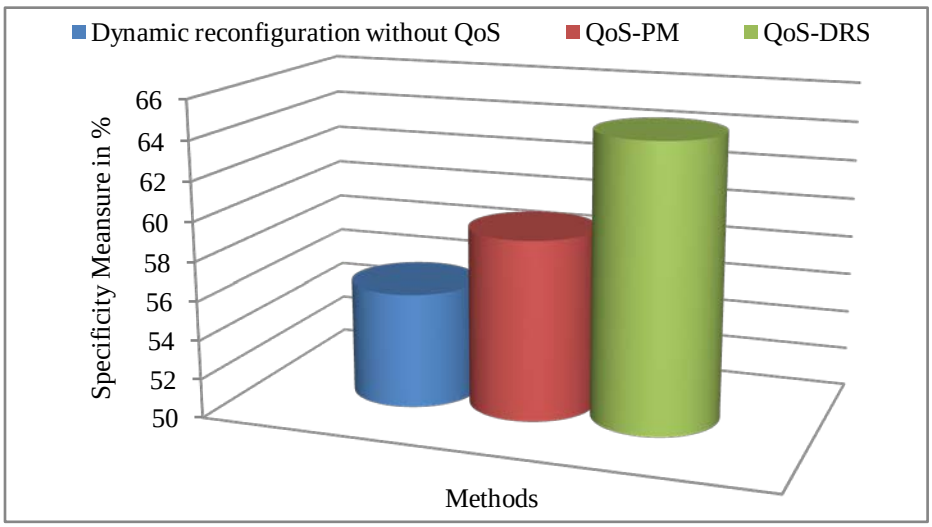

Figure 2: Specificity Comparison

The comparison of specificity measure of the proposed research methodologies is illustrated in figure 2. This graph is conferment that the proposed research methodologies can accurately calculate the reconfiguration component available in the software efficiently with the enhanced performance.

Precision

In the information retrieval area, the accuracy is the fraction of retrieved documents that are related to the query:

$$\text{Precision} = \frac{|\{\text{relevant documents}\} \cap \{\text{retrieved documents}\}|}{|\{\text{relevant documents}\}|}$$

Precision takes the entire retrieved documents into account, but it can also be estimated at a provided cut-off rank considering the top most outcomes returned by the system.

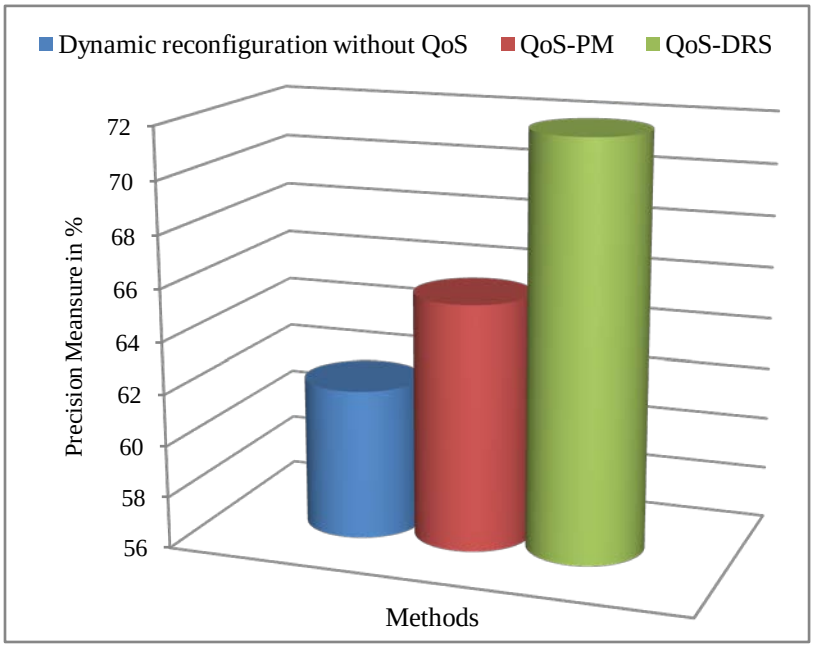

Figure 3: Precision Comparison

The comparison of precision of the proposed research methodologies is illustrated in figure 3. This graph confirms that the proposed research method can correctly calculate the reconfiguration components available in the software efficiently with the enhanced performance.

Delay

The delay is described as the time taken to identify the number of reconfiguration components available in the software. The delay should be lower to direct to efficient software development and it is completed on time. In figure 4, the delay comparison is illustrated.

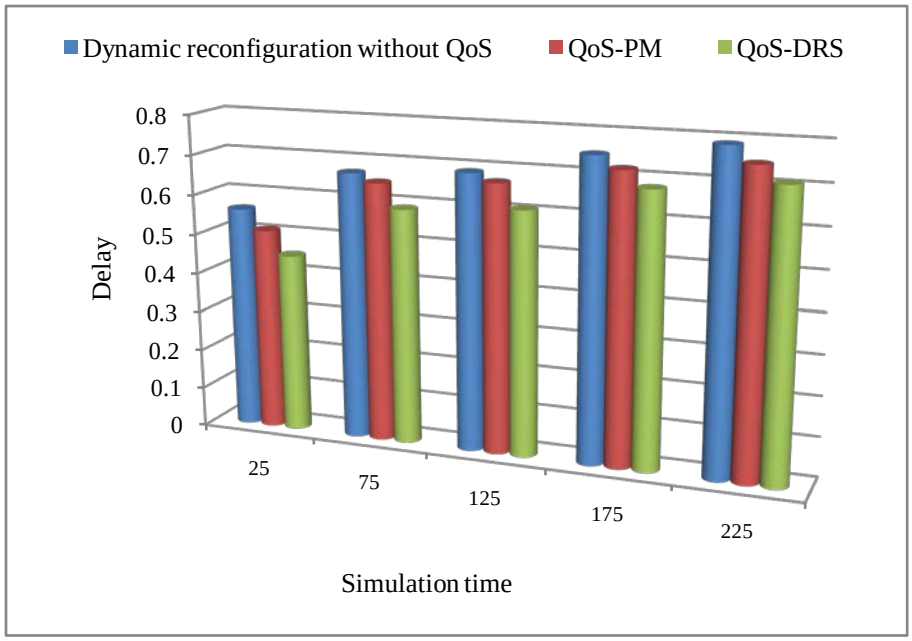

Figure 4: Delay Comparison

V. CONCLUSION

The QoS framework is presented in this research work for software components for dynamic reconfiguration of component based software systems. The research work has efficiently completed the QoS assurance. The QoS aware Dynamic Reconfiguration System (QoS-DRS) is proposed in the proposed research work and it is developed for assuring the effective and the development of component based system. The QoS metrics is also known as units and it is used for measuring the QoS attributes of a software component. The quantification of the QoS attributes of the software component is the aim of the proposed QoS framework. Therefore, the standardized metrics is required to differentiate the QoS attributes of various software components. The different QoS metrics in the proposed research work like dependability, security, adaptability, maintainability and portability is to accomplish the optimal and the good reconfiguration. The entire experimental evaluation of the proposed research methodologies is applied in the java simulation environment and it is conferment that the proposed research methodologies direct to give the excellent result compared to the preceding methodologies.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Understanding Game-players Preferences and Satisfactions with Online Social Network Games: An Empirical Evaluation Using Verbal Protocol Analysis

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Abstract---

Background/Objectives: Usability of games is highly worthwhile investigations. In order for any system or online social network game to be fully accepted from its users is to have simplicity of the use, interaction, and maximum degree of user-satisfaction.

Methods/Statistical analysis: (1) We choose interview method to concretely investigate online social game players concerning the time spent playing and more precisely their respective views to the selected games from interface standpoint. (2) We apply heuristic appraisal to examine the game interface in order to present in-depth comprehension on how to develop fantastic online games that reach certain degree of user satisfaction. (3) Think Aloud method is systematically applied as a customary usability evaluation technique.

Findings: We collect and analyze the data to find out what factors mostly influence online social games usability as well as game players attitude.(1) Incoherent instructions (E1): The online social games provide unclear instructions in the front end of the games in which leads to a conclusion that the games do not offer fluent learning process for the newcomers.(2) Content is unreadable (E2): Games are players-oriented not designers-oriented. Game designers should concretely present crystal clear content readability to enable players easily grasp things on the go.(3) Complexity of object identification (E3): Neat and tidy user-interface is essentially the main system attraction characteristics whereas messy user-interface presents reckless impressions to users despite the great underlying functionalities.(4) Clumsy menus (E4): Menus are a way of facilitating the interaction between the system and its audiences.(5) Inflexibility of objects manipulation (E5): Moving and placing an object into different area and spaces without referring to the game mechanics is what we called “Object Manipulation”. (6) Absence of help feature (H1): Generally, spectrums of features are invisible to different players’ sights in which players themselves are not being able to find the hidden attributes.

Improvements/Applications: Further research will be conducted based on user behavior and movements of the mouse to deduce more drawbacks and feedbacks regarding the game usability/playability.

Keywords--- Social Network Games, Playability, Usability, User Experience, Concurrent Protocol Analysis.

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Special Issue on “Engineering and Bio Science”

I. INTRODUCTION

In the recent years, technology has rolled out in diversified fields expanding its wings all over the world. One of the robust technologies appears to be widely well defined and known is social network technology. The social network technology has brought many interesting things and challenges to users, developers, business organizations, etc. One of the exciting things that many developers and business organization are eagerly interested about is the development of online social games that can be easily accessed via web. These games are increasingly attracting users from various continents and age[1]. On the other hands, these games are mushroomed with variation of problem solving and play strategy. Particular games have complexity of the problem solving that requires users to use much memory capacity in order to learn the problem and then figure out how to solve it. Learning and figuring out how to solve a problem needs much time. In addition, learning and solving the problem of the game depend on users' cognitive process and expertise.

However, with this huge proliferation and increase indication of online social network games, there is still one important pillar yet not received massive attentions and considerations from scholars and researchers and many game developers have not fully had full exposure of game playability and usability issues. Usability of these games is highly worthwhile investigations.

In order for any system or online social network game to be fully accepted from its users is to have simplicity of the use, interaction, and maximum degree of user-satisfaction. Usability can be defined from different perspectives since it has been a wide research subject area of many scholars and researchers.

Therefore, we can unarguably conclude that usability has received extensive study and findings across different areas and platforms. Usability refers to the degree of satisfaction in which games and its players communicate clearly without misleading or misunderstanding in terms of content and structure in Goodwin[2].

In addition, usability of any system can be tested and evaluated via different testing techniques. These techniques normally measure the system or software usability. One of the powerful techniques is protocol analysis. Ericsson and Simon[3] have shown that protocol analysis is a rigorous mechanism of tape recordings of verbal emanations of a subject that is engaged in the assigned or specific tasks.

In this paper, we mainly involve users from different expertise who are acquainted with online social network games such as Facebook games.

Two of these games are "CityVille" and "FarmVille". These games are popular in Facebook which they can be loaded and accessed via web. The remaining of this paper is organized as section 2 explains the related work, section 3 explains Internet Speed test and workstation specification, section IV describes participants and task analysis, section V describes results and discussion, and section VI concludes the paper research.

II. RELATED WORK

A. Usability of Online Social Network Games

Usability is normally the main pillar of any system acceptance. The more the system is usable, the higher it receives the acceptances and positive feedbacks. Usability has been investigated by many researchers and scholars across different areas and aspects. To study and test usability of any system or products, various parameters should be considered. Scharl and Bauer[4] have considered these parameters: 1) interactivity; 2) content; and 3) navigation. Nielson[5]has measurably defined usability as the quality of user's experience when interacting and communicating with any software or web application via the interface. Nielsen and Levy[6]have argued regarding the sample size of the participants in the experiment, they affirm that group of four to five participants in web or system design or developments can greatly identify 80% of Software or web application usability drawbacks.

Effective playability of social network games is considerably related to the effective of game usability. In other words, there have been many studies conducted on the design of online social network games for effective playability.

Järvinen[7]has argued in relation to the design of social network games' interface that game' interface should be integrated with other techniques of interaction methodology and techniques. It is worthwhile of investing time figuring out of how to design such interactive, playful, and simulated game for social network users.

The tremendous increase in the social network game is massively attentive for enhancing the usability of these games. According to AppData[8], one of the games that mostly have high number of monthly active users is "CityVille". "*CityVille"* has currently with 70 million monthly active *users* whereas "*FarmVille"* has 60 million users MAU record.

However, FarmVille users are not abandoned playing the game but stop from being active. In addition, this number is estimated to double in the coming years.

Figure 1 and figure 2 demonstrates the increase number of users in CityVille and FarmVille for the year of 2010.

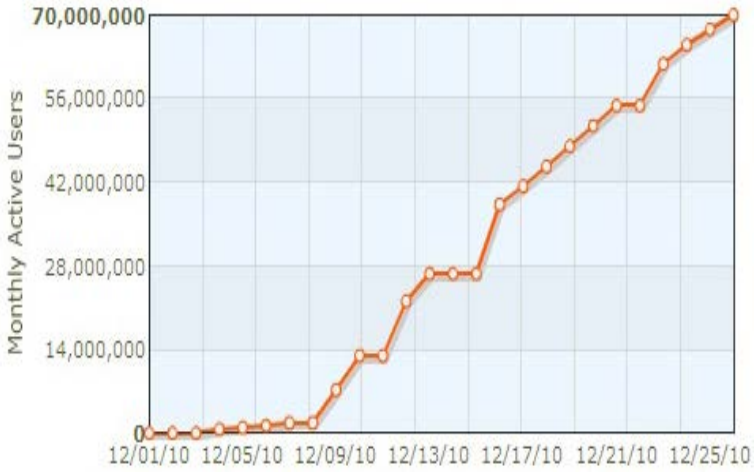


Figure 1: November-December 2010 Active Users (CityVille)

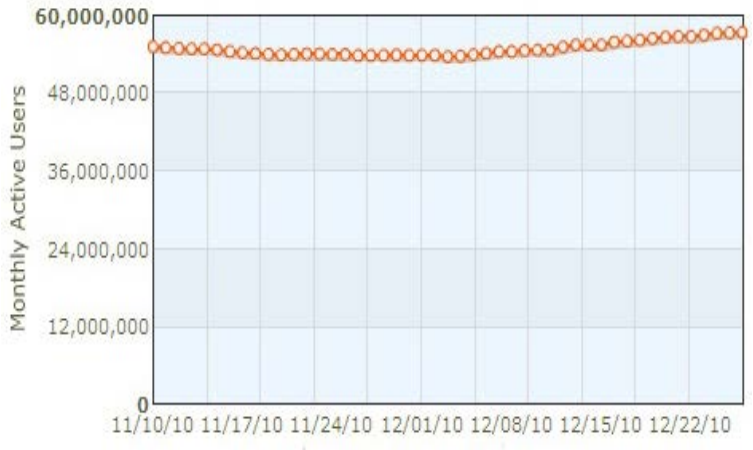


Figure 2: November-December 2010 Active Users (FarmVille)

B. Playability Test of Online Games

Apart from a fantasy design and great conception beneath online games, playability aspects are motivationally essential in other words game mechanics. The extreme of enjoyable playability is an essence of game usability from a user perspective. Enjoyable game playability is immensely a user-motive for a continuous play and leaping through game challenges and states. Extensive efforts and researches have been invested on online games playability investigations. Jeremy et al.[9]conduct study in which demonstrate that playability of online games could have a causal relationship with a propagation time (e.g. deterioration of game responsiveness, etc), game inconsistencies. Heather et al.[10]exploit Heuristic Evaluation for Playability (HEP) for evaluating playability of online games. Heuristics are a design guidelines used as an evaluation mean for both usability professionals and application designers. Hongxing et al.[11] have investigated

playability of online games exploiting heuristic appraisal and they found many shortcomings in their selected game experiment interface and game story.

More importantly, playability should be tested to improve game mechanics in which provide mind blowing and simulation attributes to gamers in which ultimately maintain the shape and emergence of the games among other console games. In addition, this can happen by measuring playability parameters such as fun, interesting, motivational, mind simulated, etc.

C. Protocol Analysis Technique Evaluation of Online Games

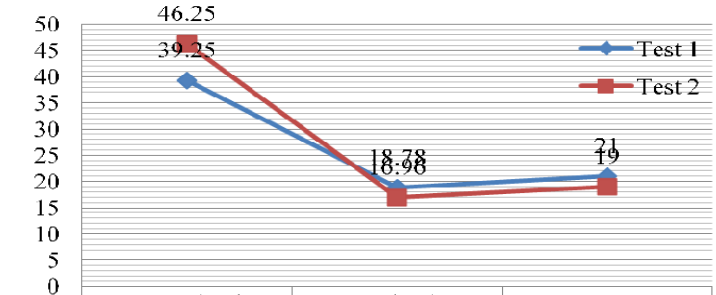
Even though there have been several techniques to test and evaluate the usability of systems and products such as heuristic evaluation, but still, protocol analysis (Think Aloud) technique considers being powerful and dependable in the midst of other mechanisms.

Bouwman [12]has concluded that protocol analysis is a method of asking participants to verbalize their thoughts while they are engaging in the performance of specific tasks or problem solving. It is also a direct observation that analyzes the human cognitive process. In the protocol analysis method as has explained in Ericsson and Simon[3], to obtain think-aloud protocols, they instruct the participants to verbalize the information they attended to while engaging in problem space. Simultaneous problem solving and verbalizations could possibly result in fruitful and reliable outcomes. These verbalizations should be used as dataset in which meaningful data are drawn in relevant to the task objective. This involves quantifying the drawn data in order to compare and contrast with the existing data and research objectives.

III. INTERNET SPEED TEST AND WORKSTATION SPECIFICATION

Aside from the artistic and fascinated an online game interface, Internet connection aspects play a significant role in keeping games running without lags. It maintains the efficiency and effectiveness of online games in which optimizes playability. Certainly, players do not want to waste time in a game in which action delays and loading lags as well as deterioration of game responsiveness.

Despite the consequences of Internet efficiency, workstation is also part of the optimality of an online game. Powerful workstation provides speedy processes and efficient resources utilization for executing particular actions efficiently. Therefore, herein, we performed Internet speed test to ensure zero-fault in terms of connectivity and computer genre.



	Download	Upload	Latency
Test 1	39.25	18.78	21
Test 2	46.25	16.96	19

Figure 3: Internet Speed Test

As we investigate the connectivity speed by conducting two sequential tests before starting the actual experiment as in figure 3, we attain the download speed is 39.25Mbps and upload speed is 18.78Mbps with a latency of 21ms under Test 1, whereas the download speed is 46.25Mbps and upload is 16.96Mbps with a latency of 19ms under Test 2. In addition, herein, we provide workstation specifications for more clarity. We terminate all running processes and applications before we initialize the experiment to positively identify pitfalls that are tied with these online games*. Table 1 presents the workstation specification that had been used for this experiment.

*We assume no connectivity propagation delays. In this paper, we attempt to utilize all ultimate processing power and network bandwidth

Table 1: Workstation Specification

Component	Specification
Operating System	Windows 7 Ultimate
Processor	Intel® Core™2 Duo CPU E8600 @3.33GH
Memory	2.0 GB
Graphic card	NVIDIA Quadro FX370
Motherboard	Ultra24 , Sun Microsystems

IV. PARTICIPANT DEMOGRAPHY AND TASK ANALYSIS

A. Participant Demographics

In our research we conduct an experiment with 30 participants' contribution that possesses different expertise in Facebook games (e.g. CityVille, FarmVille, etc). Participants vary in level of experience playing the games. By looking at the participants demographics (Table 2), we cluster participants into three groups. We interpret the three groups as follow:

Casual group: participants in this group have less experience playing online social games with relatively less amount of time spent during day (between 10 minutes to 1 hour). Majority are young boys of university student (7 boys and 3 girls). Participants' age of this group is about (between 19 to 25 years)

Intermediate group: participants of this group are far more experience playing online social games than the casual group with large amount of time spent in a day (between 30 minutes to 1 hour), and minority is university student girls (1 girl and 9 boys). This group has no homogeneity with the casual group. Participants' age is approximately (between 19 to 26 years).

Expert group: participants of this group is highly possessing large amount of experience playing online social game than the other two groups with relatively large amount of time spent during a day (between 30 minutes to 5 hours) and gender of this group is relatively equal (5 girls and 5 boys). Participants' age is comparatively the same as intermediate groups (between 20 to 26 years).

Table 2: Participant Demographics

Category	Casual	Intermediate	Experts
Participant#	10	10	10
Age	Avg: 21 Max: 25 Min : 19	Avg: 21 Max: 26 Min : 19	Avg: 23 Max: 26 Min : 20
Sex	M: 7 F :3	M:9 F : 1	M: 5 F : 5
Experience	Non: 1 1~2:9 2~above: 0	Non: 1 1~2:7 2~above:2	Non: 0 1~2:4 2~above:6
Time	Less than 10 minutes:8 30 minutes~1 hour:2 2 ~5 hours: 0	Less than 10 minutes:1 30 minutes~1 hour:9 2 ~5 hours: 0	Less than 10 minutes: 0 30 minutes~1 hour:7 2 ~5 hours :3

B. Task Analysis of Online Social Network Games

Introducing the task to participants is really intuitive and useful in order for them to gain clear understanding of the problem atmosphere before undertaking the actual experiment. Hence, we briefly describe the task to participants and the task is to play "CityVille" and "FarmVille" games on Facebook using a conventional computers. Tasks are building a dream city depending on participants' imaginative and cognitive process (e.g. building a cafeteria, police station, etc) or farming a farm or plant whatever things internally constructed by participants' perceptions with their preferences in mind, and getting friend whom they preferably want to be as their neighbor. While they are engaging with a task, they need to verbalize their

to mainly dedicate the available resources for the experiment.

thoughts telling what they are attempting to do and what they are trying to accomplish. More importantly, throughout the performance of solving a problem, they need to keep on verbalizing whatever in minds specifically their decision of reaching their target including obstacles, inferences, and flaws ties with the usability of the games they are engaging in. Note that, recording of mouse movements and gamers' verbalization is recorded using Camtasia Software for finding more details of the interaction and usability problems [13]. Besides, moderator of the experiment is presented to keep on motivating participants and reminding them of verbalizing their thoughts if they fail to remember to do so.

C. Research Procedure

Figure 4 presents the course of this research investigation and guidelines throughout the entire experiments in which interpreted as follow:

1) Interview: We choose interview method to concretely investigate online social game players concerning the time spent playing and more precisely their respective views to the selected games from interface standpoint. In addition, we investigate players using different parameters such as game feature preferences, reasons for playing games, reasons for quitting games, time spent for playing games, etc.
2) Appraisal: We apply heuristic appraisal to examine the game interface in order to present in-depth comprehension on how to develop fantastic online games that reach certain degree of user satisfaction. We perform 5 days of appraisal for the selected games. Through extreme examination of different dimensions, more than relatively 10 salient issues involving game front-end, structure, and mechanisms are identified. For example, one very critical issue presents in both games (CityVille, FarmVille) is Horizontal Multi-Tools menu layer. Horizontal task bar is subjectively not preferred. Players share some common tendencies in obtaining vertical task bar right sided. Flexibility of manipulation items in a vertical order is very relaxing and easily reachable in which eases the way of use. On the contrary, players, at certain angles, have a different behavior and cognitive process in communicating with tasks [14].

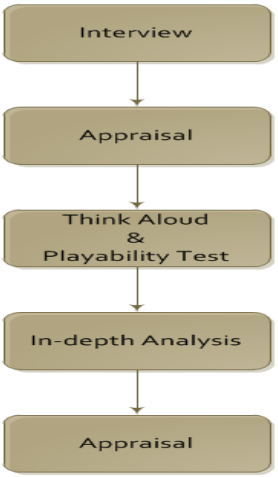


Figure 4: Research Procedure

3) Think Aloud & Playability Test: Think Aloud method is systematically applied as a customary usability evaluation technique. Specifically, we use concurrent verbal protocol. We stress on participants to continually and concurrently provide their judgment in a verbal form. Participants (players) are being observed and recorded by a moderator during the performance. The recordable media of participants' judgment is assessed and analyzed. Playability test conducts in diverse parameters. These parameters involve story of the games, degree of user-satisfactions, and degree of user-interest in online games. We respectively involve 30 participants to act as players in the experiment and to give their views about the selected games' strength and weakness from playability and usability perspective. The test carries out in a questionnaire form and the potential data is merged with the interviews' data.
4) In-depth Analysis: We mainly concentrate on the criticality of the issues identified in this research. Thus, we assess the problems of the current trend of game design by employing some statistical

computations to verify severity of the presented issues. We solely compute the mean and standard deviation of each problem stating the impact factor of the problems tie with the current game usability. At the end of this scientific research paper, we suggest some prioritized recommendation for the future online social game design strategy based on the criticality of presented problems.

V. DATA ANALYSIS AND RESULT DISCUSSION

Due to the wealthiness of data obtained from participant involvements and verbalizations through protocol analysis technique, we perform the coding development process of the recorded verbalizations in order to validate and guarantee the impact of information acquisition related to usability of the selected games. In other words, we attain stream of data that is in a form of video footages and voices, which simply need to be extracted in order to draw out meaningful information. Hence, we relatively perform coding segmentation by involving two encoding experts. In addition, quantitative measurement is applied to measure the degree of agreements among encoders as in Fleiss and Cohen[15]. Therefore, in our research, two expert encoders are involved to code the data that is in a form of verbalization. Each encoder is exposed to the verbalizations of all participants, and then they are asked to encode all the participants' verbalization including inferior verbalization to ensure the completeness of the protocol as well as the validity of the reached data. Hence, they carefully segment and encode the verbalizations based on far more frequently repeated words or phrases. Above that, we compare between each encoder's segmentation to ensure the correctness of the coding development process. We apply Kappa statistical measurements to compute the accuracy intercoding reliability of the coding schema as shown in table 4. Coding of utterances performed based on the commonalities and frequently repeated words and phrased by a single participant firstly and among individual participants secondly. Table 4 illustrates the salient and critical issues of the extracted coding from participants' utterances that affect usability of social games. We categorize the problems into six categories as shown in table 3 to differentiate between playability and usability issues.

Despite usability shortcomings, game mechanics is far more essential in keeping gamers coming back to play more often especially newbie. Based on our findings, there are still pretty much to accomplish when it comes to game design that target specific number of audiences. Thus, we present several playability drawbacks in our selected games.

Table 3: Schema Category

Code	Description
UC-0	Usability and Content
UN-0	Usability and Navigation
UI-0	Usability and Interactivity

As table 3 demonstrates the coding categories, in which we attempt to group the coding of participants' utterances that were deduced by the human expert encoders from tape recordings. These codings are representative of the shortcomings of the social games in which our contributors play in which ultimately are derived in a systematic manner.

Table 4: Coding Schema of Participants' Utterances

Segment	Description	Category
E1	Instructions are incoherent	UC-0
E2	Contents are unreadable	UC-0
E3	Complexity of object identification	UN-0
E4	Clumsy menus	UN-0
E5	Inflexibility of object manipulation	UN-0
H1	Absence of help feature	UC-0
H2	Game inconsistency	UI-0
H3	Sound and music are incompatible	UC-0
H4	Game plot is clumsy	UN-0
H5	No Feedback	UC-0

We represent each segment or code by a dummy variable (E & H). We classify each segment according to different usability parameters. As it is apparent (Table 4) articulates the coding deduce from participant

verbalizations via encoders. Code represents the keywords extracted from participant verbalizations. Description describes the meaning of each code (critical problems). Category indicates the usability parameters in which each code fall into. Parameters determine the severity of the pitfalls in relevance to games usability. After the segmentation process, we measure the intercoding reliability among encoders by performing the following computation to differentiate where each encoder disagrees and agrees regarding the coding process. Kappa measurement is used and computed as in Anthony and Joanne[16].

Table 5: Segment Occurrences and Inter Coding Reliability Test

Segment	Number of Occurrences	rater1	rater2	Corresponding
E1	36+36+16=88	1	1	yes
E2	15+24+33=72	1	1	yes
E3	18+6+8=32	0	0	yes
E4	7+9+1=17	0	0	yes
E5	11+7+0=18	0	0	yes
H1	17+10+1=28	1	1	Yes
H2	16+15+10=41	1	1	yes
H3	15+17+2=43	1	0	no
H4	15+13+4=32	0	0	yes
H5	10+25+19=54	0	0	yes

Consequently, there is no significant discrepancies between raters rating the coding scheme in which deduced from participants' utterances. Particularly, the 1s and 0s are dummy numbers to indicate where raters fall into an agreement or otherwise. As it can be seen, raters have conflicts over the segment H3. This conflict occurs due to disagreement in the segment's occurrence number. It is worthwhile noting that segment occurrences is quantified by the frequency of the words or phrases spoken by collectively and individually participants.

Table 6: Percentage of inter Coding Reliability Testing

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	8	88.9	**88.9**	88.9
	1.00	1	11.1	11.1	100.0
	Total	9	100.0	100.0	

From the carried out Kappa calculation above as in (Table 6), we come to conclude that the acquired inter coder reliability value is highly acceptable with 88.9% of intercoding agreement. Herein, note that in the coding schema, mouse movements and participant behavior and other factors are not incorporated and analyzed.

Figure 5 illustrates graphically where discrepancies and homogeneities occurred when raters carefully perform the assessment. In fact, the bar where 0.00 is shown presents the strong homogeneity among the raters rating the segments. This reveals the accuracy of the segmentation in which expert encoders coded the segments that leads to the large impact of these segments on the usability of the online social games.

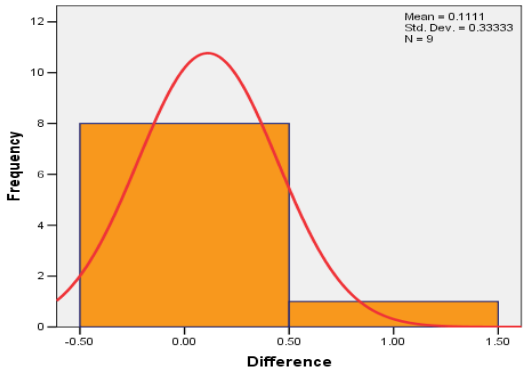


Figure 5: Discrepancies and Homogeneities Between Raters

VI. DATA ANALYSIS AND RESULT DISCUSSION

After reviewing the online social games usability, the participants who act as the evaluators study the game interface from usability standpoints. This includes game plot, graphic, menus, controls, music, sound, contents, etc. After the evaluation sessions have been completed, we present an in-depth analysis to demonstrate and profoundly discuss the findings.

A. Interview Result

As interview is part of the evaluation process that leads to significant differences in problem identifications in which tie with online social games, we find several failures occurred in the front-end.

Inconvenient features: Players are regularly stuck to the games that offer convenient information display as well as ease of use and fluent learning despite players' cognitive process. Among the inconvenient features are improper information display, difficult to learn the games strategies, and hard to use. In table 7, we compare the three groups of players with respect to online social games usability. Particularly, we attempt to find out if different players have different perceptions about the games and if these features have different effects on different players.

Table 7: Inconvenient Features Affect Game Usability (Interview)

	Casual			Intermediate			Expert		
	yes	no	I don't know	yes	no	I don't know	yes	no	I don't know
Improper information display	60%	20%	20%	40%	30%	30%	**60%**	30%	20%
Interface is difficult to learn	**70%**	0%	30%	30%	**60%**	10%	**70%**	20%	10%
Poor game interface	**50%**	30%	20%	20%	40%	40%	**60%**	10%	30%
No freedom of control	**50%**	40%	10%	**60%**	30%	10%	**80%**	20%	0%
Low difficulty level of the games	30%	**60%**	10%	**50%**	**50%**	0%	**90%**	10%	0%

When they are asked to choose the most significant factor degrading social game usability, groups come to form some harmony perceptions. Firstly, 70% of the participants in the causal group said interfaces of the games are difficult to learn, 50% of them said no freedom of control over the games, 50% of them said the overall games interface is poor, and 60% of them have homogenous decision on no low games difficulty level presented by the games. Secondly, 60% of the participants in the intermediate group agreed that the games offer interface that is hard to learn and use, 60% of them formed decisions that games provide no freedom of control, and 50% of them said games introduce low level of difficulty, and 50% said otherwise. Thirdly, participant groups are not homogeneous when they answering the interview question with respect to the games usability. By stating this, we find that 60% of the participants of the expert group reached consensuses that games simply introduce improper information display, 70% of them rated interface as it is difficult to learn, 60% of them agreed upon the poor game interface, and 80% of the participants of this group extremely judge there is no freedom of control over the games, and quite large number of this group come close to peak homogeneity on the low difficulty level of the games with 90% of agreement. Within the groups, lack of freedom of control, in other words, self-autonomy, shares the highest agreement. This includes setting privacy of games, tool customization, and tool bar manipulation. Thus, this indicates the huge impact on players when they involve in gameplay.

With respect to homogeneity and discrepancy of decisions made by different groups, it is likely that these features have heavy influences and disturbances upon their performance and satisfaction in way that degrade the games reputations and emergence among other competitive marketable social games.

B. Think Aloud and Playability Test Result

After conducting systematic think-aloud sessions with thirty participants where the participants spontaneously perform the task and verbalization at the same time, we collect and analyze the data to find out what factors mostly influence online social games usability as well as game players attitude.

We decide to use mean and standard deviation as statistical pathway of reaching a medium solution for determining the severity of the dataset. Based on that, we discover several significant problems that hinder players from playing games.

We would profoundly present and detail some of these problems as following:

Incoherent Instructions (E1)

The online social games provide unclear instructions in the front end of the games in which leads to a conclusion that the games do not offer fluent learning process for the newcomers. The average of casual and intermediate participants reach a homogeneity on the impact of the incoherent instructions on players that is presented by the games with (M=3.60, STD= 1.58 & 2.80). Whereas majority of expert participants do not bother with (M=1.60, STD=1.43) as in (Table 8). This problem seems to have greater influences on players who possess little knowledge about the games and little playing experience.

Table 8: Incoherent Instruction (E1-UC-0)

	Mean	Std. Deviation	N
Casual	3.60	1.58	10
Intermediate	3.60	2.80	10
Expert	1.60	1.43	10

Content is Unreadable (E2)

Games are players-oriented not designers-oriented. Game designers should concretely present crystal clear content readability to enable players easily grasp things on the go. Complexity of terminology could significantly affect players' interest and motivation to keep going on the games. Players seem to be annoyed by the content readability in which designers fail to convey. As for the casual players, contents seems to be normal with (M=1.50, STD=1.08). The underlying reasons, based on the research observations, is the random movements casual players made to go with and this cause them to spend more time trying to place everything in order and less decisions are formed. Apparently intermediate and casual players give the impressions to contents as less readable and clear with (M=2.40, STD=2.17, M=3.30, STD=1.42) as in (Table 9). These impressions are derived from their prior experience playing other games. Consequently, unclear contents or fewer descriptions on what actions should be executed next would hinder players moving forward with the games.

Table 9: Unreadable Content (E2-UC-0)

	Mean	Std. Deviation	N
Casual	1.50	1.08	10
Intermediate	2.40	2.17	10
Expert	3.30	1.42	10

Complexity of Object Identification (E3)

Neat and tidy user-interface is essentially the main system attraction characteristics whereas messy user-interface presents reckless impressions to users despite the great underlying functionalities. Placing every object in order with little object description is necessarily important to attract new audiences and maintain their loyalty. Commonly, quite large number of casual and expert players are affected by the object search and placement offered in the games in which objects are displayed with no little descriptions with (M=3.20, STD=1.03, M=3.00, STD=1.33) as in (Table 10). Intermediate players appear to be less affected by the object search and positioning from looking at the judgments they made (M=2.00, STD=1.33).

Table 10: Complexity of Object Identification (E3-UN-0)

	Mean	Std. Deviation	N
Casual	3.20	1.03	10
Intermediate	2.00	1.05	10
Expert	3.00	1.33	10

Clumsy Menus (E4)

Menus are a way of facilitating the interaction between the system and its audiences. Navigation through menu objects should present straightforward. Ambiguity in menu layout or terminology should significantly be avoided to provide simple and effective navigations throughout the entire interface. On the contrary, games seem to introduce clumsy menu in which relatively affect mostly majority of players as in (Table 11).

Table 11: Clumsy Menus (E4-UN-0)

	Mean	Std. Deviation	N
Casual	2.10	1.10	10
Intermediate	2.00	1.16	10
Expert	1.80	1.55	10

Inflexibility of Objects Manipulation (E5)

Moving and placing an object into different area and spaces without referring to the game mechanics is what we called "Object Manipulation". Simplicity of an object manipulation indicates the user-friendly interface that reveals satisfactory outcomes into the players' attitude. Flexibility of objects manipulation seems to be absent in the games in which affect all players groups and it appears to be a serious attribute that designers seems to neglect. All players groups have formulated almost similar impressions that games lack to the merits of an object manipulation and display ambiguity of tools appearance as it can be seen in (Table 12).

Table 12: Inflexibility of Object Manipulation (E5-UN-0)

	Mean	Std. Deviation	N
Casual	1.80	1.48	10
Intermediate	1.90	1.45	10
Expert	1.80	1.03	10

Absence of Help Feature (H1)

Generally, spectrums of features are invisible to different players' sights in which players themselves are not being able to find the hidden attributes. Discovering invisible features can be done by either issuing commends to the help indexing text field or by viewing a list of presented issues in the help list that assist players in getting them reach their target of the next actions. Although, causal group emerges to be affected by the invisibility of help features with (M=2.10, STD=1.37). Whereas intermediate group appears to be similarly influenced by the disappearance of the feature in the games with (M=2.50, STD=1.35). The similar tendency of both groups of formulating the same perception regarding the ambiguous emergence of help feature on both games occurs due to the factors in Table 13.

Table 13: Absence of Help Feature (H1-UC-0)

	Mean	Std. Deviation	N
Casual	2.10	1.37	10
Intermediate	2.50	1.35	10
Expert	.90	.88	10

We also carry out statistical computation on the problems found in this research. Table 14 shows the carried out statistical computation using mean and standard deviation. With the reliance of actual participant's contribution and verbalizations, we compute the mean and standard deviation based on the numbers of each word repeated times by a single participant (player).

Table 14: Impact of each Issue on Game Usability

Issue	M	SD
Perceived clarity of Instructions	2.2	1.167
Perceived guidance	1.8	0.98
Perceived shortest navigation path	2.4	1.02
Perceived Organization	3	1.41
Perceived manipulation	4	0.63
Perceived time response	4	0.89

Criticality of each individual issue is dependable on the degree of players' satisfaction as well as players experience and preferences in an online game. Most probably, majority of players favor the acquisition of functionally descriptive button on a cursor and are destructed by the presence of plain button with (M=4, SD=0.63), whereas other players are bothered by time spent waiting for a respond time that online games offers with (M=4 , SD0.89). Having mentioned that degree of user-experience has impact in understanding

and manipulating an online game. We find it is distinguishable that experienced players are more swift and quick in reaching the target than inexperienced players [11]. Figure 6 shows the average ratio of the problems involving game interface, contents, processes, mechanism, etc. A pilot study conducts on comparison among the selected games, which were chosen as the subjects of this research. We solicit participants to bestow their honest immediate feedback by evaluating three usability variables of each game.

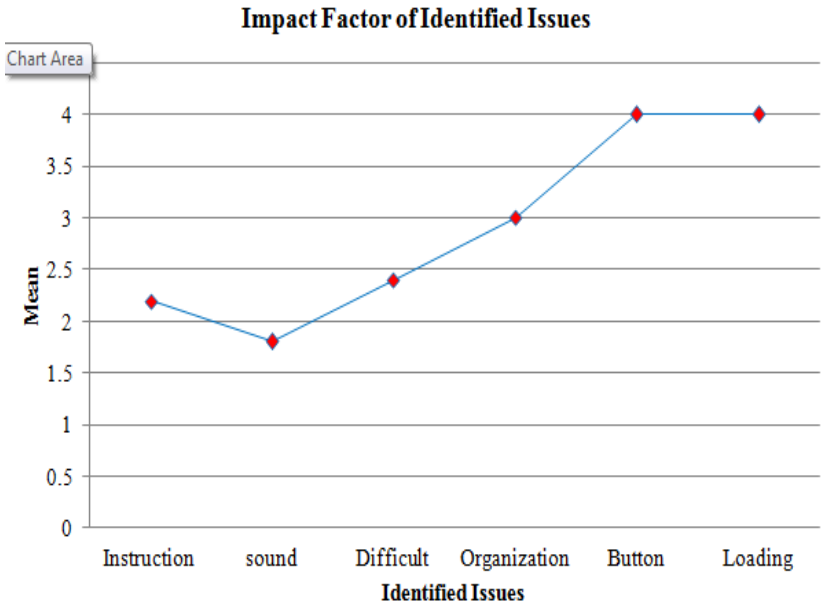


Figure 6: Mean of Problems in Games Usability

Table 15 represents the evaluation value by the participants.

Table 15: Evaluation of the Games Usability by User

Game parameters	City Ville	Farm Ville
Interactivity	Very poor: 3	Very poor:0
	Poor:0	Poor:0
	acceptable: 2	acceptable: 1
	good:0	good: 4
	Excellent:0	Excellent:0
Content	Very poor: 3	Very poor:0
	Poor:0	Poor:0
	acceptable: 2	acceptable: 2
	good:0	good:
	Excellent:0	Excellent: 3
Navigation	Very poor: 0	Very poor: 0
	Poor:0	Poor:0
	acceptable: 2	acceptable:
	good:3	good:2
	Excellent:0	Excellent:3

As shown in table 15, participants fairly and relatively point out their views by ranking three different usability parameters: navigation, content, and interactivity. Each parameter described to participants before initializing the assessment process. Based on research method, interviewing participants is a fruitful mechanism of user-satisfaction confirmation in relevance with game playability or usability variables. Figure 7 presents some playability factors that are worth mentioning. Each playability parameter plays certain degree of user-satisfaction involving in gameplay. Based on the interview carried out in the early stage of the experiment, 70% said “FarmVille” is challenging in terms of playability whereas 90% said “CityVille” is higher

challenging because it requires imagination beyond the ordinary thinking. Studying other playability parameters, we identify that "CityVille" is less guiding comparing in the direction of "FarmVille". The influential impact among participants is not high in terms of a challenge attribute. Overly, however, participants point out that presence of playability parameters is importantly fantastic and worth bearing in mind in the future trend game design strategy because they bring satisfaction along. More specifically, monotonous games prone players to quit playing online games. Existence of innovations and storytelling in online games is what keeps players motive and stimuli[17]. Notably, despite the innovations of online games, simplicity of interaction and artistic designs should present.

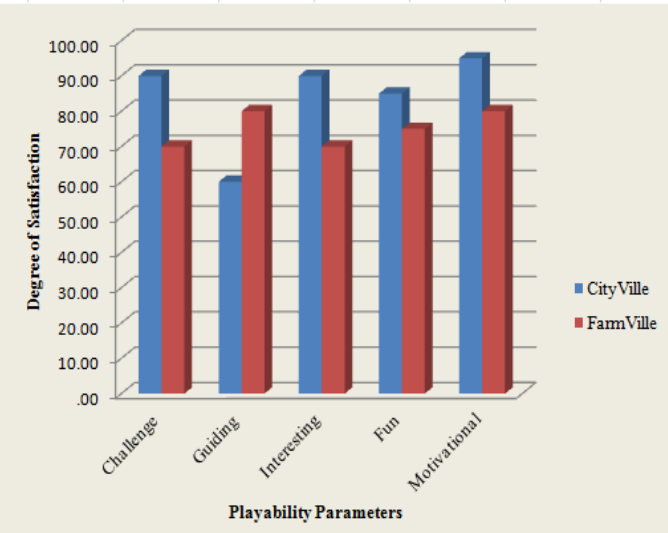


Figure 7: Usability and Playability Test Comparison between Cityville and Farmville

On top of the challenges and guiding game design, players are likely to play either when they own free time and want to pass it by playing mindless addictive game activity or when their conditions are instable (e.g. stress, etc). Some people are likely to play online games because they love mental simulations in which constantly occupying their minds most of the time.

C. Subjective Workload Test

We perform subjective workload assessment to examine the conditional situation of participants after they complete the assignment. All participants undergo to the assessment after they concretely receive clear description of each workload operators. This test is conducted to testify the variation between participants experiencing the workload task performance. NASA-TLX is used to examine participant conditions by assessing six different factors, namely, mental demand, physical demand, temporal demand, frustration, effort, and performance. We analyze results from the NASA-TLX data to confirm that participant perceived the assignment with different workload levels (Table 16). The result indicates an average mental demand of (M=75, SD=8.17). Whereas the results demonstrate that an average frustration workload index of (M=71.60, SD=11.97). Besides, we find an average physical demand workload index of (M=73.80, SD=12.37). This indicates the significant differences in the workload of the assignment as well as the participant performance (Figure 8).

Table 16: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Mental	5	67.00	88.00	75.4000	8.17313
Physical	5	59.00	86.00	73.8000	12.37740
Temporal	5	53.00	81.00	66.8000	10.15874
Performance	5	16.00	78.00	39.0000	24.13504
Effort	5	57.00	89.00	70.4000	15.75754
Frustration	5	53.00	86.00	71.6000	11.97080

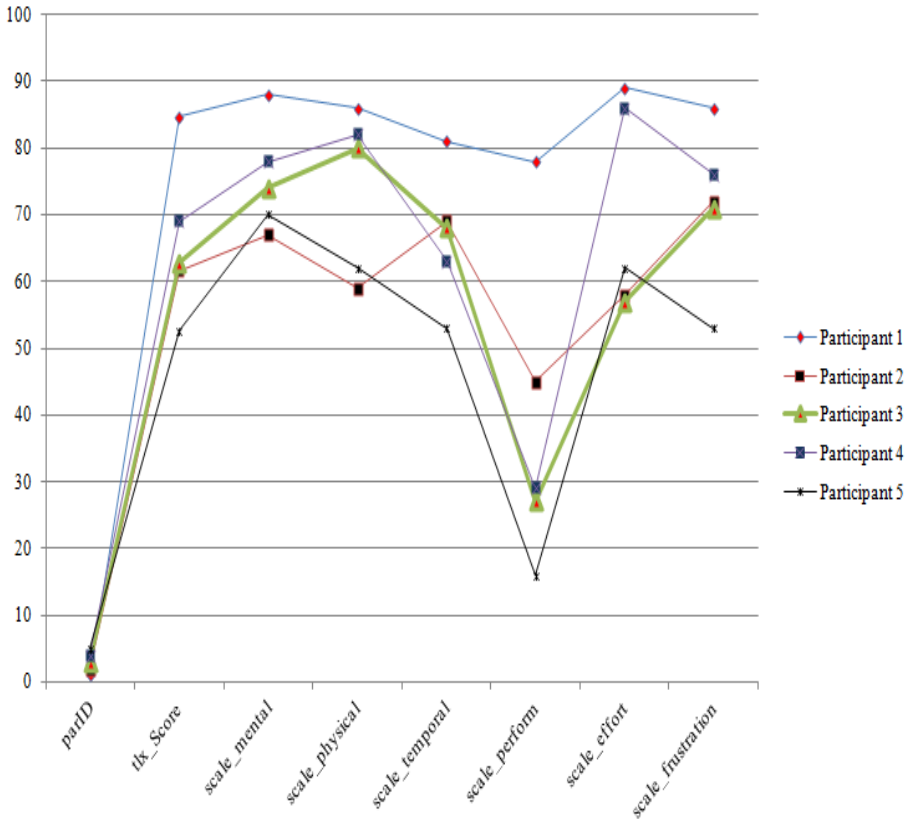


Figure 8: Subjective Workload Test

Graphical analysis indicates mental demand occupies the second highest factor in dealing with the assignment with 88% mental demand in inexperienced participant condition. In addition, frustration is highly significant factor in which participant 1(inexperienced-participant) gets highly frustrated by the assignment performance comparing with the other four participants. It is worthwhile considering gamer situation associate with social online games while designing a game that can be easily understood and lessen gamer frustration. Apart from the six-workload operators, frustration can be caused also by other external and internal objects as such latency[18].

D. Result and Discussion

In view of the fact that our research exploits the powerful technique that draw out facts and information from real time interaction and feedback of actual players, we identify that the findings present in this research is rigorously dependable because it is presented by actual participants (players) who are familiar with online social network games. Therefore, we present some of the salient issues, which reduce usability and increase the likelihood of user dissatisfactions. Based on the research methodology process, the total number of issues found using concurrent protocol analysis is greater than the number of issues from interview and other methodologies. Problems also can be categorized into different level depending on severity and conditions. In this paper, we present problems in relevant to usability and playability of online games. We tabulate the problems in terms of usability issues and playability issues as in (Table 17). Moreover, the discovered issues can be fostered in early stages of game development process to offer players maximum-rate of satisfaction in terms of game playability and usability.

Furthermore, we identify overlapped issues during players' performance. Some of the issues have high-severity while others have dire implications involving games' interface, etc.

As we present the issues that have been categorized into two groups, which are playability and usability, we attempt to bridge the casual relationships of playability/usability of the games with variant of players. In both cases, we identify that instruction of the games at the initial stages is confusing and not well described.

Table 17: High-Severity Issues Found by Our Methodology

	Description
Playability	Players feel the games are monotonous and lack of innovations (H Wi, 2009)
1	Players are unsatisfied with the challenges presented in the games
2	Players , at certain points, lose interests in the games
3	Players identify that game engagement lacks of motivational rituals and mind stimulus.
4	Inexperience players find the games somewhat are fun whereas intermediate and expert players look at the games as a dull routine games that lack of mind occupation and simulation.
5	Expert players have the disposition toward leaving the games due to an inappropriate challenges and guidelines
6	Games lack of strong storytelling.
7	
Usability	Players find games guidelines and instructions are confusing
1	Menu-layer button is not functionally described. Games only present button with symbolic language instead of plain text on a cursor (Figure 7).
2	Players find responding time is cumbersome and delays players from keeping on truck with other players
3	Game structures are incoherent and bring frustrations to players
4	

Participants (players) are not content with the instruction and faced difficulties trying to understand instructions context. Additionally, button is not functionally described on a cursor. Particularly, participants expect functional button description before pressing on it and execute action where users likely don't want to take, however, unfortunately, the expectation of participants result in failure. Nevertheless, that only occurs in "CityVille"† while in "FarmVille"‡ participants are satisfied with the appealing feature, which is missing in "CityVille". Most of participants have the preference of acquiring descriptive button instead of plain button, which has no informative guidelines. An example of participants' preference design is in (Figure 9). For example, 80% of participant would likely to have a descriptive button§.

Figure 9: Preference of Button Choice from Participant Perspective

Moreover, game's sounds are annoying while performers engaging in completing the task. Participants (players) endeavor to off the sound; however, it takes time for them to figure out how to turn it off. In addition, the fact is that due to low level and ambiguity of game interface design precision and structure, participants spend time searching for that particular feature to turn it off. Furthermore, action respond time is exceeded the participant expectations. Participants discover that each time they try to send a gift or request a neighbor; they need to wait for a few moments in order to proceed with task completeness. In other words, the games are not offering performances that are acceptable to players. Earlier research stressed that loading time should not exceed 4seconds. The underlying reasons are slow JavaScript game rending engine which seems to be not optimized adequately. It offers slow response to the player actions. Last but not limited to, item structures are vague and clumsy and bring difficulty in the behavioral interaction of game players. In

† CityVille is a game that lets user builds a dream city from scratch.

‡ FarmVille is a game that lets user plants and grows crops and raise animals in their own virtual farms.

§ Descriptive button is where user points or places a cursor on buttons and functional message pop up before taking a decision on a continuation of proceeding a button-click.

order for participants to build or replace an item, he or she needs to find out every single bit of information to make the correct move or step. For inexperienced participant, this was a huge obstacle that cannot be normally overcome in order to proceed the task and complete it within the expected range of time as well as to keep on truck with other players.

In addition, based on the observations of our players, we discover that players have the disposition toward a continuation of playing "CityVille" rather than "FarmVille". And the rational explanation, based on actual players' involvement, is the challenges and mind occupation "CityVille" offers its respective players. However, the influential percentage is slightly different (see Figure 7).

It is worthwhile taking into account these prioritized recommendation in the future game design. Although the results suggest that perceived mind simulation and occupation has stronger affect than perceived guidance, there are also other key factors believed to be equivalent in terms of gamer preferences and satisfaction. In addition, perceived clarity of instruction is also significant in the usability and quality of games design[19].

Generally, in the realm of online social network games, there is a need to go beyond the basic game interface and user requirements design for the sake of identification extraordinary features and player mind stimuli.

VII. Conclusion and Future Work

In conclusion, proliferation of online social network games is increasingly in demand and attracted huge number of users. These games are highly addictive, which means, once users start to play, they become addicted. In this paper, we robustly focus on evaluation of online social network games and we choose "CityVille" and "FarmVille" as subjects of our research due to the huge number of players play these games. We employ concurrent verbal protocol analysis to evaluate the usability and playability of these games to enhance the interfaces and playability of these games for more effective and enjoyable play. In other words, users, at certain points, find these games are such a great entertainments and an opportunity for them to find friends and enhance friendship among other players. Generally, this paper is an evidence for that any online social games need to overhaul issues before launching the actual version of the game to ensure the easiness of interaction between the game and its players by involving actual players. Some of the critical issues present in this paper are clumsy item organization, undesirable horizontal multi-tool menu-layer, shortcomings in instructions, monotonous games, games lack of strong storytelling, etc. the result of this paper suggest that perceived mind stimuli and entertainment is some of the key points of player preferences and satisfaction in online social network games. In fact, perceived clarity of instruction has priority over perceived short navigation path. Limitations of this research need to be recognized and studied in further research:

1) Time, number of errors and failures made by players are not included in this research paper.
2) There are significant aspects (such as game navigation structure, information's layout, value of information, or other diversified aspects) which are not evaluated profoundly by the study.
3) Further research will be conducted based on user behavior and movements of the mouse to deduce more drawbacks and feedbacks regarding the game usability/playability.

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MEST) (no. NRF-2015R1D1A1A01061328).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Vulnerability Analysis System Using Pattern Learning of Vulnerability for Open Source

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Abstract---

Background/Objectives: Recently, along with the expansion of area in which ICT and IoT devices are utilized, open source software has expanded its scope of application, including computers, smart phones, and IoT devices. Hence, as scope of open source software application has been varied, there have been increasing malicious attempt to attack vulnerability of open source software.

Methods/Statistical analysis: In order to address this issue, various secure coding programs have been developed. Nevertheless,, numerous vulnerabilities are still left unhandled. This paper provides some methods handles newly raised vulnerabilities based on the analysis of histories and patterns of previous open source vulnerabilities.

Findings: Through this study, we have designed a vulnerability analysis system that utilizes vulnerability histories and patterns learning, and have tested the performance of the system by implementing a prototype model.

Improvements/Applications: The paper holds its worth in that it can provide some help to further researchers studying in the areas of vulnerability analysis and to developers utilizing secure coding for vulnerability analysis.

Keywords--- Vulnerability Analysis, Vulnerability Pattern, Open Source, Secure Coding, Learning.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Recently, along with the expansion of area in which ICT and IoT devices are utilized, open source software is also expanding their scope of application, including computers, smart phones, and IoT devices Hence, as scope of open source software application has been varied, there is an increasing risk of threat that attacks vulnerabilities of open source software. A need for secure coding that solves fundamental issues of open source vulnerabilities, therefore, is being more recognized[1].

Although in case of secure coding programs, various solution programs have been developed to manage changes in configuration, relentless efforts of hackers who attack vulnerabilities of the security and related security issues have not been properly managed. Therefore, even if the vulnerabilities of previous versions source codes are not being solved and updated, the solution programs for configuration management are being distributed, and continuously remain as a vulnerability to the program[2].

Also, in case of Configuration Management System (CMS), although various feature and UI are being supported to effectively manage various contents, the system cannot handle source code vulnerabilities of personally designed API module, malicious attacks on such relatively less secure API module cannot be prevented[3].

Thus, to provide better secured coding of open sources, this paper proposes a vulnerability analysis system that analyzes and learns the vulnerability of the system, connected with a vulnerable configuration management engine, and utilize the outcome projected through the learned history and pattern of vulnerable configuration management source to address vulnerabilities of new open sources.

To test the performance of this vulnerability analysis system, we have designed and processed the system prototype.

II. RELATED WORK

A. Information Related to International Vulnerability

Common Weakness Enumeration (CWE) indicates a collection of software weaknesses in MITRE, with the support of Cybersecurity and Communications office under the U.S department of Homeland Security. Internationally, in case of the public uses, it is provided for free.

It defines vulnerabilities on respective issues, and, with sample codes and vulnerable platforms, explains some methods can alleviate vulnerabilities[4,5].

Whereas CWS is a general classification system that merely categorizes general vulnerabilities, Common Vulnerabilities and Exposures(CVE) lists down security vulnerabilities by time detected, and is a history record of detected security vulnerabilities. CVE can be further divided into either Entry and Candidate status.

Entry status refers that the inclusion of CVE identification number to the history is accepted. Candidate state refers that the history under a review before being included to the list[6].

Common Attack Pattern Enumeration and Classification (CAPEC) do not merely list down vulnerabilities, but sort out the patterns of attack that pose threats to security vulnerabilities. Under the guidance of U.S department of Home Security, a company named Cigital is responsibly managing the lists and provides some information about the patterns of attack patterns, real instances, test or detection of vulnerabilities of attack patterns on software, response methods to attacks, and priorities, in order to provide some help in addressing security vulnerabilities[7,8].

B. Configuration Management

Configuration management software systematically identifies and defines following features: identification and definition of software item, Baseline default, control on item modification and announcement, record on item status and modification request, integrity, consistency and accuracy items, saving and processing of items, management for delivery, and management of technological processes. By utilizing software's visibility and traceability, this method intends to strengthen software security and to further improve the quality of software[9,10].

Configuration management refers to the collection of individual development management activities that creates a configuration of software by aggregating all related configuration that arise along the overall life cycle of software development, and provide systematic control on such changes[11,12].

C. Configuration Management for Vulnerable Source

Configuration management of vulnerable source code continuously learns the outcome and analysis derived through the analysis of source code's vulnerabilities and detected patterns. Learned information is first saved in DB and is used for future testing of new source codes in order to effectively catch out vulnerabilities with greater accuracy[13].

III. VULNERABILITY ANALYSIS SYSTEM BASED ON LEARNING HISTORY AND PATTERN

A. System Architecture

This paper suggests a vulnerability analysis system that operates based on vulnerability history and patterns learned, and the system is comprised of vulnerability analysis engine and vulnerability source configuration management engine.

An organization chart of the system is illustrated in Figure1.

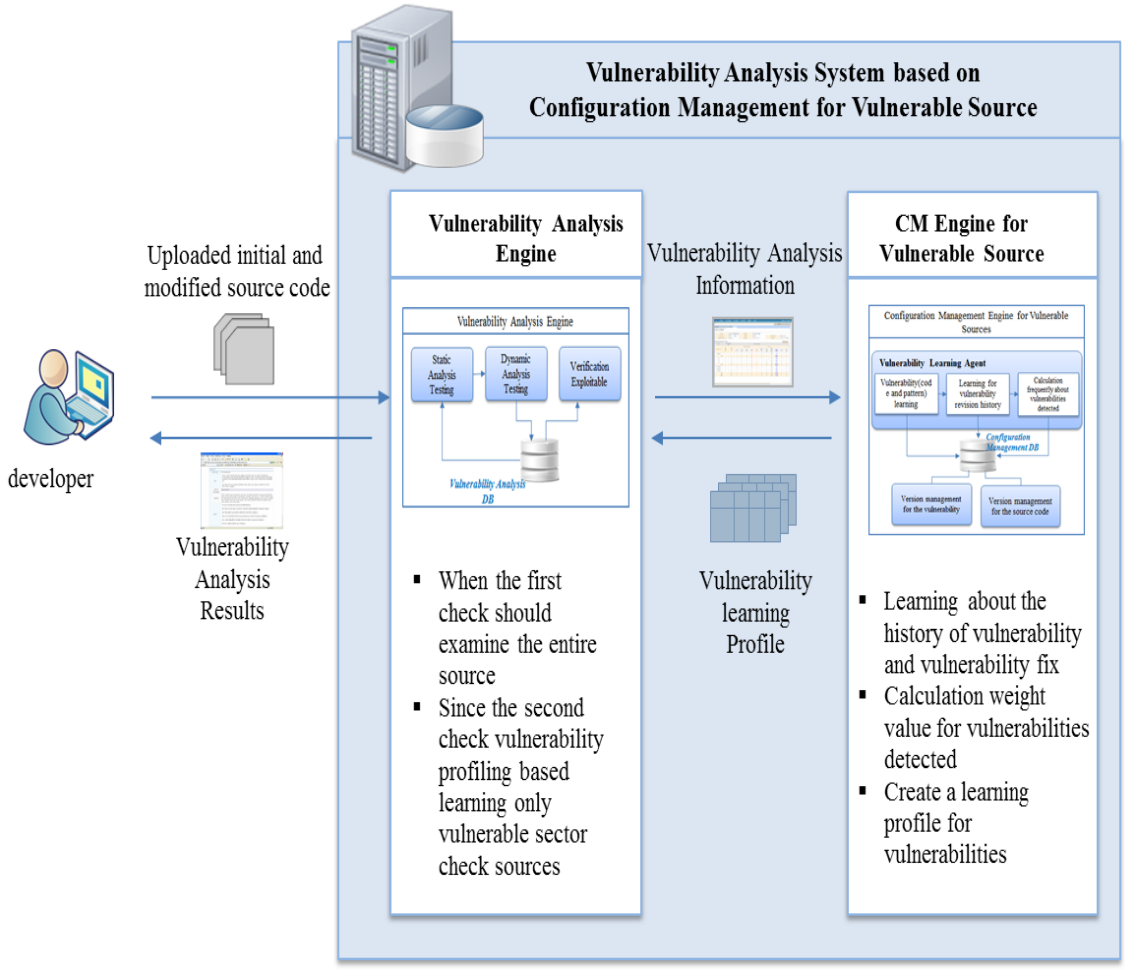

Figure 1: System Architecture

In case of vulnerable source configuration management engine, it receives vulnerability information of open source from the analaysis engine, and process vulerability learing, vulerabilty modification history

leraning, weighted calculatin o f vulerabilty detection, and vulnerability leraning profile. The generated vulnerability leraning profile is, then, transferred to vulerability analysis engine and is used to run secondary vulerability source code testing with vulnerablity learning profile aggregated.

B. Configuration Management Engine for Vulnerable Sources

At vulnerability management engine, in order to analyze vulnerability of uploaded source code, static analysis, dynamic analysis and exploitable verifications are performed. Then, analyzed information is sent to vulnerable source configuration management engine through vulnerability detection DB. Figure2 illustrates the organization chart of vulnerability analysis engine.

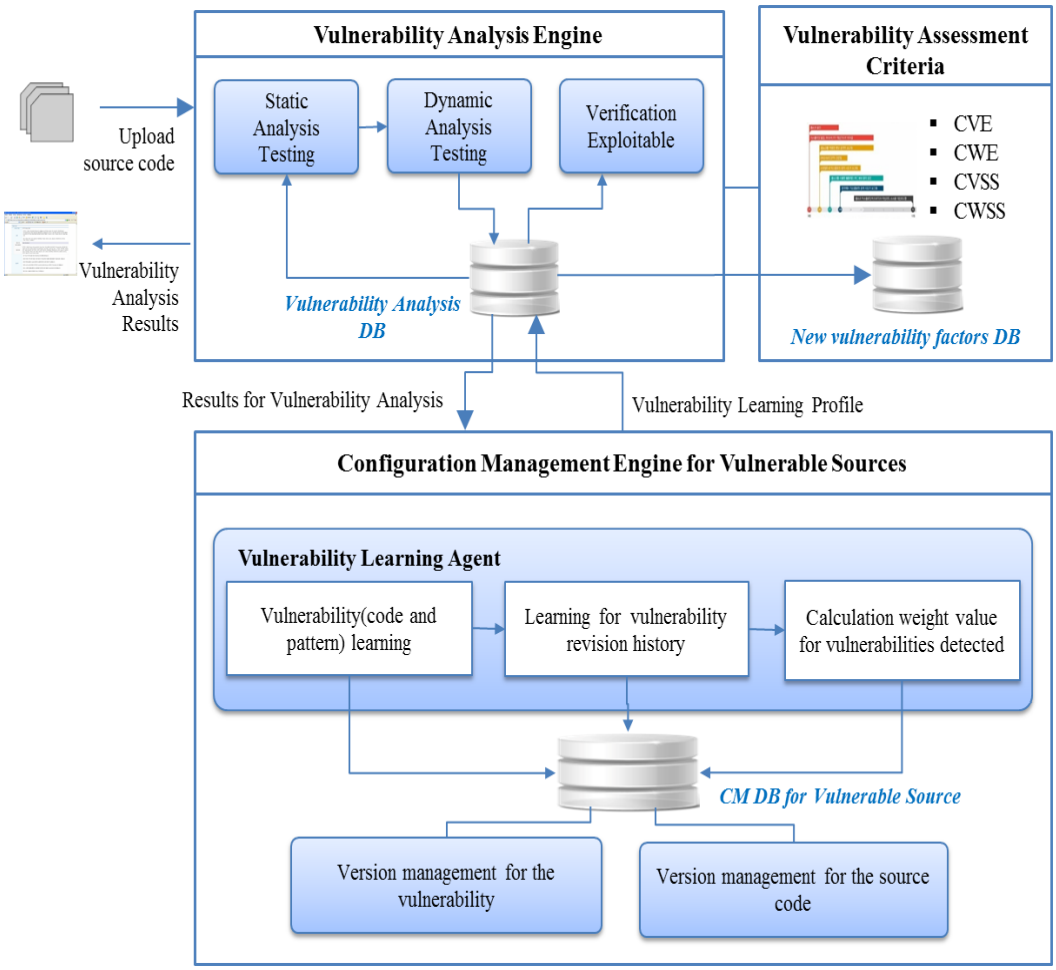

Figure 2: Architecture of Vulnerability Analysis Engine

Vulnerable source configuration management engine receives information about vulnerability analysis result from vulnerability analysis engine, and learns vulnerable source code and patterns with modification histories using vulnerability learning agent. Then, it calculates the weights of vulnerabilities detected. Learned and calculated vulnerabilities information are then stored and handled in DB. Then, the engine generates vulnerability profile and transmits vulnerability analysis to DB according to calculated weights in order to update the vulnerability list. Later, after an initial open source's secure coding work is done, in case of retesting, the engine only runs tests for vulnerability pattern detected from previous learning.

C. Vulnerable Source Configuration Management Process

Vulnerability analysis engine discerns whether an open source is a newly generated code or an updated code. If it is an updated source code, as the Figure 3 illustrates, vulnerability analysis data is stored in vulnerability analysis DB after carrying out static analysis, dynamic analysis and exploitable verification. If vulnerability is once again detected after the secondary analysis, vulnerability source configuration engine

transmits the analysis result and conducts further learning process of the code and its pattern. Also, after learning modified vulnerability history based on the vulnerability analysis result, the engine recalculates the vulnerability. Then, the learned result is stored in vulnerability learning DB. Based on the stored information in vulnerability learning DB, vulnerability analysis profile is generated and this profile is transmitted to vulnerability analysis DB to update items of a vulnerability analysis list. Figure 3 illustrates vulnerable source configuration management process.

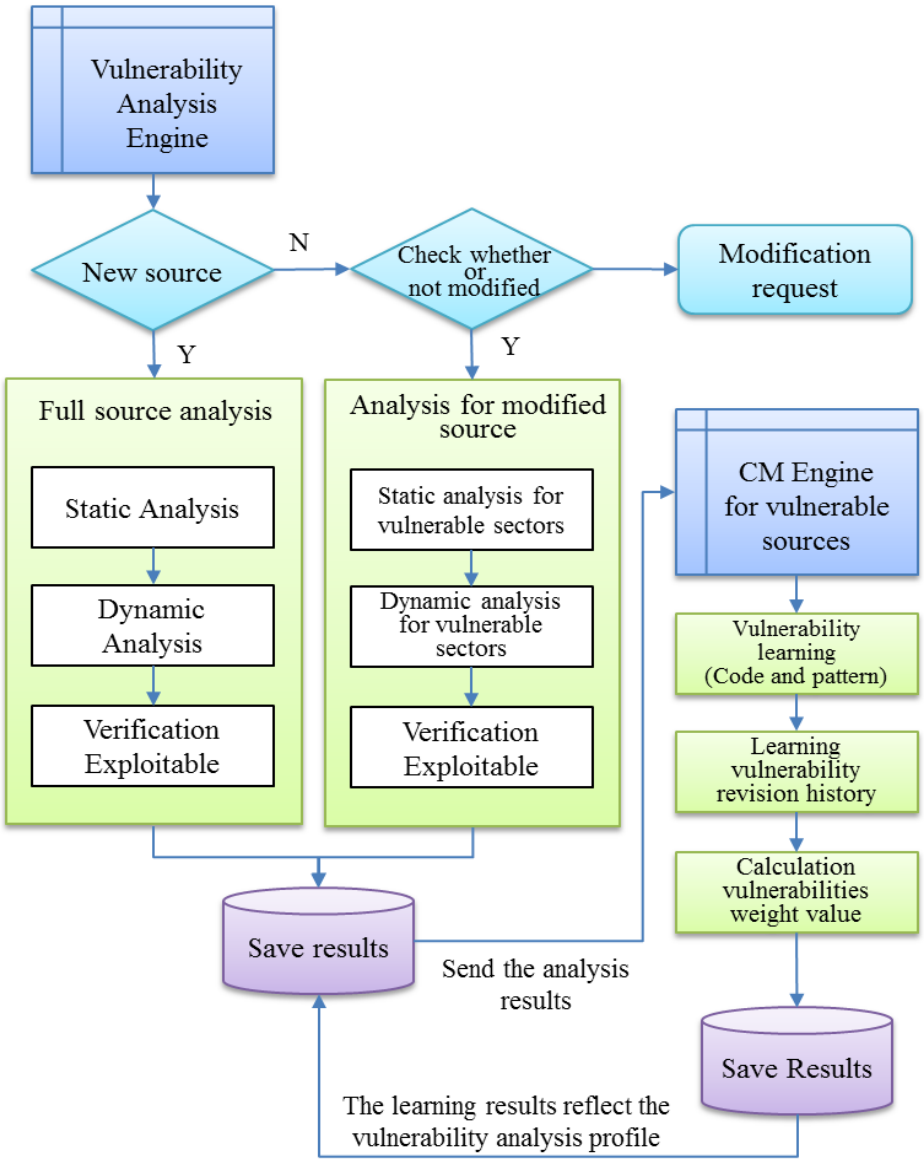

Figure 3: Process of Configuration Management for Vulnerability Source

D. Learning Vulnerability Patterns and Vulnerabilities Weight Calculation

Vulnerability pattern basically defines patterns based on CWE, an internationally used software vulnerability guideline, and CVE, a reference code used for vulnerability analysis. CWE is an aggregate of software vulnerability from various perspectives by MITRE under the support of the National Cybersecurity Division under, the U.S Department of Homeland Security. Whereas CWE is a classification system of vulnerabilities, CVE lists down security vulnerabilities by date of time and is, thus, a historical record of detected security vulnerabilities. Vulnerability patterns that cannot be defined by neither CWE and CVE are classified as new vulnerability pattern. Figure 4 illustrates process of learning vulnerability pattern.

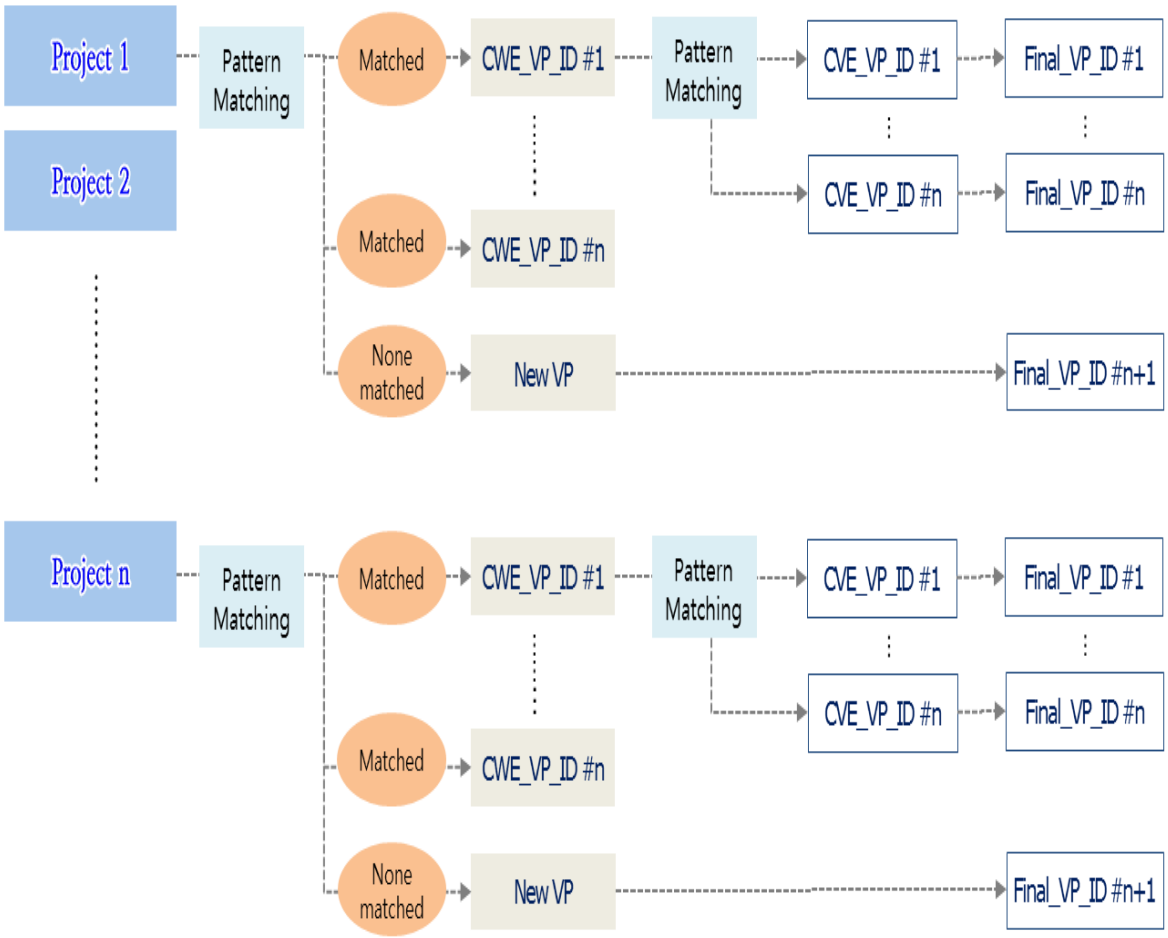

Figure 4: Process of Vulnerability Pattern Learning

In order to learn vulnerability patterns of open source, vulnerability analysis should be first conducted using vulnerability analysis engine with open source projects units registered in the system in advance. If the protracted vulnerability result matches CWE items and patterns, the vulnerability result is processed with an appropriate mapping that matches the CWE ID and the information is stored. Later, if there is any item that matches CWE's or CVE's vulnerability pattern, then respective CWE or CVE ID is selected to process mapping. Then the protracted vulnerability pattern through vulnerability analysis is mapped with CWE's or CVE's ID, and is later stored as a final vulnerability pattern ID in the man system. Here, if the protracted vulnerability pattern does not have any matching CWE vulnerability item, it is classified as a new vulnerability pattern. Every time vulnerability analysis is carried out with a vulnerability analysis engine, vulnerability pattern is learned and the learned information is updated. Weight calculation of vulnerability pattern is defined as a following formula.

$$Weight_{Vulnerability(Final_VP_ID(K))} = \frac{N_{Hit_Vulnerability(Final_VP_ID(k))}}{\sum_{i=1}^{n}(N_{Vulerability(Final_VP_ID)(i)}}$$

Weighted calculation of vulnerability analysis is carried out by dividing the number of vulnerability ID derived through every analysis by the overall number of final vulnerability pattern ID stored in existing CM DB. Hence, every time vulnerability analysis is performed, respective weight on each item is updated.

IV. Implementation and Performance Evaluation

Using suggested vulnerability analysis system that utilizes history and pattern learning has been designed and developed into a prototype. Figure5 illustrates the screen shot of vulnerability pattern analysis conducted by using suggested vulnerable source configuration management engine.

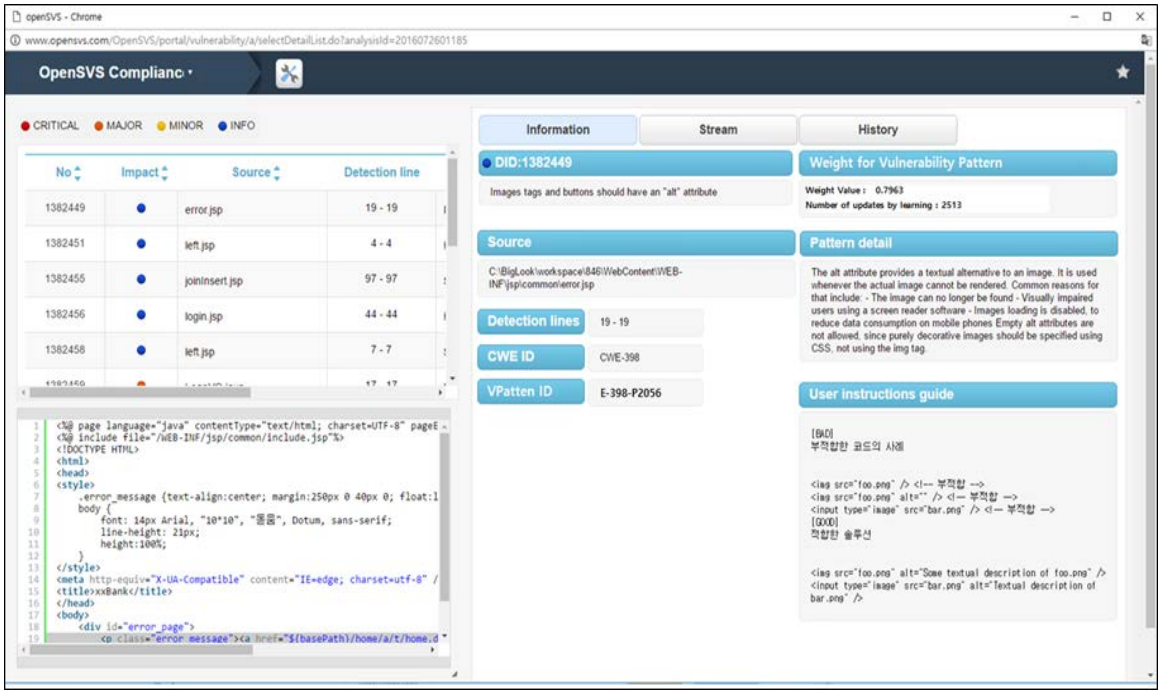

Figure 5: The Vulnerability Pattern Analysis

In a vulnerability pattern analysis screen, information about vulnerability pattern ID, vulnerability pattern information and weights on vulnerability patterns can be noticed. Figure 6 illustrates the vulnerability analysis result screen using vulnerability history and pattern learning.

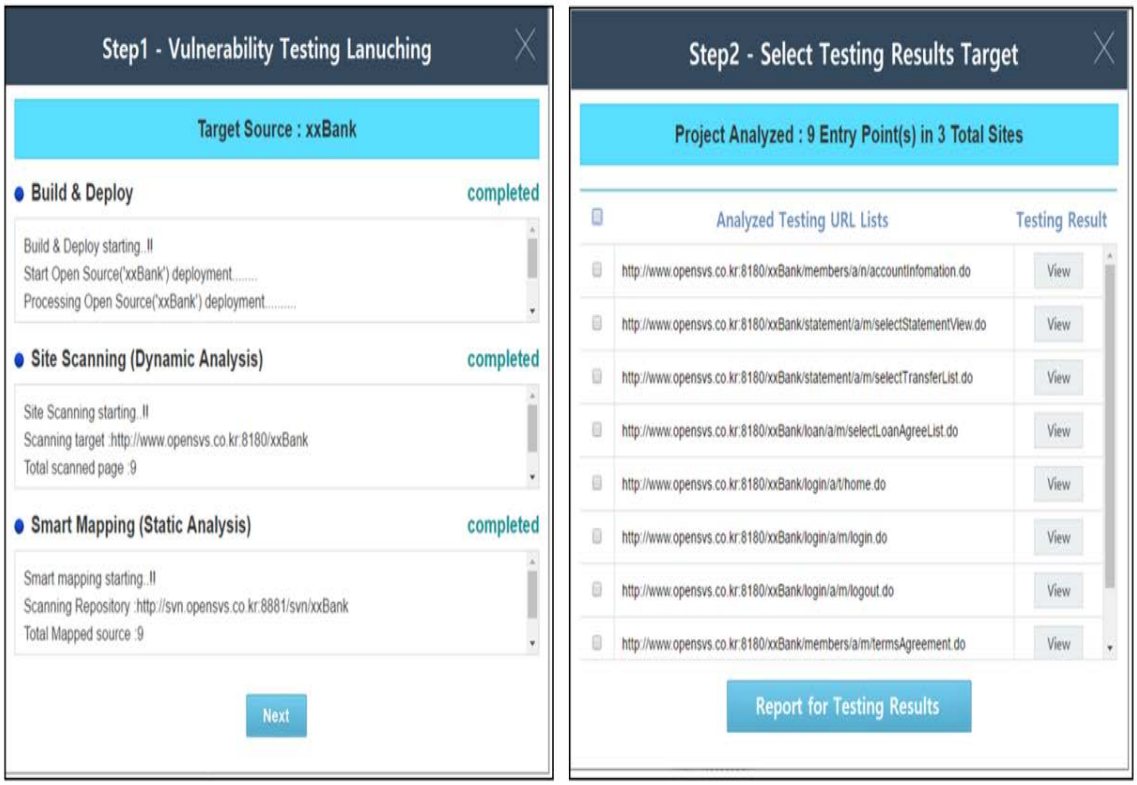

Figure 6: The Vulnerability Analysis Result

This is the result of carrying out dynamic and static analysis in order to carryout vulnerability analysis of open source used in a system. When a person chooses the vulnerability delectated URL, he can not only check the result of analysis but also an overall vulnerability analysis report.

In order to assess the performance of vulnerability analysis system using vulnerability history and pattern learning, time taken for each detection and accuracy of the system has been evaluated. Whenever an analysis on vulnerability is carried out by a system, vulnerability pattern learning and weighted vulnerability calculation have been continuously performed, and detection time and accuracy was measured after. The result is illustrated in Table1. We have utilized 356 Juliet code java files as an open source file for the experiment.

Table 1: Test Results for Vulnerability Detection Accuracy of Proposed System

Number of Tests Security Vulnerabilities	1th		10th		20th		50th	
	Detection Time (sec)	Detection Accuracy (%)	Detection Time (sec)	Detection Accuracy (%)	Detection Time (sec)	Detection Accuracy (%)	Detection Time (sec)	Detection Accuracy (%)
Race Condition	2.72sec	36.6%	1.98sec	45.4%	1.51sec	54.2%	0.98sec	75.4%
Divide by 0	3.89sec	45.4%	2.75sec	56.2%	1.91sec	67.3%	0.85sec	89.2%
Not Reachable	3.72sec	25.1%	3.01sec	32.5%	2.65sec	51.9%	1.19sec	79.6%
Null Pointer Exception	2.35sec	47.8%	2.11sec	56.6%	1.69sec	66.4%	0.54sec	88.9%
Assertion Errors	2.21sec	36.4%	2.04sec	47.2%	1.85sec	69.6%	0.76sec	78.6%

* Juliet code can be downloaded from http://samate.nist.gov/SARD/testsuite.php

As it can be noticed in the Table 1, whenever vulnerability analysis is performed by a suggested system, the time taken for each vulnerability detection has been shortened, with increased accuracy.

V. CONCLUSION

This paper suggests vulnerability analysis system that utilizes vulnerability history and patterns as a means to provide safe open source software.

Implementing our suggested system as a prototype, we have carried out an experiment to evaluate time taken for each vulnerability detection and its accuracy. Through the experiment, it has been confirmed that continued vulnerability history and pattern learning help the system improve its accuracy. Also, if a developer's open source is modified and is retested, using vulnerability pattern learned, the system only checked modified vulnerabilities, requiring lesser time for detection. After implementing reporting module feature and overall service web, we would like to carry out further experiments and evaluations on our suggested tool in depth.

We hope that our suggested vulnerability analysis system that utilizes vulnerability history and pattern learning can overcome contemporary detection limits in terms of accuracy, and can efficiently provide more accurate vulnerability detection.

ACKNOWLEDGMENT

This research was supported by the ICT R&D program of MSIP/IITP [R0112-16-1061, The analysis technology of vulnerability on open-source software, and the development of platform].

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Channel Routing Model of V2X SW Architecture Based on Layer-Queue

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Abstract---

Background/Objectives: WAVE is the core technology of the research including smart car and autonomous driving. In this paper, we designed WAVE software architecture, and developed WAVE management functions.

Methods/Statistical analysis: IEEE 1609 Standard provides guideline about functions that are necessary for WAVE service. WAVE is designed on IEEE 802.11p WLAN, with multi-channel operation. But it has been mentioned that the area of implementation is left to the developer's discretion. In order to support WAVE service, we must consider the structure of interworking between other layers as well as implementation of these capabilities.

Findings: For development of WAVE SW, we suggest main structure based on layer-queue. In WAVE standard, MAC layer has a transmit queue corresponding to the channel identifier and priority. However, there is not mentioned about an intermediate layer structure for transmission data and management packets. Because of bypassing of packets in intermediate layer, workload has been concentrated into high layer or MAC layer. Along with suggested layer-queue, we separate a module independently to handle inbound and outbound higher layer data along.

Improvements/Applications: The processing by layer-queue can be distributed the workload and delay of MAC SW.

Keywords--- WAVE, IEEE 1609, WME, Layer-Queue, VANET.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Vehicles have been developed dramatically through the convergence of ICT (Information and Communication technology). In particular, the information provided through vehicular network can improve the vehicle safety. With the advent of smart car and autonomous driving, WAVE (Wireless Access in Vehicular Environment) has become a major part of these researches. WAVE was published by the IEEE 802.11 working group. It is the core technology which is widely used in vehicle safety support service. Various vehicle data are used in VANET to improve performance. Wave is enabled to exchange of safety messages in a rapidly where low latency is an important objective.[1]

The objective of this paper is to present WAVE software architecture, which has been designed and developed based on layer-queue. It is composed of three sections. In the next session, we will refer to the WAVE standard structure. The third section is concerned with the channel routing method based on queue more detailed, the conclusion gives a summary.

II. LITERATURE REVIEW

The IEEE 1609 standards define the architecture, communications model and physical access in the vehicular environment. It includes some management structure and security mechanisms.[3] IEEE 1609.3 for network service and 1609.4 for multi-channel operation is designed to enable to process data transfers without dependency of physical layer.[2] Figure 1 shows the basic structure of WAVE system.

WAVE architecture provides management service and data delivery service between WAVE devices. Data plan transmits service data through IP or WSM protocol while the management plan performs operations such as time synchronization and channel access.[2] Management plane is subdivided into three parts vertically.

WME (WAVE Management Entity), MLME (Mac sub layer Management Entity), and PLME (PHY sub layer Management Entity).Especially, WME accepts service requests from the higher layer applications and supports the most appropriate channel assignment.

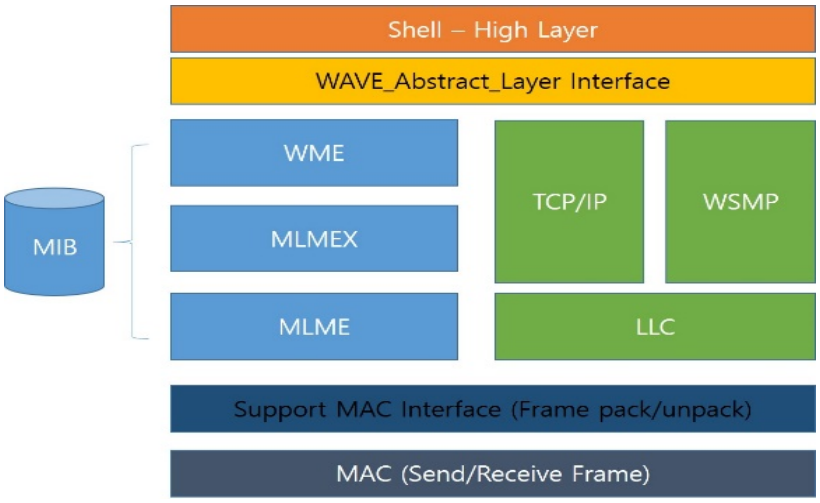

Figure 1: Relationship Among Protocol Models

From a vertical perspective of SW layer, the lowest MAC layer has a transmit queue corresponding to the channel identifier and priority. It provides two types of channels, CCH and SCH, and sends WAVE Service Advertisements (WSA), Timing Advertisements (TA), and service packets to the lower physical layer. However, there is not mentioned about another layer structure for transmission data and management packets. Besides, SAPs (Service Access Point) have information that is exchanged between inter-layer entities.[4]

In the end, the implementation of these functions is left to the developer's discretion. We follow the IEEE standard basically for implement protocol related to interoperability with other device.

III. PROPOSED WORK

The MAC handles inbound and outbound higher layer data. It includes routing of data packets from a higher layer to the designated channel, and setting parameters (e.g., transmit power, data rate) for WAVE transmissions. On the receive side, it includes delivery of data to the correct higher layer protocol.[4] WAVE supports at least one of TA (Timing Advertisement), WSM including VSA (Vendor Specific Advertisement), WSM Data and IP Data frame.

In order to transmit many packets simultaneously between adjacent layers, we propose software architecture based on layer-queue such as Figure 2. In this architecture, we consider to keep the independence of each layer as much as possible.

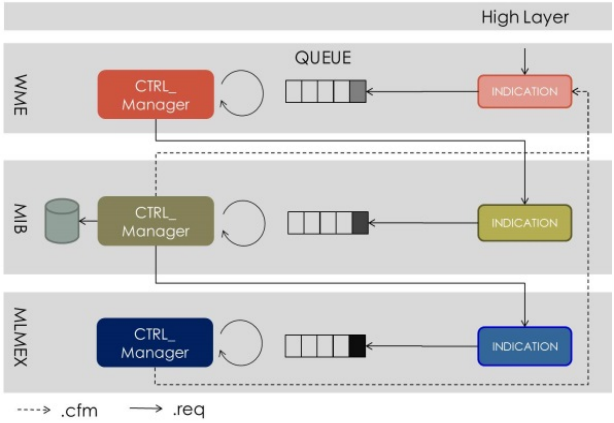

Figure 2: V2X Architecture Based on Queue

Figure 3 shows a workflow step with the TA service. At first, service requests from high layer may be made through the WME service access point (SAP) like WME-Provider Service. request. It transmits to lower layer. The request determines channel access assignments through MLMEx-CHSTART. request in MLME layer. MAC layer gathers generated messages. Finally, the provider device sending the time information frame periodically in physical layer and wireless air interface. In other words, the last workload has been concentrated in to MAC layer of WAVE device. Therefore, we try to separate a module to handle inbound and outbound packets. Each layer has a queue independently.

As shown in (Figure 2), each layer is split into a control and indication module again. The indication module inserts all the received packets received to the layer-queue. The control module reads the packets in the queue and converted to a message format suitable for the next layer. And this module determines the packet where to go. Service requests from application are processed with repetition of such operations in all layers. It works without distinguishing between data area and management area. However, it is necessary to monitor the individual processing state continuously until the service request is completed.

This architecture helps to reflect flexibly workload according to the requirements of the variety safety services.

We considered the MIB (Management Information Base) as a unique layer, too.

Figure 4 shows the test result of sending TA (Timing Advertisement) message using layer-queue. Application may request the TA information to nearby vehicles for channel synchronization when it does not receive GPS signals.

WAVE SW uses the control channel (CCH) by default.[5] However, TA Request message is sent to service channel (SCH).In the same service channel, multiple services are possible. But if there are different service channels, it is carried out by high-priority service.

We select the alternative channel access method. It is checked service priority firstly when there is a change in the provider and user service list. After set the channel configuration, WAVE SW is only enabled to use the same service channel.

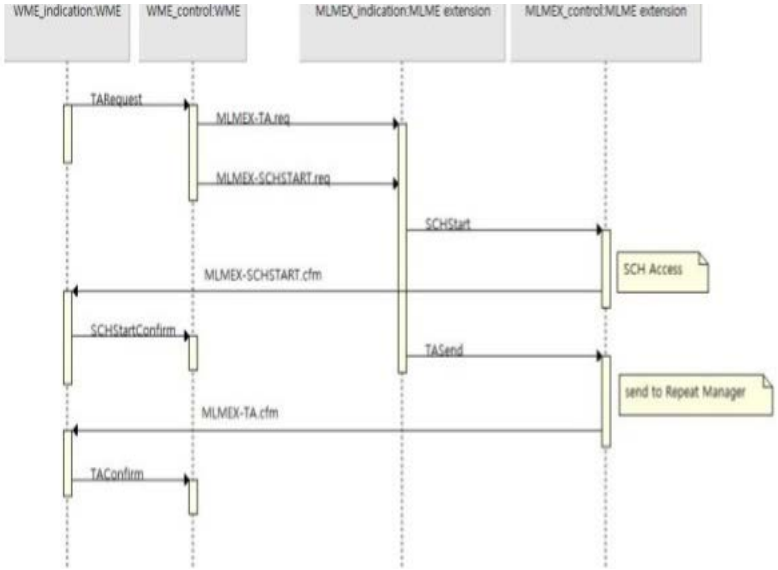

Figure 3: Sequence Flow of TA Service Request

```
------------------------------------------------------

$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[APP]] WME-TAService.req
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: => TA LSI:3, action:0, MAC Addr:115599bb, Priority:07
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[WME-IND]] WME-TimingAdvertisementService.Req
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[MLMEX-IND]] MLMEX-SCHSTART.Req
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[MLMEX-IND]] MLMEX-TA.Req
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[Higher Layer]] WME_TaService.Cfm
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: ==> RESULTCODE : 0
$ [DT=2015-01-05.07:01:46.672] OBU[1] - DEBUG[1]: [[WME-IND]] MLMEX-SCHSTART.Cfm
$ [DT=2015-01-05.07:01:46.674] OBU[1] - DEBUG[1]: [[MLME-IND]] MLME-TIMING_ADVERTISEMENT.Req
$ [DT=2015-01-05.07:01:46.674] OBU[1] - DEBUG[1]: [[MLME MIB-IND]] MLME-Set.Req / TimingInformation

                (Len : 0x4E(78) bytes)
               ================================================
               Hex.   00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
               ------------------------------------------------
               000- : 00 00 00 00 00 00 1E 78 00 00 00 00 01 00 00 00
               001- : 00 00 00 00 0F 23 C8 00 00 00 1E 2A 00 00 00 00
               002- : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               003- : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               004- : 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               ================================================
$ [DT=2015-01-05.07:01:46.675] OBU[1] - DEBUG[1]: [[WME-IND]] MLMEX-TA.Cfm
$ [DT=2015-01-05.07:01:46.675] OBU[1] - DEBUG[1]: [[MLME-CTRL]] MLME-TIMING_ADVERTISEMENT.Req
$ [DT=2015-01-05.07:01:46.675] OBU[1] - DEBUG[1]: [[MLMEX-IND]] MLME-SET.Cfm / TimingInformation
$ [DT=2015-01-05.07:01:46.676] OBU[1] - DEBUG[1]: [[Higher Layer]]  WME-Notification.ind
$ [DT=2015-01-05.07:01:46.676] OBU[1] - DEBUG[1]: ==> Event : 0, LSI: 3, Reason: 1
```

Figure 4: Result of TA Service Request

Making a MAC frame to send is the last role of WAVE provider. The TA service request is transmitted to the Repeat Manager. Repeat Manager sends a message periodically by receiving the value from the internal Time Sync module. (Basically it transmitted once per second.)

IV. CONCLUSION

It has been recognized that WAVE SW except MAC layer is less important. However, WAVE protocol needs to consider overall implementation structure for commercialization. In this paper, we designed WAVE SW architecture and implemented these functions including service primitives. This architecture can be applied to a vehicle should a mandatory install WAVE. According to the Korea ministry of Land, Infrastructure, and Transport, C-ITS trial service is performed. The vehicle can be provided for safety service when entering a pilot road with a C-ITS terminal (WAVE communication device).

ACKNOWLEDGMENT

This work was supported by an ETRI SW/Contents basic/original technology development project of the Ministry of Science, ICT and Future Planning. [Development of high-speed V-Link communication technology for real-time control of autonomous driving vehicle]

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Optimal Cooperative Retransmission and Rate Control on Wireless Networks

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Abstract---

Objectives: Reduce both the number of retransmissions and the transmission time for each packet to get over the unreliability of the wireless medium.

Methods/Statistical analysis: Due to the inherent unreliability of the wireless medium, any transmitted packets are subject to fail to decode at the receiver. In this paper, we jointly consider both the cooperative re transmission and the transmission rate control in order to reduce both the number of retransmissions and the transmission time for each packet.

Findings: We first propose an optimal retransmission scheduling scheme with the optimal transmission rate control. In addition, we propose an advanced scheme by taking the energy constraint into our consideration.

Improvements/Applications: By performing an extensive set of evaluations, we validate the proposed schemes.

Keywords--- Wireless Network, Reliability, Retransmission, Transmission Rate, Energy Constraint.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The ease of installation, access and maintenance, the wireless networking technology has been widely studied and deployed. In addition, the fast-growing market of the mobile devices, such as smart phones, tablets, laptops, etc., has enabled a significant improvement of the wireless technology within a short period of time.

However, the wireless medium has an inherent vulnerability that it significantly suffers from the signal *attenuation* as the transmitted signal travels in the air. To be specific, the received signal power at the receiver is inverse proportional to the distance to the power of n(n varies according to the surroundings, e.g., open space, indoor, city, etc.)

$$P_r \propto \frac{G \cdot P_T}{f_c^2 \cdot d^\alpha}$$

Where P_r is the received signal power, P_T is the transmit power, d is the distance between the sender and the receiver ,f_c is the carrier frequency, G is the power gain from the transmit and receive antennas, and α is the propagation loss exponent (for example, 2 for free space)[1]. This is one of the reasons why the received signal is subject to failure when the receiver tries to decode it.

In order to overcome the unstableness of the wireless medium, IEEE 802.11 standard which is one of the most widely used technologies defined a procedure called retransmission which operates in the following manners.

If the transmitted packet is in error, the receiver explicitly or implicitly sends a request to the sender for a retransmission of the same packet. When the sender notices the retransmission request, it retransmits the same packet again and again until the receiver successfully receives the packet or the number of retransmissions reaches the limit.

Obviously, the increase of the number of retransmissions degrades the overall network performance (i.e., throughput)as well as the lifetime of the battery-limited devices because it implies that the wireless devices spend more time and battery to transmit a certain amount of information to their receivers[2-5].

In order to decrease the expected transmission time and thus to increase the lifetime of wireless devices, we propose an optimal cooperative retransmission scheme. The proposed scheme tries to minimize the expected time for a successful transmission on each transmission attempt by choosing the optimal transmission rate and the relay. In addition to that, we propose an advanced scheme that considers the energy constraint when choosing a relay so that one can prevent the case that only a small number of devices are excessively used as a relay.

This paper is organized as follows. In the following Chapter 2, we propose the optimal cooperative retransmission scheme that minimize the expected transmission time. The Chapter 3 introduces an advanced scheme that not only minimizes the expected transmission time but also considers the energy constraints. Finally, we conclude the paper in Chapter 4 by summarizing the work performed in the present paper.

II. COOPERATIVE RETRANSMISSION WITH RATE CONTROL

In this chapter, we first show how to find the optimal transmission rate that minimizes the expected transmission time without considering any cooperative retransmission. Then, we take the cooperative retransmission into our consideration so as to further minimize the expected transmission time.

Throughout the present paper, the expected transmission time will be frequently used as it is the main metric that is to be minimized. The expected transmission time $\bar{T}$is defined asan average time required to make a successful transmission, and is mathematically expressed as[1]

$$\bar{T} = \frac{P_{idle}}{P_{succ}} \times \overline{t_{idle}} + \frac{P_{err}}{P_{succ}} \times \overline{t_{err}} + \overline{t_{succ}} \qquad (1)$$

Where P_{idle} is the probability that a node senses the channel idle, and $\overline{t_{idle}}$ is the expected time that a nodes spends for idle contention. P_{err} is the probability that a transmission is in error, and P_{succ} is the probability that a transmission is successful($P_{succ} = 1 - P_{err} - P_{idle}$).

Also, we assume IEEE 802.11 standard adopts ARQ (Automatic Retransmission Request)as a retransmission protocol. ARQ is a stop-and-wait error-control mechanism that does not allow the next

transmission without confirming the current transmission is successful by receiving an ACK message from the receiver. When the receiver fails to decode the received packet, it asks for a retransmission of the same packet to the sender by sending an NAK (negative ACK) response. Also, the sender might realize that the packet should be retransmitted if there is neither an ACK (acknowledgement) nor NAK within the predefined timeout period[6-8].

A. Optimal Transmission Rate Control

Under the regular ARQ scheme where any retransmissions are made by the same sender, the optimal transmission rate is the one that minimizes the expected transmission time. According to the IEEE 802.11 standard, IEEE 802.11b, for example, defines four transmission rates; 1, 2, 5.5 and 11 Mbps. If it is applicable, any wireless device may try to use the highest transmission rate to minimize the transmission time. However, as the transmission rate increases the probability that the transmitted signal can be corrupted also increases as in Figure 1.

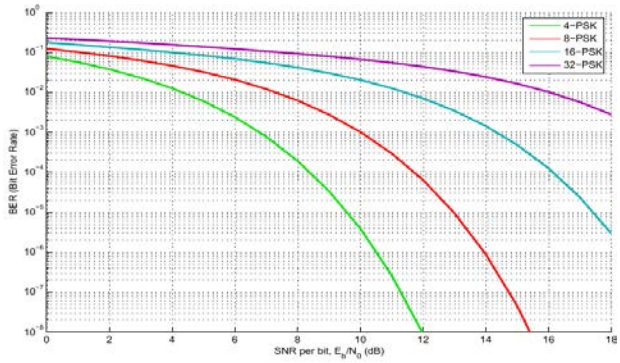

Figure 1: Bit Error Rates Under the Four Difference Modulations with Respect to SNR per bit, EbNo

As seen in Equation 1, if the transmission rate increases, both $\overline{t_{err}}$ and $\overline{t_{succ}}$ decrease becausethe both terms are inverse proportional to the transmission rate.At the same time, however, P_{err} increases as a higher transmissionrate is used.

If one uses the highest transmission rate while the transmission error probability is also high, it will suffer from frequent retransmissions. On the other hand, if all devices make transmissions only with the lowest transmission rate, the transmission time per packet becomes large, thereby the overall network throughout will decrease. Therefore, it is important to find the optimal transmission rate so as to minimize the expected transmission time.

We finally make one more assumption that each node learns and records the following information during its operation. Each node-i makes a list of receiver nodes,$R_i = \{r_k\}$within its transmission range,by overhearing or receiving a signal (packet)from its neighboring node-k. On each transmission, a node should select a transmission rate φ_m among the available rates that are pre-defined by the network standard where the node belongs.

For example, IEEE 802.11b supports four transmission rates, 1, 2, 5.5, and 11 Mbps; in other words, the set of available transmission rate is$\prod^{802.11b} = \{\varphi_m; m = 1,2,3,4\}$andeach transmission rate in the set $\prod^{802.11b}$ is$\varphi_1 = 1, \cdots, \varphi_4 = 11$. Upon each transmission to its receiver $r_k$the sender node-i records the error probability and the transmission rate with which node-i communicated with r_k.Therefore,node-i can build the error probability set with regards to transmission rates of all neighbors. In the same manner, each node-i can learn the probability P_{idle} of sensing the channel idle andthe expected time t_{idle} that a node spends for idle contention.

Formulation

The objective of a sender is to achieve the optimal (minimum)expected transmission time,$\overline{T^*}$, for each transmission to its destination.To do so, a sender calculates the expected transmission time$\Delta_{(\varphi_m)}$with respect to the transmission rateφ_m,and then selects the minimum.In this manner, each sender selects the different optimal transmission rate for different receiver before transmitting a packet. For the receiverr_k, the sender node-i solves the following problem in order to minimize the expected transmission time.

$$\overline{T^*} = \min_{X_m} \sum_{m \in M} X_m \Delta_{(\varphi_m)} \quad (2)$$

where

$$\Delta_{(\varphi_m)} = \frac{P_{idle}}{P_{succ\,(\varphi_m)}} \times \overline{t_{idle}} + \frac{P_{err\,(\varphi_m)}}{P_{succ\,(\varphi_m)}} \times \overline{t_{err\,(\varphi_m)}} + \overline{t_{succ\,(\varphi_m)}} \quad (3)$$

subject to,

$$\sum_{\forall m} X_m = 1 \quad (4)$$

$$X_m \in [0,1], \forall m \quad (5)$$

where $P_{err\,(\varphi_m)}$ is the transmission error probabilitywhen the transmission rate is φ_m, $P_{succ\,(\varphi_m)} = 1 - P_{err\,(\varphi_m)} - P_{idle}$, $\overline{t_{err\,(\varphi_m)}}$and $\overline{t_{succ\,(\varphi_m)}}$ are the expected time for an erroneous transmission and a successful transmission when the transmission rate isφ_m, respectively,$\overline{t_{succ\,(\varphi_m)}} = \frac{B}{\varphi_m} + \{$ACK notification time$\}$, and$t_{err\,(\varphi_m)} = \frac{B}{\varphi_m} + \{$implicit or explicit NAK notification time$\}$, where B is the average number of bits in a packet and is assumed to be known.

The objective Equation 2is to minimize the expected transmission time which is defined by Equation 3. Since the decision variable $X_m$is allowed to take any values between 0 and 1 (Equation 5), and they should sum up to 1 (Equation 4), the optimal value can be interpreted as the proportion of the time that the sender decides to use each of the transmission rates when communicating with the corresponding receiver, while the optimization problem will be letting only one of the variables be 1.

B. Cooperative Retransmission with Rate Control

Although the optimal transmission control scheme can reduce the expected transmission time, it may not work as expected if the channel gain between the sender and the receiver is very bad. It happens when the transmitted signal from the sender experiences a significant attenuation due to the existence of barriers, high interferences, and so on. If that is the case, even the most robust transmission rate may incur a large number of retransmissions and any of the higher transmission rate might not even available to use.

By exploiting the overhearing nature of wireless networks, however, we can increase the reliability of transmissions while reducing the expected transmission time. To be specific, instead of letting the sender retransmit the same packet again and again until the receiver is able to decode the signal without any error, a nearby node, if there is any, which correctly overheard the packet can relay it. If the relay has better channel condition to the receiver than that of the sender, it can retransmit the packet with a high transmission rate and a low error probability[9-12].This is called *cooperative retransmission*.

Protocol Description

When there is a transmission request at a sender S, it first checks the receiver of the packet. Then, S calculates the following two. One is the optimal expected transmission time with the optimal problem defined in Equation 2∼5,whose optimal value is denoted by$\overline{T^*}$.The other is the expected transmission time with the optimal rate control and the cooperative retransmission being jointly considered, whose optimal value is denoted by$\overline{T'^*}$.

If$\overline{T^*} \leq \overline{T'^*}$, S handles the retransmission, if necessary, by itself with the optimal transmission rate. If not, S encapsulates the ID of the optimal relay nodeL^* into the packet header so thatL^* can retransmit the packet if applicable.If the intended receiver R receives the packet without any error, transmission finishes. If neither R nor L^*receives the packet in error-free,S initiates the IEEE 802.11 ARQ method to retransmit the packet. However, if R failed to correctly receive the packet whileL^* capturesthe packet without any error, L^* retransmits the packet on behalf of the S after confirming it is chosen as the relay by checking the packet header. In this case, L^* waits for SIFS interval right after the end of thepacket transmission from S. If there is no ACK transmitted from R,L^* initiates the retransmission procedure.

It is also possible that the retransmission made by L^*failed to be decided at R. In this case, the following retransmission will be in charge of L^*instead of S. This is because 1) L^* already has the packet to be retransmitted, and 2) the expected transmission time between L^* and R is less than that between S and R.

Formulation

In order to take the cooperative retransmission into our consideration, we have modified the previous optimal transmission rate selection problem(i.e., Equation 2∼5)as follows.

Let us define $\overline{T'^{*}}$as the minimum expected transmission time with the cooperative retransmission enabled. Also, let $\Delta^{(l_j)}$ bethe expected transmission time between the sender *S* and the receiver *R* with a cooperation from a neighboring node-*j*(l_j) enabled, where $\Delta^{(l_j)}$ is mathematically expressed as:

$$\Delta^{(l_j)} = \underbrace{\frac{P_{idle}}{P'_{succ\,(l_j)}} \times \overline{t_{idle}} + \frac{P'_{err\,(l_j)}}{P'_{succ\,(l_j)}} \times \overline{t_{err}} + \overline{t'_{succ}}}_{\text{(a)}} + \underbrace{\overline{t_{extra}}}_{\text{(b)}} \quad (6)$$

where$P'_{err\,(l_j)}$is the probability thatneither *R* nor l_j successfully decodes the transmitted packet from *S*,that is $P'_{err\,(l_j)} = P_{err}^{S\to R} \times P_{err}^{S\to l_k}$. The successful transmission probability$P'_{succ\,(l_j)}$is$1 - P'_{err\,(l_j)} - P_{idle}$. Therefore, the set of terms marked by (a) in Equation 6 is the expected transmission time to makea successful transmission from *S* to at least one of *R* and l_j.In addition,$\overline{t_{extra}}$ is an extratime required to make a successful transmission when one or more retransmissions are required. Note that $\overline{t_{extra}}$ becomes 0 if *R* receives the packet from *S* without any error.

$$\overline{t_{extra}} = \begin{cases} 0 & \text{R (or both R and } l_j\text{) successfully receive the packet} \\ 0 & \text{neither R nor } l_j \text{ successfully receives the packet} \\ \overline{T^{l_j\to R}} & \text{only } l_j \text{ successfully receives the packet} \end{cases} \quad (7)$$

where$T^{l_j\to R}$is the expected transmission time from l_j to *R* which is assumed to be known to *S*.

By replacing the$\overline{t_{extra}}$term in Equation 6 with the corresponding term in Equation 7, we can get the following expression that describes the expected transmission time for a transmission between *S* and *R* when the cooperation from l_j is enabled.

$$\Delta^{(l_j)} = \frac{P_{idle}}{P'_{succ\,(l_j)}} \times \overline{t_{idle}} + \frac{P'_{err\,(l_j)}}{P'_{succ\,(l_j)}} \times \overline{t_{err}} + \frac{P_{succ}^{S\to R}(\overline{t_{succ}}) + P_{err}^{S\to R} \times P_{succ}^{S\to l_j}(\overline{t_{wait}} + \overline{T^{l_j\to R}})}{P'_{succ\,(l_j)}} \quad (8)$$

where$\overline{t_{wait}}$ is the expected time that the relay has to waituntil it notices the transmission from *S* to *R* is failed, that is close to$\overline{t_{succ}}$. For the sake of the simplicity, let us assume$\overline{t_{wait}}$=$\overline{t_{succ}}$.

Another assumption we make here is when a cooperating node retransmits a packet on behalf of the sender, it uses a fixed transmission rate that is already known to both the sender and the receiver. Therefore, a node-*i* should know the existence of the neighboring nodes as well as their optimal transmission rate to all possible receivers.

Let us now formulate the optimization problem which is very similar to the one for the optimal transmission rate selection. The objective of node-*i* is to select the optimal relay node-*j* that minimizes the expected transmission time.

$$\overline{T'^{*}} = \min_{X_j} \sum_{j\in J} X_j \Delta^{(l_j)} \quad (9)$$

subject to,

$$\sum_{j\in J} X_j = 1 \quad (10)$$

$$X_j \in [0,1], \forall j \in J \quad (11)$$

Where *J* is the set of indices of node-*i*'s neighboring nodesl_j.

However, it is not always the case that there is a relay which has better link to *R* than that between *S* and *R*.In other words, it is possible that the cooperative transmission with the optimal relay yields longer time

than the transmission without it. Therefore, after finding the optimal expected transmission time with the cooperation, a sender should compare it to the optimal expected transmission time without any cooperation as follows.

$$\min\left\{\overline{T^*}, \overline{T'^*}\right\}$$

As indicated above, if cooperation does not contribute to reducing the expected transmission time, the sender chooses not to trigger a cooperation procedure, and follows the standard transmission process.

On the other hand, if a cooperative retransmission is enabled, the sender puts the ID of the relay node into the packet header so as to let the relay node be ready for retransmission when the transmission to the receiver fails.

If the relay fails to decode the packet and the transmission between the sender and the receiver also fails, the sender will retransmit the packet by following the standard re transmission procedure.

Evaluation

We implemented and evaluated the proposed scheme on MATLAB[13].The network configuration is as follows.

There are three nodes placed in a line on the network. The sender *S* and its receiver *R* are at different end of the line, and the (possible) relay *L*is placed in the middle.

Each node on this network is within the transmission range of other nodes. The parameter configuration and the simulation result are described in Table 1.

Due to the weak link between *S* and *R,* they have to transmit packets with low transmission rate. In addition, the error probability between *S* and *R* is high. The relay node *L*, however, placed in the middle of *S* and *R* pair, and thus it has better links to both *S* and *R*, enabling high transmission rate with low transmission error probability guaranteed.

Table 1: Parameter Configurations for the Chain Topology Network

P_{err}^{SR}	0.1	Pr(transmission S ⇒R is in error)
P_{err}^{SL}	0.02	Pr(L fails to overhear the transmission S ⇒ R)
P_{err}^{LR}	0.01	Pr(transmission L ⇒ R is in error)
P_{succ}	0	Pr(S senses the idle channel)
t_{succ}^{SR}	10	Time to make a successful transmission S ⇒ R (and L)
t_{err}^{SR}	10	Time to make a successful transmission R ⇒ R (and L)
t_{succ}^{LR}	2	Time to make a successful transmission L ⇒ R
t_{err}^{LR}	2	Time to make a successful transmission L ⇒ R
t_{idle}	1	Average amount time the sender spends sensing the idle channel

As the simulation result indicates (see Table. 2),the proposed protocol spend less amount time per successful transmission. This is because the neighboring node that has better link condition to the receiver than that of the sender retransmits the packet from the sender when the receiver fails to decode the received packet. Since the relay is able to transfer the same amount of bits within a shorter time than the sender the average amount of time to make a successful transmission is decreased. Also, the better channel gain between the relay and the receiver reduces the expected number of retransmissions.

Table 2: Simulation Result for the Chain Topology Network

Retransmission scheme	Average time spend per a successful transmission
IEEE 802.11 ARQ	1 (==11.11)
Proposed	0.92 (=10.22)

III. KEY CONCEPT

A. Motivation

If a sender performs the optimal relay selection whenever there is a transmission request, it might cause nontrivial processing delay if both the number of available transmission rates and the number of neighboring nodes are large. The centralized approach, however, can solve this problem by letting a central unit process

the complex processing burden. This centralized scheme is useful in particular when many of the devices on the network are battery-operated.

On the networks are one or more central nodes or units that have much higher processing power and larger transmission range than those of the rest *normal* wireless communication devices. The central unit (CU) periodically gathers necessary information from wireless devices within its reach so that it can perform the optimal decision-making.

The most important role of the CU is twofold. One is to perform the decision making process and the other is to collect and manage information.CU finds the optimal relay for all wireless nodes, and a threshold called *request acceptance threshold* (RAT).The RAT is a probability with which a node decides to whether accept or denya cooperation request from a sender near by. So far, we assumed that any wireless device that is asked to bea relay is willing to retransmit the packet if it has to. However, we no longer rely on the assumption because some nodes that lack of power may not want to relay a packet in order to minimize the energy consumption[14].

Due to the dynamically changing nature of wireless networks, each wireless node on the network periodically informs the CU of any changes on success or error probability of links.CU gathers the information for a certain period, and updates the optimal relay decision and RAT. Then, the CU distributes the both information to its network.

B. A Credit in Compensation for Cooperation

Another important feature of this network is that any cooperating node gets a *credit* when it *actually* retransmits a packet on behalf of the sender. In other words, just being selected for a relay does not guarantee a credit; when a relay relays the packet that has failed to be delivered to the receiver, the relay can get a credit. The way a credit is used is as follows. Under the standard networking protocol, a wireless node can transmit a packet when it is granted access to the shared channel. That is, if a node wants to transmit n number of packets, n>1,it has to contend with other nodes on the network to exclusively use the channel n times.

The channel contention causes huge overhead when the network is so populated. Since the wireless medium is shared, the increased number of nodes decreases the probability that a node is granted for the channel use, and also causes frequent signal or packet collisions if multiple nodes send the signal at the same time.

If a node can send multiple packets once it is granted access to the shared channel, it yields the increased throughput since the amount of time wasted for the channel contention decreases. However, it can make the network unfair, because every node is highly likely to send as many packets as possible once it gets the shared medium.

To increase the channel efficiency by reducing the channel contention, while guaranteeing the fair, reasonable channel use, only those nodes that cooperate with others are allowed to send multiple packets at a time which requires credits. If a node has k credits, it can send up to k+1 number of packets per channel use. k is upper bounded by the number of credits that a node can have, and the node loses k credits after transmitting k packets.

To simplify the protocol, we assume that a node can use up to one credit per transmission. In other words, even if a node has multiple credits, it can send two packers per transmission.

C. Protocol Detail

This section describes details of the centralized energy-aware selective retransmission scheme.

Information Gathering and Distribution

At the beginning of the network, wireless nodes on the networks do not have any information to make the optimal retransmission. Therefore, they just follow the standard transmission procedures, e.g., IEEE 802.11b.Whenever they communicate with others, each node records the average SNR between each receiver with which it communicated. The average SNR between a sender and a receiver it notified to the CU periodically. The CU gathers the information for a certain period of time, and when sufficient information has been gathered and the timer of the information gathering session expires, it processes and finds the optimal

relay for all sender-receiver pair and the RAT. Then, both are broad casted so that all wireless nodes can receive it.

Optimal Relay Selection

The CU performs the procedures introduced in the previous chapter to find the optimal relay. However, the CU does not consider the energy constraints when finding the optimal relay, because in this framework, a relay decides to whether accept or deny a cooperation request based on its energy status.

Request Acceptance Threshold (RAT) with Fairness

As mentioned earlier, RAT (Request Acceptance Threshold) is a probability with which a relay decides to accept a cooperation request from a sender. What RAT implies is how much reward can a relay (is expected to)get if it accepts a cooperation request.

The reward from getting one credit is the amount of energy saved by making two packet transmissions at a time; i.e., the amount of time for channel contention is decreased by half. Let $\overline{t_{idle}}$ be theaverage time a node spend for channel contention, ande_{idle}^{j} be the amount of energy consumed per unit time by node-*j* during the channel contention period. The reward to node *j* when cooperating with a sender (s_i)-receiver (r_k) pair, referred to as$W_{s_i r_k}^{j}$is the amount of energysaving from earning/using one credit, which is:

$$W_{s_i r_k}^{j} = \overline{t_{idle}} \times e_{idle}^{j} \quad (12)$$

However, the reward should be given to the relay (l_j)if the relay actually relayed thepacket when s_i failed to deliver a packet to r_k;which happens when $l_j$successfully gets a packetfrom the sender (s_i)while the receiver (r_k) does not, which is:$P_e^{s_i \to r_k}(1 - P_e^{s_i \to l_j})$.

Therefore, the expected reward to the $l_j$when cooperating with $s_i r_k$(sender-receiver pair)should be written as below.

$$W_{s_i r_k}^{j} = P_{err}^{s_i \to r_k}(1 - P_{err}^{s_i \to l_j})\overline{t_{idle}}\, e_{idle}^{j} \quad (13)$$

However, whenever a relay cooperates with $s_i r_k$ pair,it has to spend its energy (e.g., battery) to transmit the captured packet to the receiverr_k. The amount of energy consumption of l_j whencooperating with$s_i r_k$pair isthe expected transmission time between l_j tor_k,$\overline{T^{l_j r_k}}$ (refer to Equation 7),multiplied by the energy consumption per unit time, e_{tx}^{j}. In other words, the expected cost that l_j has to pay whencooperating with $s_i r_k$ pair, referred to as $C_{s_i r_k}^{j}$is defined as follow.

$$C_{s_i r_k}^{j} = \overline{T^{l_j r_k}} \cdot e_{tx}^{j} \quad (14)$$

For all $s_i r_k$ pairs within the reach of l_j,the objective function of l_j with regards to cooperation is tomaximize the total rewards while minimizing the total cost for the cooperation over all$x_{s_i r_k^j}, \forall i, k \in N^j$.

$$\max_{x}\left\{\sum_{i,k\in N^j} W_{s_i r_k}^{j} \cdot x_{s_i r_k^j} - \sum_{i,k\in N^j} C_{s_i r_k}^{j} \cdot x_{s_i r_k^j}\right\} \quad (15)$$

subject to,

$$\sum_{i,k\in N^j} x_{s_i r_k} = 1, x_{s_i r_k} \geq 0 \quad (16)$$

where$x_{s_i r_k^j}$ is the decision variable, which describeshow much proportion should be given by l_j to each cooperation request from $s_i r_k$ to maximize the rewards while minimizing the cost.In other words, it is the probability with whichl_j decidesto whether accept or deny the cooperation request from $s_i r_k$.N^j is the set of the indices of the nodes in the vicinity of node-*j*.

Here, we introduce two weight parameters. One isα, which is the traffic load sensitivity weight, andthe other is β, which is the battery sensitivity weight. If αis high, the node tries to cooperatewith the pair that is expected to give more credits, thereby it can increase the number of transmission per channel use. On the other hand, if β is high, the node tries to minimizethe battery consumption.

The α is defined as $q/\bar{q}$, where q is the number of packets in the queue, and $\bar{q}$ is the averagenumber of packets in the queue.The βis defines as b/b_{MAX}, where b is the current battery level and b_{MAX} is the maximum battery level.However, to make both weights have the same scale, we modified the two weights as follow.

$$\alpha = \frac{q}{q_{MAX}/2}, \qquad \beta = \frac{b_{MAX}/2}{b} \tag{17}$$

Where q> 0 and b> 0.

In addition, we normalized two features, the reward (W) and cost (C),to make both have the same amount of effect on the optimal value. The normalized value of y within the range of (a,b),referred to as $\tilde{y}$ is defined as below.

$$\tilde{y} = \alpha + \frac{y - \min(y)}{\max(y) - \min(y)} \times (\mathrm{b} - \mathrm{a}) \tag{18}$$

As a result, the optimization problem becomes as below.

$$\max_x \left\{ \alpha \sum_{i,k \in N^j} \widetilde{W^j_{s_i r_k}} \cdot x_{s_i r_k} - \beta \sum_{i,k \in N^j} \widetilde{C^j_{s_i r_k}} \cdot x_{s_i r_k} \right\} \tag{19}$$

which is equal to

$$\max_x \left\{ \sum_{i,k \in N^j} (\alpha \widetilde{W^j_{s_i r_k}} - \beta \widetilde{C^j_{s_i r_k}}) x_{s_i r_k} \right\} \tag{20}$$

subject to,

$$\sum_{i,k \in N^j} x_{s_i r_k} = 1, x_{s_i r_k} \geq 0 \tag{21}$$

When a node-j receives a cooperation request from a sender-i and a receiver-k pair, $s_i r_k$, it decides to whether accept ordeny the request based on the probability $x_{s_i r_k}$.

In addition, the CU tries to maximize the fairness with respect to cooperation .

The CU encourages each relay node to fairly cooperate with its neighboring nodes.

We adopted a simple fairness measure which calculates the distance between all pairs of decision variables, $|x_i - x_j|$.

To maximize the fairness, the CU finds the difference in x value between every pair of decision variables, and then tries to minimize the summation of them. The simplified objective function for achieving the fairness can be described as minimizing the 1-norm distance between all decision variables.

$$\min_{i,j} \sum_{i,j} |x_i - x_j|, \quad i \neq j \tag{22}$$

Putting it all together, we have the following multi-objective optimization problem.

$$\min_x \sum_{i,k \in N^j} \left| \frac{x_{s_i r_k}}{(\alpha \widetilde{W^j_{s_i r_k}} - \beta \widetilde{C^j_{s_i r_k}})} - \frac{x_{s_{i'} r_{k'}}}{(\alpha \widetilde{W^j_{s_{i'} r_{k'}}} - \beta \widetilde{C^j_{s_{i'} r_{k'}}})} \right| \tag{23}$$

$$, for\ all\ pairs\ (i,k) \in N^j, where\ (i,k) \neq (i',k'), and\ i \neq k$$

subject to,

$$\sum_{i,k \in N^j} x_{s_i r_k} = 1, x_{s_i r_k} \geq 0. \tag{24}$$

In Equation 23, the coefficient of each x is the inverse proportional of that in in Equation 20. It makes a decision variable with a higher coefficient have a higher value while preventing the rest decision variables with lower coefficients from being zero. Since Equation 23 is not an LP form, it needs to be transformed so that we can get a single objective LP problem as below

$$\max_{x}\left\{\left[\sum_{i,k\in N^j}(\widetilde{\alpha W^j_{s_i r_k}}-\widetilde{\beta C^j_{s_i r_k}})x_{s_i r_k}\right]-\left[\sum_{\forall i,k\in N^j} y(i,k),(i',k')\right]\right\} \quad (25)$$
$$, for\ all\ (i,k), where\ (i,k)\neq(i',k'), and\ i\neq k$$

subject to,

$$\sum_{i,k\in N^j} x_{s_i r_k}=1, x_{s_i r_k}\geq 0,$$
$$-y(i,k),(i',k')\leq \frac{x_{s_i r_k}}{(\widetilde{\alpha W^j_{s_i r_k}}-\widetilde{\beta C^j_{s_i r_k}})}-\frac{x_{s_{i'} r_{k'}}}{(\widetilde{\alpha W^j_{s_{i'} r_{k'}}}-\widetilde{\beta C^j_{s_{i'} r_{k'}}})}\leq y(i,k),i',k') \quad (25)$$
$$, for\ all\ y(i,k),(i',k')\geq 0$$

D. Evaluation

We performed a numeric evaluation of the Centralized Energy-Aware Selective Cooperative Retransmission scheme. Table 3 and 4 shows the fixed and randomized parameter configuration for the numeric evaluation, respectively. We performed the evaluation for multiple iterations with assigning randomized values to those variables. Both Table 3and 4 shows one instance of the fixed and randomized parameters. There are three sender-receiver pairs on the network, i.e., s_1r_1, s_2r_2, s_3r_3, and there is only one relay node-l_1, which can hear all of the transmission between the three sender-receiver pairs.

Both Table 5 and 6 show the result of the evaluation. Table 5 shows the optimal *x*'s when there is no weights. On the other hands, Table 6 shows the optimal results when the scheme is used with the queue and battery weights. As it can be seen from the table, even under the same configuration (e.g., error probability and transmission rate), the difference in the current queue length and battery level change the optimal values.

To be specific, both the first and third rows have almost the same queue length. On the other hand, both the second and the third rows have similar battery level. In both cases, the other weight has an effect on the optimal values as can be seen in Table 6.

Table 3: Fixed Parameters for the Numeric Evaluation

e_{tx}^{l1}	3	Energy spend for transmission per unit time
e_{idle}	1	Energy spend for idle contention per unit time
t_{idle}	50	Average amount of time for idle contention
tx ratex	{1,2,5,10}	Available transmission rates
m	1000	Average number of bits in a packet
q_{max}	50	Max. queue length
b_{max}	100	Max. battery level

Table 4: Randomized Parameters for the Numeric Evaluation

$P_{err}^{s1\to r1}$	0.1195	Transmission error probability, s_1→r_1
$P_{err}^{s1\to l1}$	0.0214	Transmission error probability, s_1→ l_1
$P_{err}^{l1\to r1}$	0.0922	Transmission error probability, l_1→r_1
$P_{err}^{s2\to r2}$	0.2930	Transmission error probability, s_2→r_2
$P_{err}^{s2\to l1}$	0.0351	Transmission error probability, s_2→ l_1
$P_{err}^{l1\to r2}$	0.0592	Transmission error probability, l_1→ r_2
$P_{err}^{s3\to r3}$	0.1971	Transmission error probability, s_3→r_3
$P_{err}^{s3\to l1}$	0.0242	Transmission error probability, s_3→ l_1
$P_{err}^{l1\to r3}$	0.0974	Transmission error probability, l_1→r_3
$r^{l1\to r1}$	10	Transmission rate, l_1→ r_1
$r^{l1\to r2}$	10	Transmission rate, l_1→ r_2
$r^{l1\to r3}$	10	Transmission rate, l_1→ r_3
q^{l1}	41	Current queue length of node l_1
b^{l1}	15	Current battery level of node l_1

Table 5: Evaluation Result Without Weights

	$x_{s_1r_1}^{l_1*}$	$x_{s_2r_2}^{l_1*}$	$x_{s_3r_3}^{l_1*}$
Optimal value	0.0539	0.7708	0.1752

Table 6: Evaluation Result with Respect to Weights

Queue length	Battery level	$x_{s_1r_1}^{l_1*}$	$x_{s_2r_2}^{l_1*}$	$x_{s_3r_3}^{l_1*}$
41	15	0.2462	0.4924	0.2614
22	92	0.1418	0.6050	0.2532
40	96	0.1871	0.5196	0.2933

IV. CONCLUSION

In the present paper, we have studied a way to guarantee a stable transmission while decreasing the expected time for a successful packet delivery. We first propose an optimal transmission selection scheme that minimizes the expected transmission time. Next, we have taken advantage of the overhearing nature of the shared wireless medium and proposed a cooperative re transmission scheme that allows any neighboring nodes to relay the failed packet if it is expected to decrease the expected transmission time .Finally, we have taken the energy constraints into out consideration and proposed an energy-aware cooperative re transmission scheme. The evaluation performed on the MATLAB shows that the proposed scheme is able to reduce the expected transmission time as well as the number of retransmissions.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Dose Reduction by Body Mass Index: Different Protocol in Low-dose Chest Computed Tomography

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Abstract---

Background/Objectives: We investigated the effects of exposure involving reduction of automatic exposure control value based on body mass index and image quality using the AAPM phantom in low-dose computed tomography (CT).

Methods/Statistical Analysis: The study was carried out on subclinical, normal persons without lung diseases among students in a single university. The examination was the same as the phantom experiment. Scan protocol conditions in the phantom study were always tube voltage 120 kVp, 30 mA tube current, 0.5 sec rotation time,360 mm field of view, and dose modulation (Fixed, D-DOM, Z-DOM, D-DOM+automatic current selection (ACS), Z-DOM+ACS). Comparison and analysis was based on D-DOM

Findings: Using the same protocol condition used for the examination targets, changes of exposure dose, in case of CTDIvol on dose modulation depending on BMI were observed. In the low weight group, the fixed (CTDIvol) was 1.94 mGy, and D-DOM (CTDIvol) was 1.60 mGy. The exposure doses of the normal weight group were 1.94 mGy for Fixed (CTDIvol) and 1.56 mGy for D-DOM(CTDIvol), representing a difference of 0.38 mGy. For the obese group, the fixed (CTDIvol) value was same as the values of low weight and normal weight, and D-DOM (CTDIvol) was 1.55 mGy, representing a difference of 0.39 mGy.

CTDIvol did not change with the difference exposure doses based on BMI. However, in case of DLP, in low weight group, fixed (DLP) was 82.07 mGy·cm and D-DOM (DLP) was 68.40 mGy·cm, representing a difference of exposure dose of 13.67 mGy·cm. As the normal weight subjects received a higher exposure dose than low weight subjects, the fixed (DLP) was 84.92 mGy·cm and the D-DOM (DLP) remained 68.4 mGy·cm

Improvements/Applications: Improvement of exposure dose and the image quality of obese patients could result using a protocol that offers more appropriate image quality and minimum dose

Keywords--- BMI, Chest CT Dose Reduction.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Public interest in personal health has increased the awareness of, and concern with, radiation exposure during medical and diagnostic examinations. Sustaining the image quality with reduced exposure dose is an area of interest[1-11].

As the frequency of medical examination increases, more studies are focusing on computed tomography (CT) examination. While CT is used relatively less frequently, it has a high exposure dose. The frequency of CT examinations were predicted to increase by 13% in the next year based on 2002 data from the Korea Health Insurance Review & Assessment Service, with claim frequency increasing by 18% in 2005[12,13].

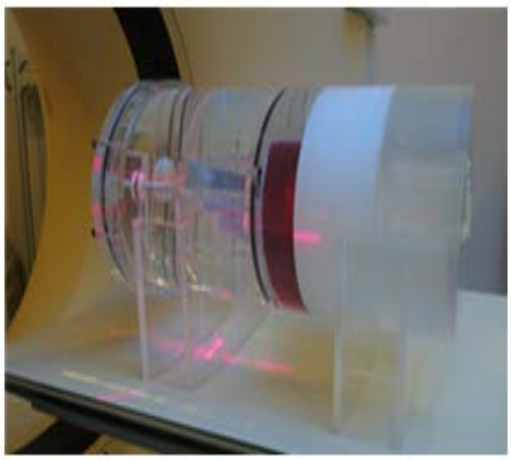
The use of low-dose CT has been increasing based on the associated reduction in lung cancer-related mortality[14]. There are several ways to reduce the radiation exposure dose in low-dose CT delivered from diagnostic medical equipment. Representative methods are is the Adaptive Statistical Iterative Reconstruction Algorithm (ASIR) and Body Mass Index (BMI). BMI is applied in accordance with body shape of patient to reduce unnecessary exposure dose. BMI-mediated CT dose reduction has been studied for the heart and abdomen[15, 16].

Maintaining image quality and reducing exposure dose are necessary for accurate diagnosis. But, there is still no standardized and accurate clinical standard dose protocol and the optimal standard for low dose CT[17]. The present study explored the effects of the reduction of previously established automatic exposure control (AEC) dose using BMI protocol, and image quality using an American Association of Physicists in Medicine (AAPM)phantom in low-dose CT.

II. MATERIAL AND METHODS

The AAPM phantom used to examine image quality at the Korean Institute for Accreditation of Medical Imaging had a diameter of 32cm. When two phantoms are connected, an elliptical shape results that is similar in shape to the human body. A Brilliance TMCT **6**4slice apparatus (PHILIPS, The Netherlands) was used (figure 1a).

To find the optimal exposure dose based on BMI, a Quality Assurance Water Phantom (GE Healthcare, USA) was positioned in the gantry. Image quality and exposure dose depending on variations by using dose report supplied from the manufacturer were determined in five chest measurements with changes in dose modulation (Fixed, D-DOM, Z-DOM, automatic current selection (ACS), D-DOM+ACS, Z-DOM+ACS) at low-dose protocol parameters of 120kVp and 30mAs; Fixed mAs. The results were compared (figure 1b).



Exam Information
Study ID: 37145
Time: Aug 27, 2013, 17:11:52
Total DLP: 160.3 mGy*cm
Estimated Dose Savings: 11%

Dose

#	Description	Scan Mode	mAs	kV	CTDIvol [mGy]	DLP [mGy*cm]	Phantom Type[cm]
1		Surview	1	120	0.08	2.3	BODY 32 CM
2	Low Dose	Helical	30	120	1.94	26.2	BODY 32 CM
5	Low Dose	Helical	23	120	1.47	20.1	BODY 32 CM
7	Low Dose	Helical	26	120	1.70	23.2	BODY 32 CM
10	Low Dose	Helical	28	120	1.82	24.9	BODY 32 CM
12	Low Dose	Helical	35	120	2.22	30.4	BODY 32 CM
14	Low Dose	Helical	38	120	2.46	33.2	BODY 32 CM

(a) (b)

Figure 1: AAPM Head Phantom (a) and Dose Report of CT (b)

The study was carried out from July 20, 2015 to August 20, 2015 at K University Medical Center, Seoul, South Korea. The volunteer subjects were students in the Radiology Department of Chungnam H University. They were sub clinically normal without lung diseases.

Their examinations were done identically as the phantom experiment. The subjects agreed to participate after it was explained to them that the exposure dose will be reduced depending on body shape.

The average age of the 12 people (six males, six females) was 22.4 years(range, 23-26 years). Their average BMI was 24.2±4.1 kg/m^2 (range, 16.4-33.4 kg/m^2). Low weight (A), normal weight (B), and obese (C) groups (n=4 per group) were defined as BMI <18.5 kg/m^2, 18.5-24.9 kg/m^2, and 25.0-29.9 kg/m^2), respectively. After examination, the image quality and the dose was compared and evaluated(Table 1)

Table 1: Characteristics of the Subjects

NO.	Height (cm)	Weight (kg)	Age	Sex	BMI	Division
1	156	43	23	F	17.6	A
2	165	46	22	F	16.9	A
3	158	45	20	F	18.0	A
4	154	42	24	F	17.7	A
5	163	52	21	F	19.5	B
6	177	71	23	M	22.6	B
7	179	66	21	M	20.6	B
8	173	65	23	M	21.7	B
9	172	76	26	M	25.6	C
10	162	80	21	F	30.4	C
11	175	82	23	M	26.7	C
12	170	78	22	M	26.9	C

The scan protocol in each phantom study was 120 kVp tube voltage, 30 mA tube current, rotation Time 0.5 sec, field of view 360 mm, and dose modulation (Fixed, D-DOM, Z-DOM, D-DOM+ACS, Z-DOM+ACS), and was compared and analyzed based on D-DOM, which gave the lowest dosage value.

In the second clinical study, each subject was positioned supine on the CT table with the arms as relaxed as possible. Mediastinal image sat the level of carina bifurcation in non-contrast images were not using obtained with the low-dose chest CT protocol used in clinical experiments; instead, the dose modulation protocol was used. The evaluation of exposure dose was analyzed by recording the volume CT dose index ($CTDI_{vol}$) and dose length product (DLP)calculated through automatic computation with the fixed group, in whom dose modulation was not applied, and the D-DOM group, in whom dose modulation was applied. Noise was calculated by designating the region of interest of the obtained image.

III. RESULTS

Fixed $CTDI_{vol}$and DLP values were1.94 mGy and26. 2 mGy·cm, respectively. For D-DOM, the respective values were 1.47 mGy and20.1 mGy·cm. For D-DOM+ACS, the respective values were 1.70 mGy and23.2 mGy·cm, the $CTDI_{vol}$ value of Z-DOM was 1.82 mGy, and the DLP value was 24.9 mGy·cm. For Z-DOM+ACS, the$CTDI_{vol}$ value was 2.22 mGy and the DLP value was 30.4 mGy·cm. For ACS, the respective values were 2.46 mGy and33.2 mGy·cm.

Using the same protocol condition used for the examination targets, changes of exposure dose, in case of $CTDI_{vol}$ on dose modulation depending on BMI were observed. In the low weight group, the fixed ($CTDI_{vol}$) was 1.94 mGy, and D-DOM ($CTDI_{vol}$) was1.60 mGy, representing a difference of 0.34 mGy. The exposure doses of the normal weight group were 1.94 mGy for Fixed ($CTDI_{vol}$) and 1.56 mGy for D-DOM($CTDI_{vol}$), representing a difference of 0.38 mGy. For the obese group, the fixed ($CTDI_{vol}$) value was same as the values of low weight and normal weight, and D-DOM ($CTDI_{vol}$) was 1.55 mGy, representing a difference of 0.39 mGy.

$CTDI_{vol}$did not change with the difference exposure doses based on BMI. However, in case of DLP, in low weight group, fixed (DLP) was 82.07 mGy·cm and D-DOM (DLP) was 68.40 mGy·cm, representing a difference of exposure dose of 13.67 mGy·cm. As the normal weight subjects received a higher exposure dose than low weight subjects, the fixed (DLP) was 84.92 mGy·cm and the D-DOM (DLP) remained 68.4 mGy·cm. The difference between the two exposure doses was 16.52 mGy·cm, which differed by 2.85 mGy·cm from low weight

subjects. In the obese group, fixed (DLP) was 79.85 mGy·cm and D-DOM (DLP) was 64.6 mGy·cm, representing a difference of 15.25 mGy·cm; the obese subjects received less exposure dose than normal weight subjects (Table2).

Table 2: CTDIvol and DLP Results According to BMI

Group		Dose	
		$CTDI_{vol}$(mGy)	DLP(mGy· cm)
A	Fixed	1.94	82.07
	D-DOM	1.60	68.40
B	Fixed	1.94	84.92
	D-DOM	1.56	68.40
C	Fixed	1.55	79.85
	D-DOM	1.55	68.40

By designating three targets as the region of interest (trachea, aorta, and lung), the difference of noise value was found to be highest in obese subjects. Noises in low-weight subjects for fixed and D-DOM were similar(figure 2).

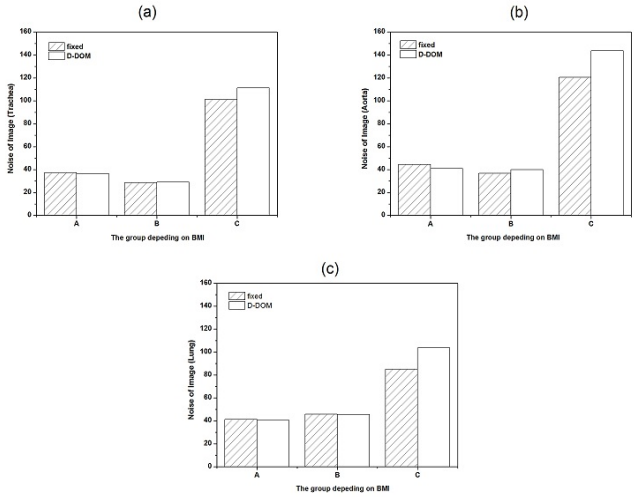


Figure 2: Comparison of Noise Value in ROI of Image, Trachea(a), Aorta(b), Lung(c) According to BMI

IV. DISCUSSION AND CONCLUSIONS

Radiation dose exposure in CT can be damaging to patients and radiological technologists.[18, 19] Because of this, low-dose CT is becoming more widely being used. In a study using standard CT, 120kVp and 250mA yielded an average DLP value of ATOM dosimetry phantom of 182.80 mGy· cm[16]. Presently, conditions of 120kVp and 30mA produced an average DLP and D-DOM value of the AAPM phantom of 26.2mGy· cm and20.1 mGy· cm, respectively In case of low weight group, Fixed (CTDIvol) was 1.94 mGy, and D-DOM (CTDIvol) was1.60 mGy; therefore, the difference between two values came out to be 0.34 mGy. Exposure dose of normal weight group were 1.94 mGy Fixed (CTDIvol) and 1.56 mGy D-DOM(CTDIvol), and the difference between two values was 0.38 mGy, and in case of obese group, Fixed (CTDIvol) value was same as the values of low weight and normal weight, and D-DOM (CTDIvol) was 1.55 mGy, and the difference between two values came out to be 0.39 mGy. In case of CTDIvol, it could be known that there was no change of exposure dose depending on BMI. However, in case of DLP, in low weight group, Fixed (DLP) was 82.07 mGy·cm, and D-DOM (DLP) was 68.40 mGy·cm; therefore, the difference of exposure dose came out to be 13.67 mGy·cm. As normal weight received higher exposure dose than low weight, Fixed (DLP) came out to be 84.92 mGy·cm, but D-DOM (DLP) came out to be 68.4 mGy·cm, which was the same value. The difference between two exposure doses was 16.52 mGy·cm, which had difference of 2.85 mGy·cm from low weight, and, in obese group, Fixed (DLP) was 79.85 mGy·cm and D-DOM (DLP) was 64.6 mGy·cm. The difference was 15.25 mGy·cm, which means that obese subjects received less exposure dose than normal weight subjects The exposure dose measured 82.07 mGy, 84.92 mGy, and 79.85 mGy in low weight, normal weight, and obese subjects, respectively. The fixed and D-DOM DLP values using low-dose CT showed a minimum difference of

102.95 mGy· cm. Such a reduced dose might be anticipated to decrease the incidence of new cancer relative to standard CT.

Along with dosage, image quality is important as well. If the image quality decreases as the value of tube current, low-dose CT might not be used. However, the images of low weight and normal weight groups using low-dose CT had similarly low noise. Noise was appreciable for obese subjects, similar to a prior study[20]. Image quality using low-dose CT was similar and suitable for the low weight and normal weight subjects group, but differed for obese subjects, also similar to prior evidence[15].

Improved exposure dose and image quality for obese patients may be best realized by developing a protocol that offers more appropriate image quality using a minimum dose, rather than adjusting fixed kVp and mAs, which is commonly used in hospitals.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

An Efficient Image Compression Scheme based on Quincunx Mexican-Hat-Like Wavelet Transform with Modified Support Vector Clustering for SD-OCT Image

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Abstract---

Background: In worldwide, the Glaucoma is the second-leading cause of blindness and it affects the optic nerve and this leads to loss of vision. Today's Optical Coherence Tomography (OCT) images has been used for diagnosing the glaucoma. So, the image quality and size of the image is very important for diagnosis and maintain the record. Spectral-domain optical coherence tomography (SD-OCT) provides high-resolution imaging, which allows more detailed retinal and choroidal evaluation. Though, improvement in the resolution of the images can be increased the size of the image. This will increase the time delay to transfer or download the data in electronic medical record system based patient care and also increased the difficulty when conducting studies by using web-based data collection.

Aim / Objective: to solve the above problems and to improve the image quality and reduced the image size for storage, an efficient image compression scheme has been presented by using transform and clustering schemes.

Methodology: Vedic mathematics in the form of Quincunx mexican-hat-like Wavelet Transform (QWT) with modified Support Vector Clustering (mSVC) proposed for enhancing the capabilities of the existing processor to produce improved compression experience.

Results: The obtained experimental results show that the proposed QWT-mSVC attained good performance in terms of average compression ratio of 1.311, average structural similarity of 0.915, average PSNR of 29.81, average Correlation of 0.979, average MSE of 12.04 and average Execution Time of 0.050s for all images compared to existing Biorthogonal Wavelet Transform with Windowed All Phase Digital Filter (BWT-WAPDF), DTCWT and then DWT.

Keywords--- Glaucoma, Spectral-domain Optical Coherence Tomography, Quincunx Mexican-Hat-Like Wavelet Transform, Modified Support Vector Machine Clustering.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Nowadays, the development of computer technology has been increased and it used in many real time applications. In this computer and network system, the size of hard disk has been increased, similarly the growth of medical image also increased. Medical image with computerized visualization used for many disaease diagnosis processes, thus it needs a good image quality and visual quality. In these medical technologies, each and every day a large amount of data's are needed. So, in this paper, the image compression scheme [1] introduced to reduce storage space and fastly transfer the image in patient care via web. In medical imaging field, glaucoma is considered as a main eye disease and it affects the optic nerve and this leads permanent vision loss [2]. It is also called as sneak criminal of sight. In eyes, Retinal Nerve Fiber Layer (RNFL) defects precede the growth of visual field defects with glaucoma [3]. Therefore, early recognition of RNFL abnormalities is crucial for early diagnosis of glaucoma. Yet, detecting RNFL defects [4] the RNFL photography has been used, but, its only visible RNFL defects areas of decreased optical reflectance compared with RNFL thicker areas. Sometimes, it is difficult to identify RNFL defects in color fundus images, particularly in eyes with diffuse RNFL thinning. To discover the glaucoma various image handling procedures has been used like picture enlistment, picture division, picture combination, picture upgrade, highlight extraction, morphology, picture arrangement and factual estimations.

To overcome the RNFL image measure, Optical Coherence Tomography (OCT) has been introduced, and it is defined as a noninvasive imaging scheme used to attain high-resolution cross-sectional images of the retina. In addition, many studies have been introduced for glaucoma detection based on OCT images attained with time-domain equipment and it represented as TD-OCT images. It demonstrates that, the thickness of the circumpapillary RNFL in an area 3.46mm in diameter perfectly distinguishes eyes with glaucoma from normal eyes than thickness of the macula identification [5]. Though, it is not easy to distinguish the shape of an RNFL defect on TD-OCT images, since image quality is limited through the acquisition of only six radial scans.

To overcome this difficulty, a new technology has been based OCT attained with of Spectral-Domain (SD) and it's known as SD-OCT images. These images are obtained faster 43 to 100 times faster compared with TD-OCT images and it used for 3D imaging of macular structures [6], which give visualization of RNFL abnormalities. It also provides higher axial resolution compared than TD-OCT and OCT. these axial resolution are improve the RNFL in the macula thinner detection [7]. But, it's not fully explored the macula RNFL detection. Therefore, the SD-OCT color images and red free images are studied and compared for detection of macula RNFL abnormalities in eyes with glaucoma [8]. SD-OCT images are provided the high resolution images and very useful for evolution of specified retinal and choroidal. However, the improvement of image resolution has been increased the size of the image and it takes more storage space. It is very difficult for patient care due to the time delay in exporting image and high memory in storing image.

To solve this problem, the proposed system focused efficient image compression scheme using wavelet transform. In this paper, QWT with mSVC based image compression is proposed for glaucoma detection image of SD-OCT. Here, initially, the wavelet coefficients are clustered based on their absolute values to reduce the size and high compression rate achieved through applying various compression thresholds for those wavelet coefficients of each QWT band. The simulation results show that the proposed QWT-mSVC attained better performance in terms of performance measures compared than existing compression algorithms.

II. LITERATURE SURVEY

In this section, the existing medical image compression schemes have been discussed. Nassiri et al., [9] presented a Discrete Wavelet Transforms (DWT) based compression for diagnostically important regions in medical image for minimizing total degradation and achieving better performance. But, it was computationally intensive. Tiwari et al., [10] presented three different image compression schemes like DWT, Discrete Cosine Transform (DCT) and Compressive Sensing schemes for CT, MRI and Ultrasound image. The simulation results show that compressive sensing with DWT has good PSNR, compression ratio and less MSE compared than other compression algorithms.

Gupta et al., [11] proposed Integer Wavelet Transform (IWT) based lossless compression for medical images. It also used predictive coding and minimum entropy schemes. The simulation results show that it provides high compression ratio with minimum entropy for large datasets. But, it has computational complexity. Kunchigi et al., [12] studied Vedic mathematics and applied for 2D-DCT compression for medical

image. It needs quantization process for providing output results, so the processing time was high. Hashemi-Berenjabad et al., [13] reviewed medical image types and their compression schemes. This survey gives the feature idea to develop new compression scheme to improve the PSNR and reduce the processing time and used to new applications. Fang et al., [14] proposed a 3D adaptive sparse representation based compression (3D-ASRC) compression scheme for tomographic images. The performance was evaluated in clinical-grade retinal OCT images and the results show that it has good performance compared than other compression schemes. But, the processing time was high. Amit et al., [15] reviewed various compression schemes. It's mainly focused the medical image compression schemes. It was very useful for beginners to choose their research ideas.

Songlin Du et al., [16] proposed a Grover's Quantum search algorithm (QSA) to decrease the fundamental computational difficulty of Fractal image compression (FIC) and this approach called as interdisciplinary approach. The experimental results show that the proposed method execution time was 100 times shorter than that of the baseline FIC Without sacrificing compression ratio. But it was not suitable for large datasets. Gaurav Vijayvargiya et al [17] proposed a diminution of non-structured packet in Integer Wavelet Transform (IWT) function. Particle Swarm Optimization (PSO) algorithm used to perform the gathering of repetitive exterior structure. The seeking of overload bundle structure takes additional time, so the computation time was increased.

III. PROPOSED METHODOLOGY

In this section, the proposed QWT-mSVC based step by step process has been discussed.

System Overview

In this work, a novel image compression scheme has been presented by using QWT and the modified SVC technique. In QWT, the images are divided into textual significance regions to extract textually important characteristics and employing textural descriptors as criteria. Then, these are including co-occurrence matrices based measures. While glaucoma SD-OCT image compression methodologies utilizing the QWT and applying it to the whole original image, and then applied threshold scheme to involve a more sophisticated scheme. Specifically, different compression ratios are transfer to the wavelet coefficients based on the different Regions Of Interest (ROI), in which either each and every wavelet domain band of the image is clustered itself. The architecture diagram of proposed scheme is shown in Fig.1.

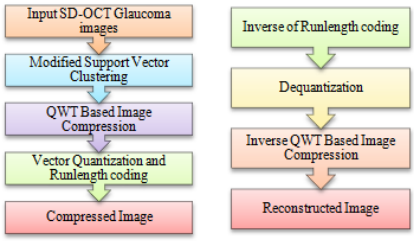

Fig. 1: Step by Step Process of Proposed Compression and Decompression Process

The step by step process of proposed QWT-mSVC has been illustrated given below

Step 1: initially, the input image is selected from image database.

Step 2: after that, the image are separated into textual regions. These regions are clustered by two classes like significant region and non-significant region by using mSVC approach. First, the SD-OCT images are scanned with M x M dimensions of sliding windows. Here, 256 x 256 size of images are considered and the dimension is M=8, and it is denoted as size of sliding window.

Step 3: then, texture identification analysis is performed by using co-occurrence matrices [23]. The entry of matrices is represented as (m, n) and it denotes the probability is going from one pixel with grey level (m) to another pixel with grey level (n) based on the predefined angle and distance. For specific spatial distance and angles, new matrices are formed. After that, set of statistical measures (i.e feature vectors) are calculated for forming various texture models. Here, 4 angles have been considered such as 0, 45, 90, 135 and distance of one pixel is predefined. So, four cooccurrence matrices are formed in this method. In this quantization, 16 and 64 grey level has been considered. In [31], Haralick presented 14 statistical measures, here only 4 of them has been considered to evaluate the cooccurrence matrices and the measures such as correlation, angular second moment, entropy and difference moment.

$$\text{Correlation } Cf_1 = \frac{\sum_{m=1,n=1}^{N_g}(m*n)p(m,n)-\mu_m\mu_n}{\sigma_m\sigma_n} \quad (1)$$

Where Cf_1 is represented as correlation feature, N_g is denoted as energy, $p(m,n)$is defined probability (m,n) $\mu_m\mu_n$is defined as mean value of m,n and $\sigma_m\sigma_n$ represented variance of m,n

Energy-Angular second moment $EAf_2 = \sum_{m,n} p(m,n)^2$ (2)

Entropy $Ef_3 = -\sum_{m,n} p(m,n)\log(p(m,n))$ (3)

Inverse difference moment $If_4 = \sum_{m,n} \frac{1}{1+(m-n)} p(m,n)$ (4)

Step 4: Check if cooccurrence matrices derived features are used when a pattern has been marked as texturally significant, after that, the upper-left point of the equivalent sliding window takes on the label of 255, else the label of zero has been taken. Based on this condition, new black-white image (i.e IMP) results show the significant region and non-significant region for each original gray level image.

Step 5: then, QWT compression has been introduced. In this compression, first the original image is decomposed into two images like $OI_1$and OI_2. The OI_1 is computed via using given below formula to each pixel (m_0, n_0) of the original image OI_0 is

$$OI_1(m_0,n_0) = Min\,(OI_0(m_0,n_0), IMPOI_0(m_0,n_0))$$

Where $IMPOI_0$ is defined as the textually significant image region of black-white image representing of OI_0. Simultaneously, the second image OI_2 is represented as

$$OI_2(m_0,n_0) = Min\,(OI_0(m_0,n_0), 255 - IMPOI_0(m_0,n_0))$$

Step 6: consequently, the QWT is applied to two images of $OI_1$and OI_2 successively. The wavelet representation is $QWT - OI_1$ and $QWT - OI_2$ and their compression ratio is determined by using quantization procedure.

Step 7: the quantization preferred bit discrete stage for performance compared to common style of applying quantization [24].

Step 8: after quantization, the results are transferred to run length coding [25]. It is mainly used for reduced the redundancy problem in large data compression.

Step 9: finally, the compressed image is reconstructed by using given below formula from $QWT - OI_1$ and $QWT - OI_2$

$$OI_o = a * INV(QWT - OI_1) + b * INV(QWT - OI_2)$$

Where a,b is defined as the user defined coefifceint and here both values are maintained as 1. It is efficiently decompress the image. The important and non-important textual region clustering has been discussed in given below subsection.

A. Modified Support Vector Clustering

SVC is a density based c1ustering scheme, which handles the arbitrary shape clusters effectively [26]. The pseudo code of mSVC is given below

Algorithm: mSVC approach

Input: cooccurrence matrix, Convergence Criteria (CC), Fuzzification Value (FV), Kernel width (K_w), penalty tern (p_t), maximum number of iteration maxstep;

output: Cluster for significant and non significant region

1. the radius of the sphere is found in the kernel space
2. the regions are assigned to the clusters by calculating the adjacency matrix
3. the cluster centers are computed
4. the cluster centers are used as initial cluster centers in FCM clustering and perform the clustering to assign the Support Vectors to clusters.
   number of iteration t=0 initialized
   Repeat
   the membership value is computed
   the cluster centers are updates
   t=t+l until $\{v^{(t)} - V^{(t-1)}\} < 10$ (or) t> maxstep;
5. cluster representative results stored into knowledge base.

After clustering the wavelet based compression has been focused and it discussed in given below subsection.

B. Quincunx Mexican-Hat-Like Wavelet Transform

In discrete dyadic wavelet transform (DyWT) analysis, three families of wavelet are required and it considered as a drawaback. This problem has been solved by two successive scales but the cost and loss of filter caused the computation complexity. So to solve these problems, quincunx has been introduced in [27]. In this system, follow this idea the wavelet compression has been done. In this decomposition, onlu fewer subbands only there compared than other decompositions, and that features are may produce lower visual quality of reconstructed image. But, this problem also overcomes in [28]. The simulations show that the quincunx decomposition performs efficiently in many practical applications. So, it is considered for this SD-OCT image compression. Step by step process of compression is given below

1. First, original image is considered as $OI = \{OI[l], l \in \Pi\}$ and it's denoted an image on a 2-D orthogonal sampling grid. Where $\Pi = \{(r,c)^T \in Z^2 \,|0 \le r \le R-1, 0 \le c \le C-1\}$
2. Before applying QWT, the image is divided into two fields like $OI_e = \{I[l_e], l_e \in \Pi_e\}$ and $OI_o = \{OI[l_o], l_o \in \Pi_o\}$ with quincunx subsampling fields like $Qu_e = \{(r,c)^T \in \Pi | r + c\ even\}$ and $Qu_o = \{(r,c)^T \in \Pi | r + c\ odd\}$, and this is showed in fig 3(a) and 3(b).
3. After that, the low-pass subband sample on Qu_e by $LP = \{LP[l_e], l_e \in Qu_e\}$ and high-pass subband onQu_o by $HP = HP[l_o], l_o \in Qu_o$, wavelet analysis on OI using lifting with quincunx subsampling can give as

$$HP[l_o] = OI[l_o] - P_{l_o}(I_e), \forall\, l_o \in \Pi_o$$
$$LP[l_e] = OI[l_e] + U_{l_e}(HP), \forall\, l_e \in \Pi_e$$

where $P_{l_o}(\cdot)$ and $U_{l_e}(\cdot)$ are defined as functions of the sample values in the input field with a scalar output. Each of LP and HP contains of half samples as in the original image OI. From one level of the conventional separable QWT, structure similar has been obtained that is four subbands of each having quarter of samples as in OI. The proposed scheme further applies other wavelet transform on LP to produce Low-Low (LL) and Low-High (LH) and on HP to produce High-Low (HL) and High-High (HH). In this system, the best direction is selected for each block in LP and HP and is divided into $\frac{K}{2}$ blocks and defined orthogonal grids like $\Pi_{Le}, \Pi_{LPo}, \Pi_{HPe}$, and Π_{HPo}, so they can easily rearranged into the original grid Π. in order to keep the transform close to orthonormal, the sample values in LL and HH are normalized by a factor of 2 and 1/2. This process can be applied to produce a wavelet pyramid. These coefficients are transferred to the redundancy and then the results are transferred to Vector Quantization (VQ) to reduce the computational complexity. Then, the results are encoded by using run length encoding.

Vector Quantization : The main aid of this Quantizer is reducing the number of bits required to store the transformed coefficients through decreasing the precision of those values. It is mainly used for image compression, because it has theoretical benefit over the scalar quantization schemes. Generally, during the encoding phase, the codebook design and the vector lookup is computationally complex. So, the codebook has been generated before encoding process as well as the efficiency of lookup table is more significant. In this work, the encoding values are collected from a multidimensional vector space into a finite set of values, which is collected from a discrete subspace of lower dimension. In addition, the lower space vector needed less storage space, therefore the image compression has been easily compressed.

Run Length Encoding (RLE): When the probability of frequency of the corresponding symbol is higher entropy coding substitutes a series of codes for a sequence of symbols, where the codes are chosen to have fewer bits. In this process, the redundancy has been reduced in the form of repeated bit patterns in the output of the Vector Quantizer (VQ). The RLE scheme only encodes the successive number of same color pixels the probability of occurrence of consecutive same color is very high. It provides competent compression of data, while the data with large number of runs or large number pixel contains same intensity value. Finally, the compressed image is reconstructed. It is efficiently decompress the image. The important and non-important textual region clustering has been discussed in given below subsection.

IV. RESULTS AND DISCUSSION

In this section, the performance of proposed QWT- mSVC image compression is evaluated and the performance results are compared with existing BWT-WAPDF, DTCWT and DWT image compression schemes. The performance is measures based on the Peak Signal to Noise Ratio (PSNR), Compression Ratio (CR), and Correlation, structural similarity (SSIM), Execution Time and Mean Square Error (MSE). The real time SD-OCT image dataset has been used for evaluated the performance of proposed scheme. It contains 256x256 sizes of RGB images in JPEG format. Initially, these images are converted to grey scale images. It has 55 abnormal and 45 normal patient images. The test image is taken as Input image. It has very high frequency components, so the DWT, 2D-DTCWT, QWT with mSVC is used to compress the Image. When compared to the DWT, 2D-DTCWT, BWT-WAPDF, QWT-mSVC produces better compression ratio which is shown in fig-4. This shows that the QWT with mSVC has shown good efficiency for image compression. The main reason us that, the proposed work has clustering process which reduces the storage space even more than the existing works. The numerical evaluation for proposed QWT-mSVC and existing BWT-WAPDF, 2D-DTCWT, DWT are shown in table 1-2. The given below table shows the proposed system has attained better performance in terms of CR, PSNR, MSE, SSIM, correlation and execution time. Because, the compression rate of proposed scheme is high.

Table 1: All Measures Numerical Performance Evaluation Results using DWT and 2D-DTCWT for SDOCT

	DWT						2D-DTCWT					
IMAGES	CR	PSNR	MSE	CORRELATION	SSIM	EXECUTION TIME	CR	PSNR	MSE	CORRELATION	SSIM	EXECUTION TIME
Image1	1.0452	19.9498	32.0413	0.8851	0.6447	7.7583	1.1875	22.5208	14.7144	0.9266	0.8816	0.1437
Image2	1.0345	18.4437	48.1138	0.8837	0.6709	8.2769	1.1891	24.4127	17.2719	0.9365	0.8705	0.1672
Image3	1.0231	17.9113	55.1676	0.8735	0.7064	9.1642	1.1906	26.2785	20.4045	0.9353	0.8735	0.2098
Image4	1.0444	19.1913	38.7259	0.8678	0.7209	10.5116	1.1915	28.3288	23.0499	0.9239	0.8653	0.2494
Image5	1.0427	17.7712	41.7191	0.8597	0.7454	11.4049	1.1930	24.3224	26.7390	0.9233	0.8682	0.2907

Table 2: All Measures Numerical Performance Evaluation Results using 2D- BWT with WAPDF and QWT-mSVC for SDOCT

	QWT with 2D- BWT with WAPDF						QWT- mSVC					
IMAGES	CR	PSNR	MSE	CORRELATION	SSIM	EXECUTION TIME	CR	PSNR	MSE	CORRELATION	SSIM	EXECUTION TIME
Image1	1.1962	26.4351	16.8018	0.9570	0.9102	0.1344	1.3112	27.9894	13.9106	0.9870	0.9224	0.0487
Image2	1.1966	28.3361	14.2605	0.9666	0.8963	0.1349	1.3078	29.9004	12.1998	0.9766	0.9046	0.0496
Image3	1.1980	30.2787	15.5305	0.9663	0.8864	0.1385	1.3091	31.9594	11.0006	0.9863	0.9164	0.0507
Image4	1.1995	28.3288	16.9348	0.9756	0.9069	0.1376	1.3102	31.2116	12.0006	0.9656	0.9121	0.0516
Image5	1.2010	24.3224	13.9325	0.9650	0.8843	0.1451	1.3195	27.9893	11.1264	0.9813	0.9243	0.0531

Fig. 2 shows that the CR performance comparison results between proposed QWT-mSVC and existing 2D-BWT with WAPDF, 2D-DTCWT and DWT. From the results, it is well know that proposed QWT - mSVC obtain high CR indicating the good purity of retrieved image. The main reason is that the clustering of large coefficients resembles that of the QWT; hence we conclude that QWT is a viable for SD-OCT images. Fig. 3 shows that the PSNR comparison results between proposed QWT-mSVC, and existing 2D-BWT with WAPDF, 2D-DTCWT and DWT. The proposed method has high value of PSNR. From the results, it is well know that proposed QWT-mSVC obtain high PSNR indicating the good reconstructed image. The proposed scheme is based on a various principle which does not need any factorization of the dilation matrix and also more stable from a wavelet designer point of view. Fig. 4 shows that the MSE performance comparison results between proposed QWT-mSVC, and existing 2D- BWT with WAPDF, 2D-DTCWT and DWT. It illustrates, the proposed method has less value of MSE. From the results, it is well know that proposed QWT-mSVC obtain less MSE indicating the good reconstructed image. The importance of proposed work lies in the likelihood of decreasing the rates for which the image quality remains acceptable. Fig. 5 shows that the correlation comparison results between proposed QWT-mSVC, and existing 2D- BWT with WAPDF, 2D-DTCWT and DWT. Ist illustrates, the proposed QWT with mSVC obtain better performance compare then existing methods. It is an effective way of getting rid of the less informative part of this redundancy without compromising perfect reconstruction.

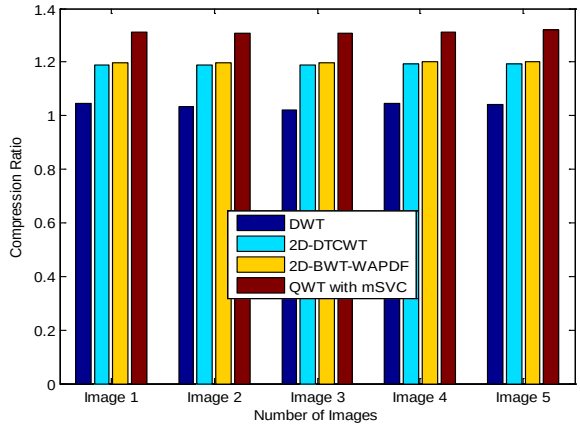

Fig. 2: CR performance Comparison in Various Compression Techniques

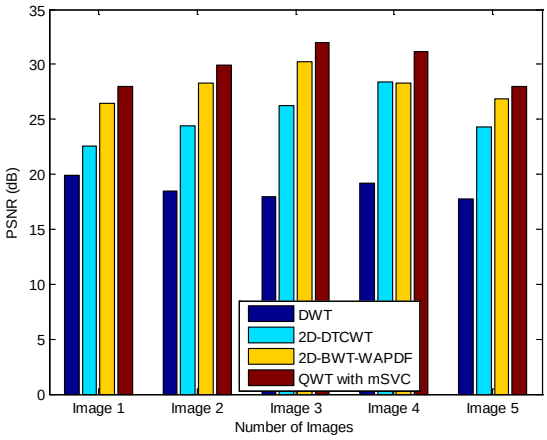

Fig. 3: PSNR Performance Comparison in Various Compression Techniques

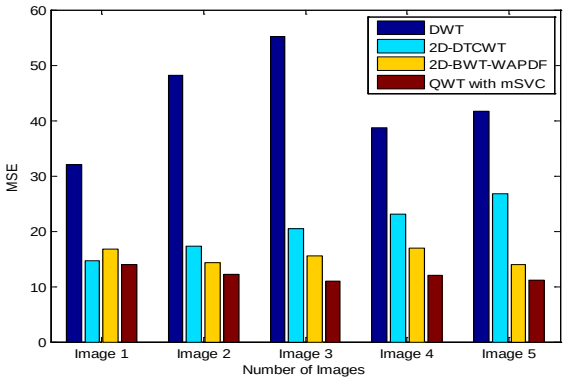

Fig. 4: MSE Performance Comparison in Various Compression Techniques

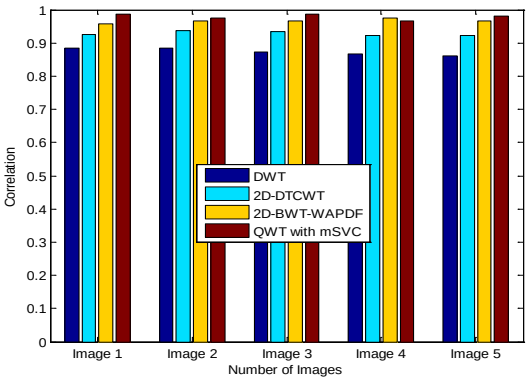

Fig. 5: Correlation Performance Comparison in Various Compression Techniques

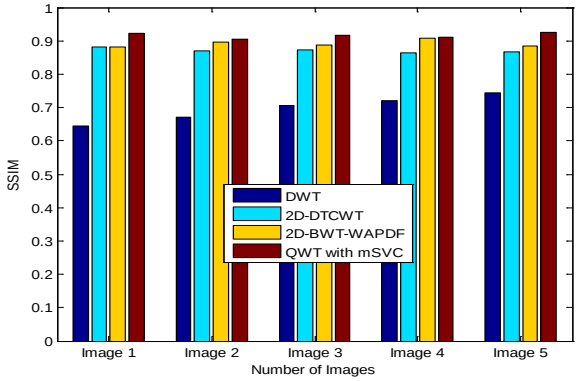

Fig. 6: SSIM Performance Comparison in Various Compression Techniques

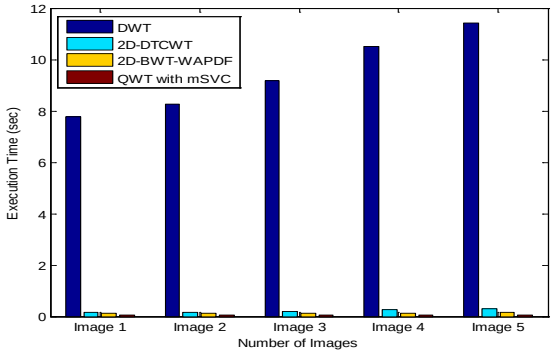

Fig. 7: Execution Time Performance Comparison In Various Compression Techniques

Fig. 6 shows that the SSIM performance comparison results between proposed QWT-mSVC, and existing 2D- BWT with WAPDF, 2D-DTCWT and DWT. The proposed method has high value of SSIM. From the results, it is well know that proposed QWT with mSVC obtain better SSIM compare then existing methods. The main

reason is that the proposed quincunx transform has the least redundancy. Fig. 7 shows that the execution time comparison results between proposed QWT-mSVC, and existing 2D- BWT with WAPDF, 2D-DTCWT and DWT. The proposed method has less execution time. From the results, it is well know that proposed QWT - mSVC obtain less execution time compare then existing methods.

V. CONCLUSION

In this work, a novel image compression schemes for SD-OCT images have been presented based on the QWT and the modified support vector based clustering scheme. The efficient results attained concerning reconstructed images quality with preservation of significant image details. The obtained experimental results show that the proposed QWT-mSVC attained good performance in terms of average compression ratio of 1.311, average structural similarity of 0.915, average PSNR of 29.81, average Correlation of 0.979, average MSE of 12.04 and average Execution Time of 0.050s for all images compared to existing Biorthogonal Wavelet Transform with Windowed All Phase Digital Filter (BWT-WAPDF), DTCWT and then DWT.

In future, focused the main problem remaining to be dealt with is the elimination of blocking effects in the partitions boundaries, which is there is need for smoothing the reconstructed image in these boundaries.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES
IJPBS

ISSN
0975-6299

Comparison of the Macintosh, Glide Scope®, AWS®, McGrath® Video Laryngoscope in Simulated Difficult Airway

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Abstract---

This study was undergone to compare and analyze the endotracheal intubation success rate of the 4 video laryngoscopes made by Macintosh, GlideScope®, AWS® and McGrath®, the time spent for intubation, performer's preference, and the preference level of the students from the department of emergency service on each device. The subject of the research is composed of 22 senior students of the department of emergency medical service. The education was first implemented with 10 minutes of a general lecture on the 3 airway management devices, and then with another 10 minutes of an education on how to use the video laryngoscopes of 4 companies using a manikin and its practice was performed. The lecturers were 3 professors of the department of emergency medical service and two graduate students. The SPSS 13.0 version was used for statistics, and the One-way ANOVA test and the Chi-squared test were applied, and its significance level was $p<0.05$. The results is as followed. The comparison of the success rate of the endotracheal intubation devices, the time spent for intubation, the performer's preference showed a meaningful difference among Macintosh, GlideScope®, AWS® and McGrath®. The first trial, which was a prehospital airway management phase using a manikin, presented a meaningful difference, but there was little difference in the second trial because the performers were trained. In the preference survey on endotracheal intubation devices, AWS® was most preferred.

Keywords--- Prehospital, Manikin, Laryngoscope.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Endotracheal intubation in S. Korea is an emergency treatment saving lives from serious diseases or injuries in a prehospital emergency situation. However the endotracheal intubation presents high difficulties, showing low success rates. Moreover, the failure of endotracheal intubation can cause severe outputs, such as airway damage, hypoxia, etc.[1] Recently a variety of laryngoscopes, which can be applied without the condition of the array of pharynx, larynx and trachea, have been developed, consequently reducing the risks of the prehospital endotracheal intubation. The most preferred laryngoscopes used in ambulances are GlideScope® (Saturn Biomedical System Inc., Burnaby, Canada), AWS®(Hoya Corporation, Tokyo, Japan), McGrath® (Series 5 Portable Video Laryngoscope, UK). The latest study shows that video laryngoscopes display higher success rates in tracheal intubation than conventional laryngoscopes in the case of applying endotracheal intubation to serious patients, spending lesser time and lesser movement of cervical spine with better visibility[2, 3] In particular, a research offers that the video laryngoscope is more effective to a patient with a cervical spine protection and to an emergency medical technician (EMT) with little experience.[4] The upper airway obstruction by a foreign body is an emergency situation with a high death rate, thus a foreign body removal time and its success rate is crucial. A video laryngoscope is known to be a useful device for an unskilled technician, and the airway can be checked even in a serious airway condition. A research finding presented that some parts of locations reached down the larynx was able to be removed in a safe an effective way.[5] Researchers conducted this study in order to find out which video laryngoscopes were better in endotracheal intubation in emergency situations. Therefore, the study compared success rate of endotracheal intubation of video laryngoscopes, intubation time, operator's preference among Macintosh, GlideScope®, AWS®, McGrath®, and compared and analyzed the preferences of the students from the department of emergency medical service on the devices.

II. MATERIALS AND METHODS

The subject of this study consists of 22 senior students of the department of emergency medical service. The education was first implemented with 10 minutes of a general lecture on the airway management devices, and with another 10 minutes of a lecture on how to use the video laryngoscopes of 4 companies using a manikin and its practice was also conducted. The lecturers were 3 professors of the department of emergency medical service and two graduate students. The lecturers shared the knowledge of each device with one another and implemented practices by using a manikin. The 4 airway devices tested were GlideScope®, AWS®, McGrath® and Macintosh. The manikin model used was Airway management trainer Simman (Laerdal Medical Corporation, Stavanger, Norway), and it was previously learned that there were no differences between success and failure. two students were instructed to practice with one manikin. In 10 minutes of training, a performance evaluation was conducted at a designated room next to the education room.

The success of endotracheal intubation was decided on whether or not the chest of the manikin was risen after intubation and ventilation. No rise of the chest was regarded as failure. Moreover, the case of unsuccessful intubation within one minute was also judged to be failed. In case of the failure at the first trial, the subjects were given the second opportunity of trial, and the first used airway devices were removed and the second devices were applied, and the same success standard as the first trial was carried out. As for the evaluation results regarding the trial, the success of the first and the second intubation of each airway device, the time spent until the intubation became successful, and the preference of EMTs for each airway device. The time spent until the intubation became successful was from the time when the airway device inserted into the mouse and to the time the BVM was connected. The trainee's preference for each airway device was found immediately after the evaluation through the survey. The data collected in the study was analyzed by using the SPSS (Statistical Package for the Social Science) WIN 13.0 program. In regard to analysis method, frequency and percentage were produced in order to general characteristics of the subjects. In addition, the One-way ANOVA test and the Chi-squared test were applied to check the influence on the prehospital simulation training. The significance level of all the statistical analysis was set up as $p<0.05$.

Table 1: Demographic of the Participants

Gender	n(%)
Male	10(45.0%)
Female	12(55.0%)

III. RESULTS

Table 2 presents that the first success rates of the airway devices were 68.2% for GlideScope®, 90.9% for AWS®, 54.5% for McGrath® and 81.8% for Macintosh, showing that the success rate of AWS® was the highest, with the statistically significant difference among 4 groups (p=0.048). Considering the second success rates, GlideScope® was 90.9%; AWS® was 100%; McGrath® was 72.7%, and Macintosh was 95.5%, displaying that AWS® was the highest, but there was not statistically significant difference among 4 groups (p=0.283).

Table 3 shows that, regarding the first intubation time of the airway devices, GlideScope® made 26.3±8.71 secs.; AWS® was 13.7±5.65 secs.; McGrath® was 16.8±2.71 secs.; and Macintosh was 27.9±7.05, indicating that the intubation time of AWS® was shorter, making statistically significant difference among groups (p=0.045). The second intubation time was that GlideScope® produced 23.6±6.56 secs.; AWS® made 12.5±7.46 secs.; McGrath® was 17.6±6.77 secs.; and Macintosh made 25.6±5.61 secs.; revealing no statistically significant difference (p=0.471). According to Table 4, the preference survey of trainees for each device conducted immediately after training showed that AWS® recorded 40.9%, showing the highest preference rate, followed by GlideScope® of 27.3%, McGrath® of 18.2% and Macintosh of 13.6%.

Table 2: The Results of Success Rates

N (%)	Glidescope	AWS®	McGrath®	Macintosh	p
First.trial	15(68.2%)	20(90.9%)	12(54.5%)	18(81.8%)	0.048
Second trial	20(90.9%)	22(100%)	16(72.7%)	21(95.5%)	0.283

Table 3: The Results of Success Times

Time to insertion(sec)	Glidescope®	AWS®	McGrath®	Macintosh	p
First trial	26.3±8.71	13.7±5.65	16.8±2.71	27.9±7.05	0.045
Second trial	23.6±6.56	12.5±7.46	17.6±6.77	25.6±5.61	0.471

Table 4: The Results of the Preference Survey

Preference survey	N(%)
Glidescope®	6(27.3%)
AWS®	9(40.9%)
McGrath®	4(18.2%)
Macintosh	3(13.6%)

IV. DISCUSSION

When the airway obstruction occurs, the prompt emergency treatment is needed, and the voluntary cough must not be disturbed if a patient cannot cough him/herself. However, if his or her dyspnea gets worse, he or she must be thumped on the back, and stomach pressure or chest pressure must be applied; and about 50% cannot be improved in symptoms with one treatment.[6] The Heimlich maneuver is not applicable to a pregnant patient or an obese patient, and some complications, such as gastric rupture, pneumomediastinum, mesenteric injury, esophageal rupture and diaphragmatic rupture can be developed. But it is used as the latest and most effective way to remove foreign body in airway, and its success rate is reportedly about 86.5%.[7]

The video laryngoscope is reported to reduce the difficulty of endotracheal intubation compared to the conventional laryngoscopes. Moreover a research participated by medical students, who were unskilled practitioners, mentioned that the endotracheal intubation by using the GlideScope® video laryngoscope was more useful than the endotracheal intubation by the conventional video laryngoscopes in every normal airway and difficult airway scenario only except for neck stiffness scenario in VAS which implied the level of easiness of intubation.[8] Benjamin et al.[9] reported that the GlideScope® video laryngoscope provided

more improved visibility than the Macintosh video laryngoscope. This study showed that the case using the GlideScope® video laryngoscope displayed more improved visibility than the case using the Macintosh video laryngoscope in the normal and difficult scenario except for the pharyngeal obstruction scenario in the visibility opinion by the Cormack-Lehane classification system ($p<0.048$). This implies that the video laryngoscope can secure visibility easily without the axial alignment of the mouth-the pharynx-the device which was essential for the Macintosh video laryngoscope, which makes the GlideScope® video laryngoscope more useful for the medical students, unskilled workers, to use in order to secure visibility.[10-11]

The study compared 4 video laryngoscopes of Macintosh, GlideScope®, AWS® and McGrath® regarding the intubation success rate, the time required for intubation and the user's preference while training participants on the airway management techniques using a manikin. The study results showed that there was a statistically significant difference between the first success rate and practice time as to 4 airway devices' intubation. AWS® displayed the highest success rate on the airway device intubation, but there was no statistically significant difference among 4 groups ($p=0.283$). In regard to the time spent for the first airway device intubation, GlideScope® showed 26.3±8.71 secs., AWS® was 13.7±5.65 secs., McGrath® was 16.8±2.71 secs. and Macintosh showed 27.9±7.05 secs., giving a statistically significant difference among 4 groups ($p=0.045$). Considering the preference survey of trainees on each device conducted immediately after education, AWS® presented the highest rate of 40.9%. After the utility of a video laryngoscope was widely known, the use of a conventional laryngoscope decreased, but it is still regarded as the must-have device in case of emergency situation including removing endotracheal foreign body. This study has a limit. The fact that a certain range of video laryngoscopes were used for this study makes itself difficult to be spread as a generalized case. If an optimized type of video laryngoscope for an airway foreign body is developed, it might be easier than the study output to implement the endotracheal intubation and the foreign body removal using the video laryngoscope. Moreover a comparative analysis on a skilled group and an unskilled group is needed to be carried out.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Development of a Eco-friendly Inorganic Consolidated Soil

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Abstract---

Background/Objectives: In Japan, environmental problems have been a big social issue such as ground contamination due to heavy metal and water pollution due to hexavalent chromium.

Methods/Statistical analysis: This study is related to a soil solidifying agent of soft ground to be made by mixing and homogenizing 800~1000 furnace at a paper mill sludge material 40~60wt% calcined at slag fine powder, 20wt%, mixed homogenized quicklime 10~32wt%, anhydrite 3~10wt% as a raw material.

Findings: There is a big advantage in the most used raw material waste as an environmental dimensions or production stage mask.

Improvements/Applications: Also, recording of the plant is available because there are no substances causing pollution in the modified soil functions and soil is close to neutral, and a solidification time is faster and improved processing can be easily and widely applicable to shorten the air on a large scale without limitation to the type of soil.

Keywords--- Soil, Sewage, Consolidation, Recycling, Sludge.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Organic waste treatment of rotten fish was suggested by using heat energy recycling[1]. In inorganic waste case, red soil and paper waste can be manufactured to mud blocks by mixing with cement[2]. There are many solidifying agents and hardening agents used for stabilizing reinforcement of soft soil and the soil, and poor soil modification or settable material such as the water glass type of solidifying agent cured of sodium silicate as curing agents such as calcium chloride, aluminate shed,, acetic acid and dichromic acid soda, and regulations fluoride Soda change silicate gel type solidifying agent, lignin and dichromate curing initiator, such as soda, chrome lignin-based soil that is configured with water, a solidifying agent, acrylamide-based solidifying agent for polymerization by adding an initiator and promotes material, etc. to an aqueous solution of monomer and cross linking agent, urea resin initial condensate and injecting a small number of curing agent and an aqueous solution of acrylic acid calcium boundary. There are polyurethane-based solidifying agents with a hydrophilic polyurethane. Also in the function of the solidifying and solidified by the curing, there are differences such as solidified by hardening and the solidifying insoluble by polymerization. Solidifying agent is difficult to use in large soil solidification regardless of the performance because the solidifying agent is expensive. Especially when solidifying dredging soil from ponds, rivers, lakes or swamps, or a large scale of soil with silty clay from construction site, the cement (PO Haute sealant cement) solidifying agents, lime-based, plaster-based agent, and the solidifying agent composed of more than one have been used widely. However, these solidifying agents need heavy oil as a fuel because the sewage sludge ash and waste incineration ash used as raw materials were heated with high temperatures, so they further increased manufacturing costs due to heating work again. Also ashes have been used as a soil conditioner for a long time as an effective material by incineration of paper sludge, but rising production costs cannot be avoided due to the step of firing again. In addition, Chromium in the ash is changed to hexavalent Chromium because waste or sewage sludge incineration ash, waste paper are burnt at a high temperature of 1400 ~ 1500 ℃. If a soil solidifying agent is used in such a high temperature, the pollution is unavoidable due to hexavalent chromium in the environment. In case of using ash in the step of re-heating, being cement is inevitable since gypsum or other components such as C11A7CaCl2 and C11A7CaF are added to cement. In case ash is used as a solidifying agent, pH is higher to PH10.5~13 and that results in even adversely affecting the ecosystem in the environment. Moreover, there are shortcomings in the cement solidifying agent that cannot be transported and mixed with mud because the time required to screen unworthy 5-7 days long. This study is on a development of the solidifying agent and suggests conventional soil to solve the problems of the solidifying agent by incinerating the paper sludge at a comparatively low temperature of 800 ~ 1000 ℃. That can reduce the fuel cost and suppress generating hexavalent chromium, and does not rise up environmental problems and reduce the problems of the prolonged time of the curing of the cementitious drawbacks and odors. The main ingredient is obtained by adding Paper sludge ash, quicklime, anhydrite and Fry Ash added with small amounts of polymer flocculant to incineration furnace slag. It is suitable for large-scale construction to improve soil solidifying agent of the massive demand.

II. THE CONFIGURATION AND OPERATION OF THE SOLIDIFYING AGENT

Developed solidifying agent which supplements the problem of function and cost of manufacturing ensures excellent functionality as well as adding high-value by recycling nearly all of the materials of the solidifying agent. Thus, it is suitable for large-scale soil improved construction that requires a lot of amount of solidifying agent.

Main material is a paper sludge material 40wt% ~ 60wt% 20wt% in blast furnace slag fine powder calcined at 800 ~ 1000 ℃, calcium oxide 10 ~ 32wt% and Anhydrite 3 ~10wt%. Here, depending on physical properties and the type of soil, a fry ash 5 ~ 20wt% containing an organic polymer flocculating agent 0.1 ~ 1.0wt% is added to the basic mixture 80 ~ 95wt%. The main ingredient of paper sludge incineration ash, blast furnace slag fine powder, calcium oxide, the components of the anhydrite and fry ash are shown in Table 1[3,4].

Table 1: Components of Raw Materials

Raw Materials \ Components	CaO	SiO2	Fe2O3	Al2O3	TiO2	ZnO	P2O5	SO3	MgO
Paper ash	27.5	25.3	22.1	12.2	4.37	1.85	1.58	1.23	1.14
Slag of a blast furnace	42.6	33.7	0.6	14.6	-	-	-	2.0	6.1
Slaked lime	70.1	0.6	0.1	0.4	-	-	-	0.4	0.1
Fly ash	0.51	46.92	7.4	44.45	-	-	-	0.98	1.81

III. MAIN CONTENTS

A soil is complicated substances. So chemical and mineralogenic properties should be checked and physical substitutional action should be also considered to determine the distribution of ingredients. The property change should be considered when clay mineral with electric neutrality makes isomorphous exchange. Action of clay mineral which changed to minus electric charge should be considered. If we consider what parent rock of clay mineral is, consider expansion and hydration ability, and consider the chhange of pH then we see through condensation, expansion and swelling action of soil. The ettringite reaction would be generated to prevent exudation of heavy metal, and circular crystal would be generated through above reaction to bind particles of soil. In case of heavy metal contamination, consolidation technology would be applied not to generate exudation by ingredient of heavy metal. There are several kinds of consolidation principle; hydration reaction by lime, Pozzolanic reaction, ettrngite and soil granulation. Figure 1 shows the consolidation reaction structure map.

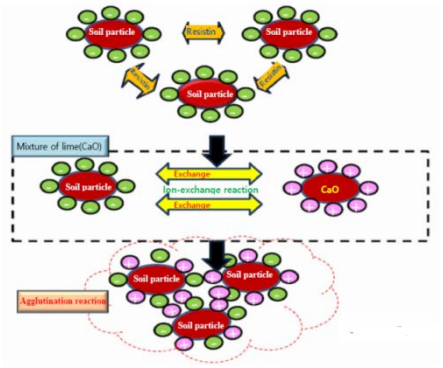

Figure 1: Consolidation Reaction Structure Map

Carbonation by remaining lime powder reacts to carbon dioxide in soil. Also, as this reaction repeats, long age strength constantly increases reaction of re-carbonation. In initial stage of reaction, we used supplemental agent such as alum which includes high activity alumina. Figure 2 shows the principle of consolidation reaction.

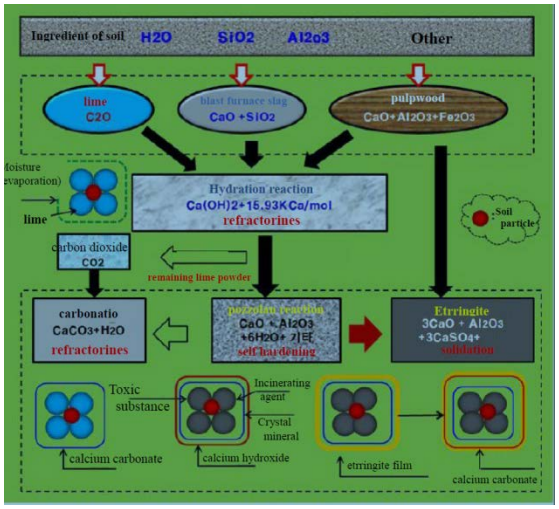

Figure 2: Principle of Consolidation Reaction

IV. APPLICATION EXAMPLE

As a paper sludge ash, other mineral powders including fillers, calcium carbonate when sizing, talc powder and clay during the process of grassland Sinai sizing are often used while being discarded propelled waste fluid contain many inorganic component with the pulp. When incinerated, or fired in any case using the

pulp or paper sizing agent, the organic material is burned away, leaving only the inorganic ingredients as shown in Table 1 of the above. The remnants are useful.

In addition, the furnace slag is a material pulverized as the iron melt solidified non-mineral contained in the ore upon melting of iron ore in steel mills and Fry Ash which is a byproduct when burning coal in thermal power plants is a porous, light, absorptive and strong gas adsorption material. Gypsum also has two kinds of types such as a natural gypsum and chemical gypsum. The chemical gypsum are mud-plaster (CaS4O and 2H2O), half of gypsum (CaSO4 and ½H2O) and anhydrite (CaSO4). In this study, the chemical gypsum with easy composition and the anhydrite which has small impurities are used.

They are homogenized to a fine powder less than 200 mesh in order to increase the specific surface area. Basic agents are widely applied to soil which has relatively less water, but solidifying agent for cultivating soil added with a small amount of organic flocculants and Fry Ash is effective in solidifying remaining soil after condensing and sinking a lot of soil with large amounts of moisture dispersed in wetlands and tidal zone, removing moisture.

Looking at the action and functionality of the raw materials used in the solidifying agent, the calcination of the paper ash (residue) hardly occur due to the incineration temperature at the 800 ~ 1000 ℃. Instead, a partial portion calcination takes place and a part of the carbon (material) remains because organic sizing agent including pulp is burned, but he chromium oxide component has not changed yet as hexavalent chromium.

When water was added to the soil as component, ratio is greater in the ingredient list in Table 1 including lime, silica, alumina, iron oxide, etc., and C3S, C2S, C3A and C4AF among these ingredients are the solubility anhydride which has very good reactivity to water and makes hydrate with low solubility.

When reacted with water, C3S is disconnected to Ca-O bond. And when Ca 2+ is melt in an aqueous solution reaches supersaturation, the crystals of calcium hydroxide are precipitated and the rest of [SiO4] 4- will react with water [Si(OH)6], such as 2- soluble silicate in the form of hydrogen ions and polymerization to make the hydrated silica gel around C3S grains. The gel is precipitated in combination with Ca2+ a crystal of Calcium Silicate Hydrate (C-S-H) is generated.

Also C3A (3CaO and A2O3) is reacted with the water very rapidly and generates heat. The produced hydrate is a mixture of C4AH10 and C2AH8 to the calcium aluminate hydrates of the hexagonal tubular which is safe to the aluminate hydrate of cubic system in accordance with a sense of time.

The gypsum should inhibit the reaction of the C3A. This is because the double salt of calcium interfere aluminate (Calcium-aluminate) hydrate made on the surface of the reaction of water with C3A C3A. The hydrate is stable in basic and has two kinds of high sulphate in the form of insoluble compounds in water-type and that has the low sulfate.

When C3A, plaster and water react together, high sulphate with the big surface area is made. And when gypsum is consumed, High sulphate reacts with C3A and becomes low sulphate. It can also improve the workability by delaying the hardening time due to poor workability if the large modified soil is rapidly solidified in the process and is used to improve the long-term strength.

And the Blast Furnace Slag does not have the characteristic of solidity due to reacting with water directly, but particularly paper sludge ash may exhibit the hydraulic potential. On other hand, Blast Furnace Cement has low hydration heat and the high chemical resistance. The state in the blast furnace slag is the main compound of the solid solution β-C2S-Ca2Mg Si2O7-CaAl (SiAlO7).

Other Fly ash is mainly composed of silica and substance with much the content of aluminum oxide glassy state and improves the workability due to giving initial strength in the soil improved construction. In spite of poor initial strength and delayed curing, latter-strength is good. The reason why latter-strength is favorable is pozzolanic reaction of the primary ash. The effects of developed soil by adding pozzolanic are improvement of the workability and stability, and the increasement of compressive strength, tensile strength and the waterproofing. Also, the strength is increased by the reduction of bleeding. In addition, the Fly ash has a small percentage and pretty good adsorption of gases such as greater absorbency.

These enable the function a ratio of the soil. But in extremely high or severe suspension water, the solidifying agent for cultivating soil added with Fly ash is used after removing as much as water in a state

with a small amount of aggregation sedimentation of suspended material with the addition of organic polymer materials. Besides adding creation serves to make up for the deficiency of calcium oxide.

As a result, the characteristics of the solidifying agent ① can safely use harmless materials in construction and environmentally ② a greater dimension in recycling because it uses industrial waste as a raw material of social and economic synergies. ③ cheap, the raw material costs enormously compared to conventional chemical coagulants can be used in large-scale soil construction ④ soil without special mixing equipment needed during construction when work is available and ⑤PH value neutral and mixed with the topic destination Saturday as a universal medium term of Forklifts etc.

pH at an early stage when it is close to neutral. ⑥ Since different functions of the soil can be solidified after by vegetation can be recorded and ⑦ such a fast time to solidify the initial act effectively as an improvement[5].

Example on Burying Work of Sewage Pipes

The solidifying agent for cultivating soil was made by mixing and homogenizing a 55wt% paper sludge produced at 800 ~ 1000℃, 20wt% slag fine powder, 15wt% calcium oxide and 10wt% anhydrous gypsum as a raw material. The results of measuring construction waste soil using the solidifying agent for cultivating soil caused by disposal sewage pipes buried are shown in the field table (2).

Table 2: The Result Table of Measuring Left Soil According to Burying Work of the Sewage Pipe

Mixing ratio(wt%)	0	8.0	10.0	12.0	14.0
Moisture content(%)	42.1	26.2	25.2	21.3	20.8
Wet density(%)	-	1.917	1.927	1.934	1.942
Dry density(g/㎤)	-	1.519	1.541	1.591	1.604
CBR(%)	1.1	15.6	20.3	24.2	26.1

The soil has been improved to 24.1% in the result of the CBR value 12wt% formulation and the mudding did not happen again. Even in absorption due to immersion test, expansion ratio from 8.0 ~ 14.0% was zero. The test method was carried out by (JIS A1211). Soil is clayey soil consisting of silt and clay from. The soil before improved was a neutral pH6.8, 42% moisture content, specific gravity 1.79. The soil after improved, greenish gray clay was improved after 48 hours and there is PH8.4. Three weeks later, it was changed to pH7.0. Also even when mixing a solidifying agent, the odor was not generated. Further embodiments (1), the hexavalent chromium was not detected in the other hazardous substances, such as the solidification processing result table (3) and the construction waste was not generated.

Table 3: The Analysis Result List of Modified Soil Hazardous Substances

The object ofthe metric	The result ofthe metric	The method ofthe metric
Cd	ND	JIS K0102
Total cyanogen	ND	JIS K0102
Pb	ND	JIS K0102
Cr(VI)	ND	JIS K0102
Arsenic	ND	JIS K0102
Total Hg	ND	S46 protection agency bulletin the 59call drifting buoy 3
Alkil Hg	ND	With the S46 protection agency bulletin the 59 callThe S49 protection agency bulletin the 64 call drifting buoy 4 and driftingbuoy 4
PCB	ND	S46 protection agency bulletin the 59call drifting buoy 5
Dichloromethane	ND	JIS K0125
Carbon tetrachloride	ND	JIS K0125
1,2- dichloroethane	ND	JIS K0125
1,1-dichloroethane	ND	JIS K0125
1,1,1-tricholoro ethane	ND	JIS K0125
1,1,2-tricholoro ethane	ND	JIS K0125
Tricholoro ethylene	ND	JIS K0125
Tetrachloroethylene	ND	JIS K0125

The Example of Using Mud on the Renovation work of Agricultural Development

Table 4: The Result List of Mud Improvement of Agricultural Development

Inspection item ＼combination ratio(%)	10%	12%	15%
Testing method	Compression resolution	Compression resolution	Compression resolution
Natural moisture content(%)	46.1	40.6	42.6
Wet density(g/㎤)	1.659	1.712	1.687
Dry density(g/㎤)	1.132	1.217	1.183
Blow ratio	0.25	0.40	0.42
Penetration test aftermoisture content(%)	47.7	42.2	44.5
Average CBR(%)	17.3	26.1	41.3

As test results, in condition of the weight of the mud at adding 12%, the mud quality improved as much as digger with 0.6 ㎡ capacity can do operation on the soil covered with the steel plate after 2 hours. This is due to the effect of absorption and paper sludge ash and anhydrite.

Also thereafter the construction site for soil improvement was observed continuously. The water level of the dam was also raised by the rains and large amounts of water penetrated improved mud, but returning the to soil did not happen. It is judged that the blast furnace slag component of the reaction slowly enough to prevent the re-solidified mud by the anger generated by hydraulic provisional. Also, the reuse of construction and mineral mud is quite possible that if CBR value is more than 20%.

The Example of Golf Course Construction

The developed consolidation soil was applied to construct the road in golf course. Figure 3 shows the construction of road with consolation soil. Figure 4 shows the grain size accumulation curve, and figure 5 shows the dry density and CBR curve.

Figure 3: Construction of Road with Consolation Soil

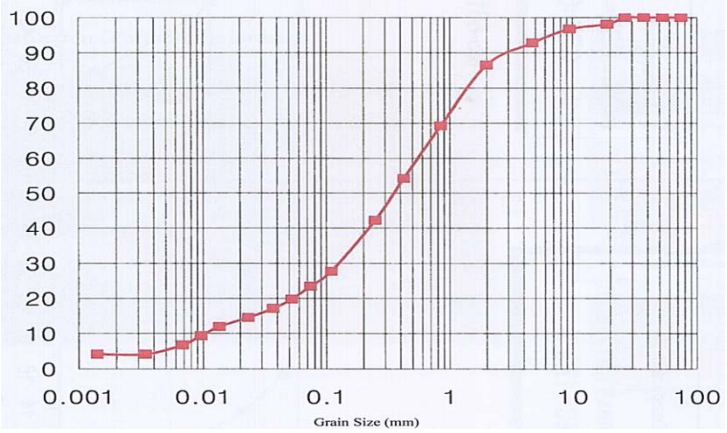

Figure 4: Grain Size Accumulation Curve

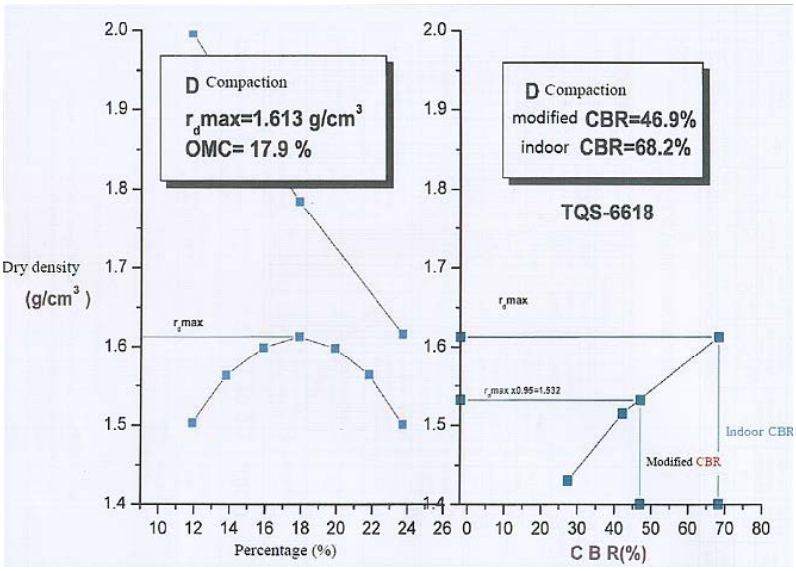

Figure 5: Dry Density and CBR Curve

V. CONCLUSION

The solidifying agent for cultivating soil in this study has a big advantage in most environmental dimension due to waste material In addition, there are no substances causing pollution in the modified soil functions and soil is close to neutral, and a solidification time is faster and improved processing can be easily and widely applicable to shorten the air on a large scale without limitation to the type of soil.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study of Operating a Server-based Biometric Authentication System for Reliability and Convenience

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Abstract---

Background/Objectives: Various services are studied and introduced on the biometric authentication. This study suggests the operation methods considering credibility and convenience of the biometric authentication system, and designs the biometric authentication system on the server.

Methods/Statistical analysis: To evaluate operation methods for both FAR and FRR of biometric authentication suggested in this paper, we performed a test for all 190 persons by constructing the vein authentication system based on the server.

Findings: Reliability of the authentication algorithm among various performance evaluation measures of the biometric authentication system is the False Acceptance Ratio(FAR) which is to recognize another person as the principal and it is crucial to reduce False Reject Ratio(FRR), representing an inability to properly recognize the principal, for usability of the algorithm. If FAR is being lowered to increase reliability, there is a possibility to cause a decrease in FRR which leads to the inconvenience in properly recognizing one's own self. Hereupon, this study suggests operating methods which can reduce FRR while still maintaining existing FAR by calculating each enrollment and authentication scores in the course of 1:1 verification authentication and enrolling the template as biometric information and designs a server-based system to verify efficiency of the suggested operating methods.

Improvements/Applications: It can be known that inconvenience that recognition of the principal is rejected in a time was significantly reduced by using the operation technique on the base of template re-enrollment and automatic re-authentication.

Keywords--- Biometric, Biometric Authentication System, Palm Vein Recognition, FAR(False Acceptance Ratio), FRR (False Reject Ratio).

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

In the situation where importance of security is emphasized, the biometric authentication system on the base of university, uniqueness and sustainability that biometrics have is introduced as means of an identification, and various services are studied and introduced on the biometric authentication. Accordingly, this study suggests the operation methods considering credibility and convenience of the biometric authentication system, and designs the biometric authentication system on the server. The False Acceptance Ratio (FAR) and the False Reject Ratio (FRR) should be reduced to establish credibility and secure convenience of the biometric authentication system. However, both FRR and FAR have an inverse relationship each other. Reducing the FAR unconditionally for credibility, FRR relatively gets high. Thus, the possibility for recognition failure in the authentication course may occur gets high. Accordingly, this study suggests operation methods through automatic re-authentication and re-enrollment of templates in the enrollment and authentication courses of the templates as feature information for biometric authentication, and suggests credibility and convenience of the system. To evaluate convenience of the suggested operation methods, we built a server-based authentication system on the base of PalmSecure which is Fujitsu's vein recognition solution and verified efficiency of the suggested methods by performing a test for 190 subjects.

II. RELATIVE WORKS

This paper examines advantages and disadvantages of the biometric authentication system depending on the existing researches, technologies and network composition methods that are related with the biometric authentication system, and existing researches for evaluating the performance of the biometric authentication system.

A. Biometric Authentication System

The existing studies define "biometric authentication technology as automated method of verifying or recognizing a living person's physical or behavioral features" [1,2]. A system to verify optional user on the base by using biometric authentication technology or identify the subject uses biometric information obtained by specific person from the optional biometric information data can be specified as a biometric authentication system [3, 4].(Table 1)

Table 1: Components of Biometric Authentication System

Component	Definition
Data Collection	The stage of collecting characteristic information of biometrics. Generally, secure measurable type of data by using appropriate sensor depending on the feature of the objective biometrics.
Data Transmission	Components required for transmitting measurable obtained types of data to other system (server or storage, etc.). They may be transmitted as compact form considering band width of network.
Signal Processing	Signal processing part of the measurable obtained types of data. They are generally composed of segmentation, feature extraction, quality controland pattern matching. The biometrics feature information obtained through feature extraction are referred to as template and saved in the media.
Storage	Templates obtained through enrollment are saved in the media and may be saved as center-intensive type for performing 1: N, not 1:1 authentication.
Decision	Determine correspondence or discrepancy between obtained templates and saved templates for comparison through pattern matching. For 1:1 comparison between obtained templates and saved templates, perform verification, for 1: N comparison, perform identification. Search for enrolled templates below critical values by comparing similarity level among the existing N-pcs of enrollment templates.

The biometric authentication system is distinguished mainly by the location of the network components where storage and decision of the biometric templates.(Table 2)

Table 2: Composition of Different Biometric Authentication System Depending on the Position of Storage and Authentication of Template

Components		***The location of certification***		
		A storage medium (Card)	**Client**	**Server**
The location of storage	**A storage medium**	Match on Card	Storage On Card	
	Client		Match On Client	
	Server			Match On Server

Firstly, the MOC (Match On Card) method saves the user's biometric templates by using a smart card and proceeds authentication processing with the sensed templates. The MOC method has advantage without need

of server but has an inconvenience of holding a media and high cost of problem of the smart card. Secondly, the SOC (Storage On Card) method is a method of saving the biometric template in the media and processing authentication in the client. The price of media is somewhat cheaper than smart card but authentication is achieved by loading the relevant templates. So, this method is vulnerable to memory hacking. Thirdly, the Match On Client method is a method where the server saves and keeps the templates and authentication is done by transmitting the sensed authentication template to the server. This method has higher security than other methods. Especially, the system must be built in the MOS method for the 1:N Verification method.

B. Palm Vein Recognition

This study applies the vein recognition solution developed by Fujitsu Japan [5]. Fujitsu's PalmSecure takes a picture of the specific components in the blood flowing through a blood vessel distributed on the palm and uses the blood vessel information obtained through this process as a feature point. The Palm Vein Recognition is a method using the blood vessel within the palm invisible with the naked eye, not feature of the outside projected skin like fingerprint and is used for identify the principal by applying it to various services in the world.

The authentication for the palm vein used to evaluate efficiency of the suggested technique uses non-contact type of sensor not directly contact with the sensor.

False Rejection Rate (FRR) is 0.01% and False Acceptance Rate (FAR) is lower than 0.00008%. Fujitsu collected 140,000 palm veins to use them for the test of evaluation purpose [6].

Several banks in Japan have been introduced the authentication system of the palm vein to identify customers since the 2004 year.

In addition, it has been started to be introduced as customer service in Korea from 2015 and it is being progressively studied for authentication in the financial world [8].

And the system is also used for the admission control or verifying the patient principal in a hospital. Figure 1 shows principle of extracting feature of the palm vein to derive the features in the authentication system of the palm vein.

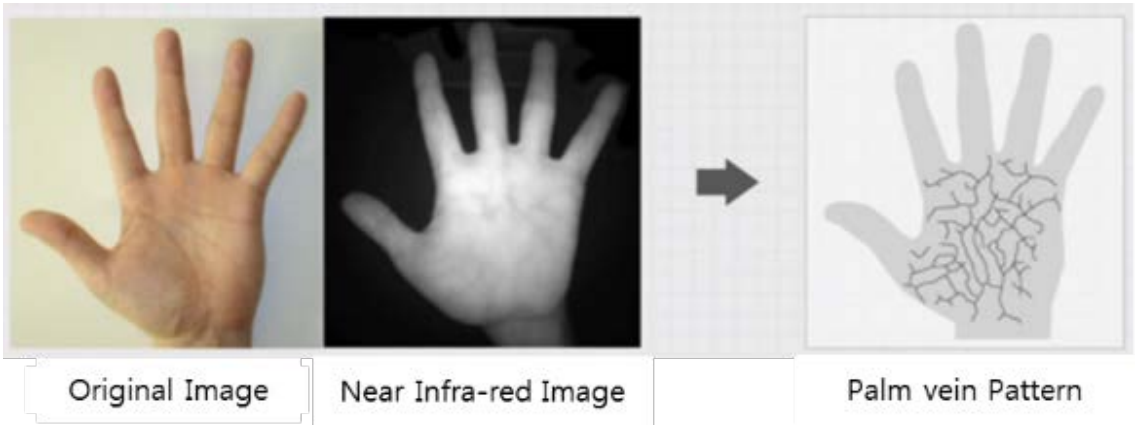

Figure1: Principle of Extracting Feature of the Palm Vein

C. BIO API Standard

The BIO API is the standard enrolled on the ISO/IEC 19784-1 and provides the environment to develop the applications related with the Enrollment, Verification and Identification with a single interface irrespective of types of sensor by using the API provided in the BIO API Framework as part of the enrolled standards.

In addition, Biometrics Service Provider (BSP) shall develop sensor drivers and authentication libraries in accordance with the standard that the BIO API Framework provides irrespective of application [8].

Function related with authentication among the BIO APIs was defined as BioAPI_Verify and BioAPI_VerifyMatch as follows table 3.

Table 3: Definition of Bio Standard API Related with Authentication

Function Name	Parameters	Remarks
BioAPI_VerifyMatch	BioAPI_HANDLEModuleHandle, constBioAPI_FAR *MaxFARRequested, constBioAPI_FRR *MaxFRRRequested, constBioAPI_BOOL *FARPrecedence, constBioAPI_INPUT_BIR *ProcessedBIR, constBioAPI_INPUT_BIR *StoredTemplate, BioAPI_BIR_HANDLE *AdaptedBIR, BioAPI_BOOL *Result, **BioAPI_FAR_PTRFARAchieved,** BioAPI_FRR_PTRFRRAchieved, BioAPI_DATA_PTR *Payload);	Function of receiving enrollment templates and authentication templates as parameter and attempting authentication. Function generally used in case of method authenticated in the server.
BioAPI_Verify	(BioAPI_HANDLEModuleHandle, constBioAPI_FAR *MaxFARRequested, constBioAPI_FRR *MaxFRRRequested, constBioAPI_BOOL *FARPrecedence, constBioAPI_INPUT_BIR *StoredTemplate, BioAPI_BIR_HANDLE_PTRAdaptedBIR, BioAPI_BOOL *Result, **BioAPI_FAR_PTRFARAchieved,** BioAPI_FRR_PTRFRRAchieved, BioAPI_DATA_PTR *Payload, sint32 Timeout, BioAPI_BIR_HANDLE_PTRAuditData);	Function of receiving only enrollment template as parameter and attempting authentication by using authentication templates obtained through the sensor. Function generally used in the client with sensor mounted.

The verification results are return values representing authentication success or failure and can be classified into BioAPI_OK and other failure, and the result values of the authentication similarity can be measured by using FARAchieved. Since FRRAchieved among items may be implemented depending on the biometric service provider (BSP), we suggest a method to design and operate the system by using FARAchieved values in this study.

D. Evaluation Items of the Biometric Authentication System

Studies for various types of evaluation methods and items to properly evaluate authentication technology have been also executed as a number of studies are performed for the biometric evaluate authentication technology. Index of evaluating the evaluate authentication system are as follows table 4.

Table4: Standards for Evaluating Biometric Authentication Performance

Evaluation Index	Items for Evaluating Authentication Technology
FAR (False Acceptance Rate)	The probability which recognizes a specific person as another person[9].
FRR (False Rejection Rate)	The probability which cannot recognize a specific person as himself[9].
ROC (Receiver Operation Characteristic) Curve	The graphic chart which shows a trade-off between FAR and FRR If the possibility of the principal's biometric information falsely accepted as biometric information of other person's biometric information generally goes down, FRR goes down but it means to make the criteria of determining them as principal's biometric information. Thus, FAR goes up. To the contrary, if the possibility of accepting other person's biometric information as the principal's biometric information goes down, FAR goes down but FRR goes up.
EER (Equal Error Rate)	The equal ratio between FAR and FRR EER's values can be easily obtained from the ROC curves. EER is the quickest way to compare accuracy of the device having different ROC curve. Generally, the device having the lowest EER is most accurate.
FTE (Failure To Enroll rate)	The probability of failure which users enroll their biometric characteristics in the system.
FTC (Failure To Capture rate)	The probability of failure which cannot perceive the biometric characteristics in the automated system.

From the performance evaluation criteria of various biometric authentication, False Acceptance Rate (FAR) and False Rejection Rate (FRR) represents index to evaluate security and convenience of the biometric authentication system and are in an inverse relationship depending on threshold values to compare the similarity between 2 biometric templates. If we set the threshold value high to reduce FAR value, the FAR will be reduced but the FRR will be increased. The rate of the case that FRR and FAR rate equals is referred to as Equal Error Rate (EER). For best results, it needs a low EER. The relationship between FAR, FRR and EER is represented as following figure 2.

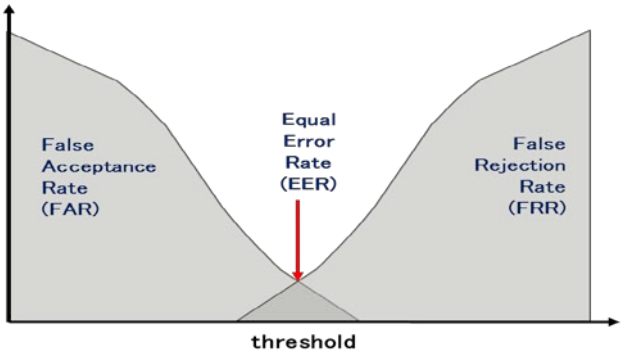

Figure 2: FAR vs FRR

There is need to use FAR and FRR values by different application depending on the introduction purpose of the biometric authentication system. For the business which is required to check accurate identification like as financial task, the threshold vales must be applied to the maximum to increase security even if the principal's recognition is not properly done at a time. In the part that convenience must be increased admission control, inconvenience due to the principal's false recognition must be minimized even if the security strength is relatively low by using somewhat low threshold values. The relationship between FAR and FRR in the system is represented in following figure 3 depending on the application purpose.

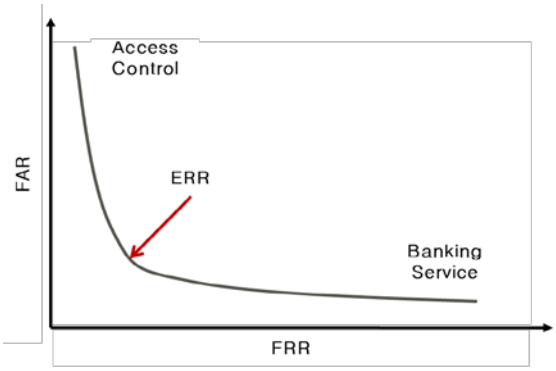

Figure 3: The relationship between FAR and FRR depending on the Application Purpose

Accordingly, this study suggests 3 operation methods on the base of server authentication that does not hinder the user's inconvenience while maintaining the existing FAR.

E. Research Related with the Use of Biometric Authentication System

The researches of biometric authentication system are used for various businesses such as admission control and identification of patient principal as a strong mean of the principal. Besides, the same system is studied as multiple signature method for the copyright by generation of private key and public key by way of biometric information and random secrete value in order to protect the copyright for the digital contents [10]. Studies by applying the biometric authentication method are also performed even in the authentication methods and encryption methods for preventing the patient's individual privacy in the health care sector like TMIS (Telecare Medicine Information Systems) [11].

In addition, a study for the user's authentication model to improve security strength on the base of the finger vein in the wireless mobile financial business that requires a high security level [12].

Standard for biometrics is ISO/IEC JTC 1/SC 37 and the standard for product quality evaluation is stated in ISO/IEC 29794 and this study covers a ISO/IEC 29794-1: information technology – Biometric sample quality – Part 1: Framework part. [13]

III. PROPOSED METHOD

The operation technique for the credibility and convenience of the biometric authentication system suggested in this study is a method to execute re-enrollment and re-authentication on the base of values calculated from FAR Achieve after authentication from the BIO_API. Largely 3 techniques are provided depending on the enrollment and authentication course as follows:

A. Template Re-Enrollment Technique

The Template Re-enrollment Technique is a technique applied in the case for the user to enroll biometrics, which is a method to enroll the highest quality of template by attempting the authentication with the obtained templates and obtaining a number of enrollments in the enrollment course. If a number of templates obtained are determined as scores below specific values, Template Re-enrollment Technique is a method to enroll templates over the specific quality and a series of course are as follows figure 4.

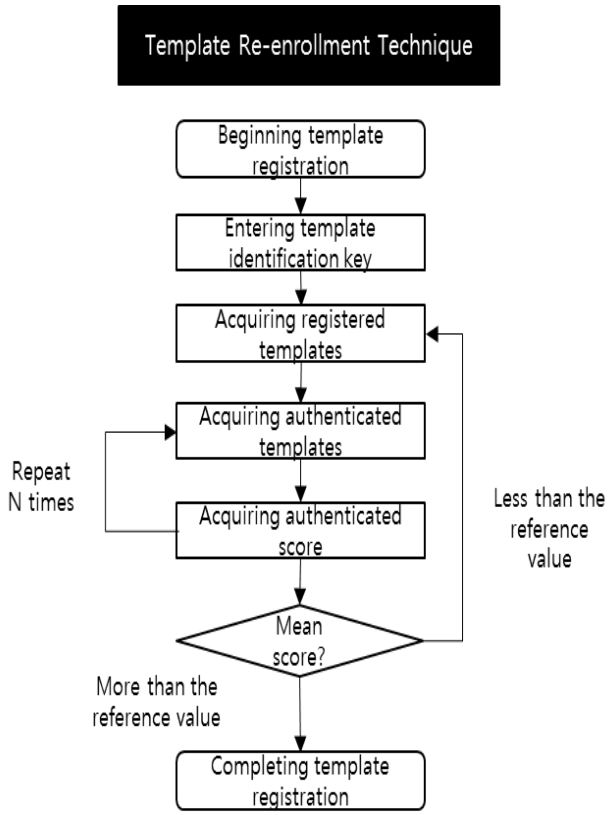

Figure 4: Template Re-Enrollment Technique (I)

B. Authentication Score Based Re-Enrollment Technique

The Authentication Score Based Re-enrollment Technique is a method to request of the template if the average values of the existing scores are below specific value by obtaining the average value of the relevant user's existing authentication scores and the user executes authentication over the specific times (critical values) determined in the authentication contents.

Where the users initially enrolled by using this technique are enrolled without applying the Template Re-enrollment Technique or where both enrollment environment and authentication environment are changed, for example the lighting environment in time of enrollment and that in time of authentication due to different locations, FRR can be relatively reduced while maintaining FAR by requesting re-enrollment of the template if necessary by evaluating every authentication of template scores enrolled in operation.(Figure 5)

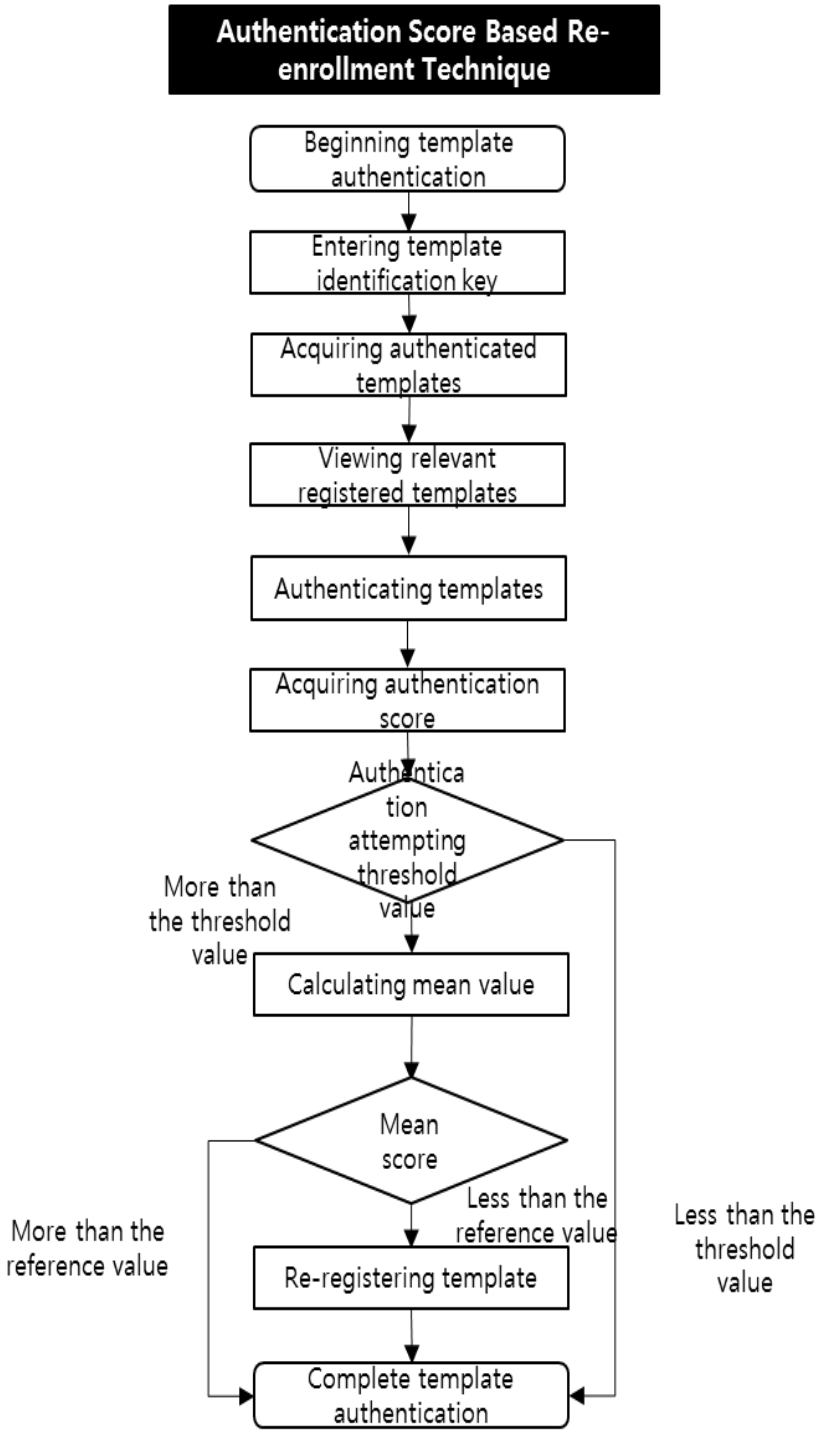

Figure 5: Authentication Score Based Re-Enrollment Technique (II)

C. Template Re-Attempting Technique

In the Template Re-attempting Technique, the FRR may be reduced automatically attempting re-attempt below the constant numbers where the user's initial authentication fails.

Generally, in case of FAR or FRR, the occurrence frequency of a recognition error increase. The lower FAR, the higher FRR gets high. In this case, the user's inconvenience must be minimized by executing automatic re-authentication by the specified numbers in the failure of initial authentication.(Figure 6)

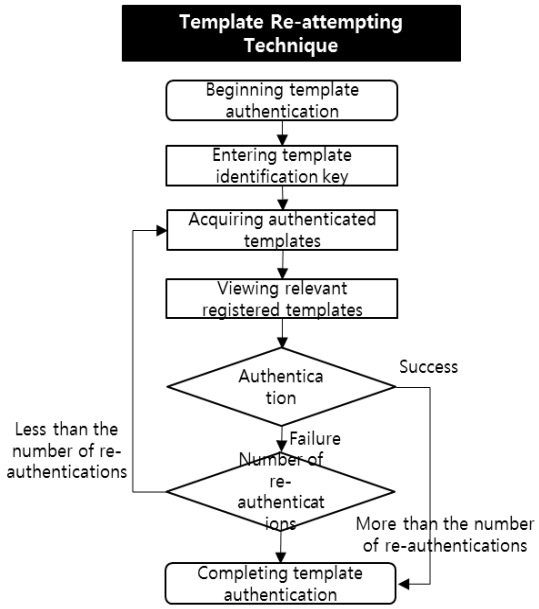

Figure 6: Re-Attempting Technique (III)

IV. DESIGN OF BIOMETRIC AUTHENTICATION SYSTEM

A. Design of Biometric Authentication System

This study designs a server-based biometric authentication system to evaluate efficiency of the proposed method. In the proposed biometric authentication system, we design the system to enroll only a template meeting the conditions by applying the Template Re-enrollment Technique in the biometric enrollment course and apply both Template Re-enrollment and Re-acceptance Techniques by using the Authentication Score Based Re-enrollment Technique and Template Re-attempting Technique in the authentication course. The Template Re-enrollment and template authentication methods of the proposed system are as follows figure 7.

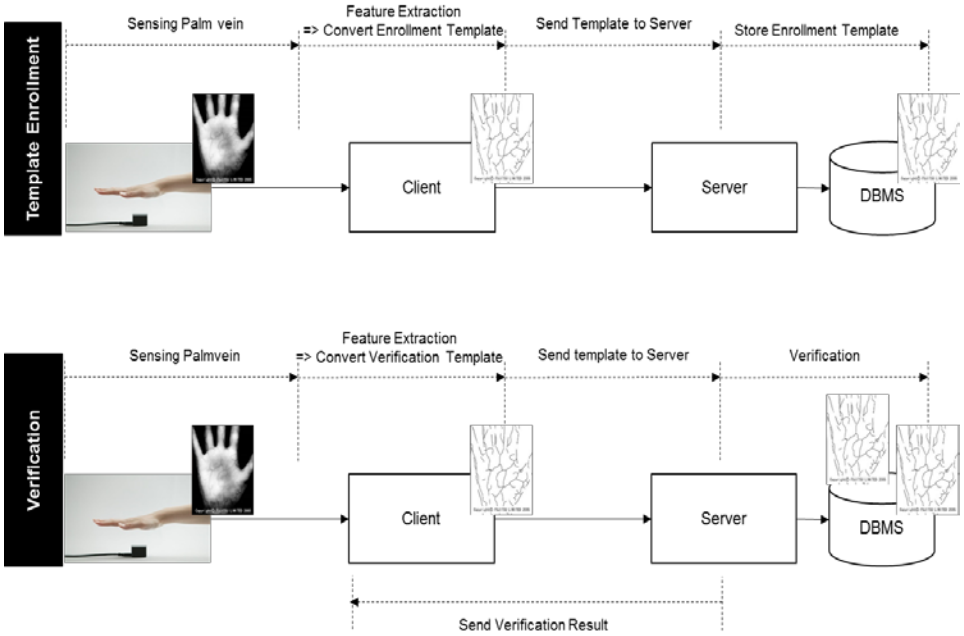

Figure 7: Enrollment and Authentication of Template in Biometric Authentication System

A client program is developed as .NET application and its server is designed as Java application type operable in the Web Application Server. To the client, the PalmSecure Sensor Driver is installed to link with a Fujitsu's PalmSecure sensor, and a PalmSecure Library is used as a capture and authentication module of templates for the Template Re-enrollment Technique. The PalmSecure V32 Version is used as module and library for authentication [14].

The server is composed as an applicable form on the Java Web Application considering the scalability, and Java Native Invocation is used and linked to call the PalmSecure library composed of Native DLL. The PalmSecure V32 Enterprise is used for simultaneous processing by the Fujitsu's library. Libraries are linked by the Object Pool Method to previously prevent generation of threads over the specified values [7]. The user's enrollment templates are saved as a BLOB type in the Oracle 11G and the JDBC Connection Pool is used for linking with the Web Application Server.

Communication between server and client is composed of HTTPS and security between templates on the network is enforced, and professional design is designed in a REST (Representational State Transfer) method. S/W schematic drawing of the suggested system is represented as follows figure 8.

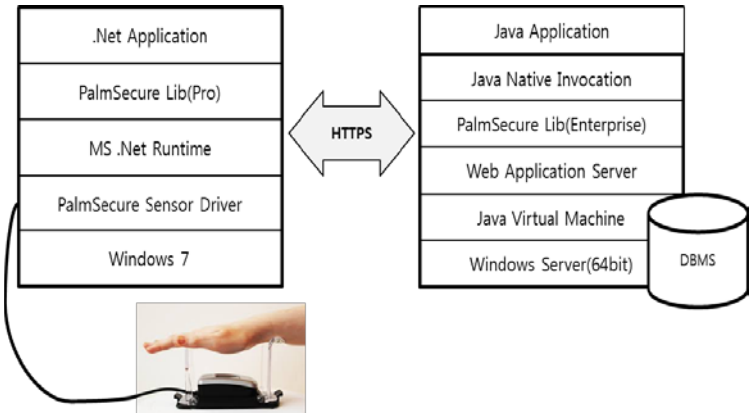

Figure 8: S/W Schematic Drawing of Proposed System

B. Application UI and its Function

Application to evaluate efficiency of the suggest method was intuitively composed for the user to participate in the test, and the user's UI is as follows figure 9.

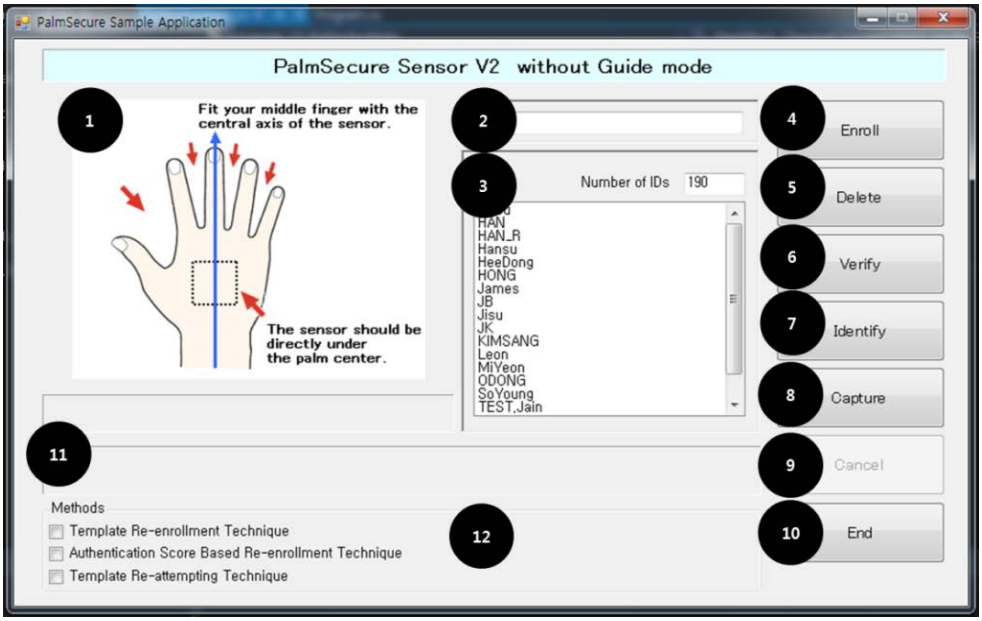

Figure 9: Schematic Drawing of Client User Interface

For the test, every component provided by the application user's UI is composed of 12 total pieces and function by component is as follows table 5.

Table 5: Function by Each Component

No.	Name	Function
1	Silhouette viewer	Function output user's hand silhouette obtained through sensor.
2	Entry field of classification key of template	Test box to enter template classification key as basic unit to store templates.
3	Inquiry of enrollment template	List box to output total numbers of enrolled templates and enrolled template lists.
4	Template enroll button	Button executed to enroll the user's templates of palm vein.
5	Template delete button	Button to delete the enrolled user's templates.
6	Verify button	Button to execute the template and authentication equivalent to the classification key entered in the No. 2 field.
7	Identify button	The button to identify templates sensed among the whole enrolled templates.
8	Capture button	Button to simply capture templates.
9	Cancel button	Command cancel button under execution.
10	Exit button	Program exit button.
11	Guide label	Button that guide message is output in time of palm.
12	Check of selecting methods	Selective check box group to select proposed methods.

V. EXPERIMENTAL RESULTS

To evaluate operation methods for both FAR and FRR of biometric authentication suggested in this paper, we performed a test for all 190 persons by constructing the vein authentication system based on the server.

190 persons were adults over the 20-age. The right palms of 143 men and 47 women were enrolled. Results were derived for the case of not applying the proposed technique, applying only one of them and applying all of them, respectively. For the re-attempt technique using all the proposed techniques, they were classified into the case of executing just once again and retry twice. Automatic re-authentication is added for the solution to the occasion of that false reject is caused in the process of bio authentication, for this reason, this study included operation of two times automatic re-authentication as an evaluation index when it is failed to authenticate in first try. Authenticated value of vein in palm of the hand produces value between 0 to 10,000 and the score is calculated in 1,000 units. This study set up critical value for re-authentication with an index score of 5,000 and it is suggested that modification of standard for critical value is required when it is not for authentication but identification and appropriate critical value is planned to be studied in the future.

By applying each method of 5 times per person, we compared cases of successful acceptance and rejection case.(Table 6)

Table 6: Result of one Time Verification

Method	FailRatio (%)	SuccessRatio (%)
N/A	9.282	90.718
I	3.254	96.746
I + Ⅱ	2.010	97.990
I + Ⅱ + Ⅲ (1 retry)	0.287	99.713
I + Ⅱ + Ⅲ (2 retry)	0.096	99.904

Success ratio of recognition rate of templates enrolled in the form of not properly recognizing in the process of enrollment was improved by 6 percent by using No. (I) and No. (Ⅱ) techniques. In addition to this, it was found that there was also 2 percent of improvement in success rate of acceptance on first try when using No. (I + Ⅱ) and in the case of applying automatic re-attempt method No. (I + Ⅱ + Ⅲ) twice, all the users succeeded in being accepted on their first tries, excluding only one person which shows that there is

approximately 9.2 percent improvement when applying all the proposed techniques compared to the existing method which is not applied.

VI. CONCLUSION

The most important thing in the course of operating the biometric authentication system is credibility for the authentication results. The increasing credibility about the authentication results are possible by minimizing FAR and it is important. But we must consider the problem FRR will be rise because of an inverse relationship. As the result, a case not being recognized in a time to improve credibility may occur and result in inconvenience to users. In this study, it can be known that inconvenience that recognition of the principal is rejected in a time was significantly reduced by using the operation technique on the base of templated re-enrollment and automatic re-authentication. The methods presented in this study were researched on the base of results of the interface provided from the standard BIO_API, and can be operated by applying this technique even in other authentication systems that use the BIO_API standard interface. Moreover, this study suggests an operating technique which performs based on a requirement of existing frame work demanding re-enrollment for the case of that the quality of bio template is lower than the standard level when enrolling templates and if necessary, automatically encourages re-enrollment during customer's re-authentication based on authentication score obtained by operation of authentication system.

In future, methods to expand and operation techniques suggested in the composite authentication systems must be further researched for via a link with other different biometrics. And we will perform a study for the user's authentication [15] on the base of distribution processing in the environment such as limited sensor mobile network as in the existing studies in addition of the operation methods by expanding methods in the composite authentication system through the link with other biometrics. Furthermore, the study on future solution, applying an identifiable key based on many servers and authentication systems, for false reject, limitation from biometrics will be conducted as well [16, 17].

ACKNOWLEDGMENT

This research was financially supported by Hansung University

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Study of ADP Systems Interfaces

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Abstract---

Background/Objectives: The effective and timely exchange of operational and combat intelligence information such as plans, orders, situation reports, friendly forces status and enemy orders of battle is needed. We study the survivability of potential of the principal theater and tactical-level command and control facilities in Korea.

Methods/Statistical analysis: The study consists of two parts. Part I focused on specific operational need-lines for tactical communications interoperability. Part II concentrated on tactical level ADP system and fixed-site installations as well as transportable command posts (CPs) that support combined U.S. and ROK organizations.

Findings: Key considerations pertaining to improving the survivability of the command and control facilities are presented.

Improvements/Applications: The existing theater-level transportable command and control facilities are considered to be semi-survivable. Tactical-level CPs should be designed to be as survivable as the forces they control.

Keywords--- Automated Data Processing (ADP), Tactical Communications, Command and Control, Interoperability, Survivability.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

A joint communications system is consisted of the services and networks enabling joint and multinational capabilities. The mission of the joint communications system is to support the joint force commander (JFC) in command, control and communication (C^3) of tactical operations. The communications system should be interoperable, agile and trusted in order to provide the flexibility to dynamically changed battlefield environment. The J-6 represents the C^3Systems Directorate of the Joint Staff and is responsible for validating operational requirements, reviewing plans, and developing guidance to the U.S. armed forces for joint and combined C^3interoperability.The J-6 also provides business class Information Technology (IT) services and support to the entire Joint Staff[1]. The Joint Staff/J-6 has tasked the study to investigate ways of enhancing combined ROK and U.S. C^3interoperability.The objective of the study is to facilitate bilateral ROK and U.S. C^3planning and coordination efforts by pinpointing operational rationale for bilateral C^3interoperability, and providing assessments of survivability and interoperability of command and control facilities and C^3systems.

ROK TACCIMS (Theater Automated Command and Control Information Management System) can be one of the most important ADP (Automated Data Processing) systems in Korea peninsulasinceitcan support ROK and U.S. combined operations[2]. TACCIMS was developed as a combined system operating at the ROK U.S. classification level.

The original intent was to combine modern technology in hardware and software to provide CINCCFC (Command-in-Chief, Combined Forces Command), his component commanders, and their combined support staffs with a responsive command operations information management tool on all aspects of forces, threats, and the battlefield situation.

It was also intended to facilitate information exchange between command organizations and with systems supporting other functional activities such as intelligence and logistics.

Capabilities if particular significance include a Hangul-English bilingual translation capability and interfaces with other theater-level and tactical-level systems. The ROK is developing a ROK C^3ADP system that would support not only the theater-level organizations but also extend to the tactical levels.

Following this introduction, we describe literature review in section 2, the ADP systems in Section 3, survivability of command and control facilities in section 4, and conclusion in section 5.

II. LITERATURE REVIEW

During more than 50 years of military relationship, the ROK has increased its military power with remarkable speed with the help of the U.S. and its own efforts. The ROK was in the process of establishing a C^3systems and studied a Tactical Command and Control Systems Interoperability Program to address combined interoperability issues of US C^3I systems with those of allied and friendly nations in the Pacific area. Under the direction of Director for C^3systems, J6 was reorganized early in 1994 to better align to meet mission requirements. The Command History Division Office of the Joint Secretary Headquarters reported commander in chief U.S. pacific command history[3].The Systems Integration Division(J61) was merged into a new C^3 Systems and Integration Division (J64) and to get new functions. Most of the J61 functions became part of the C3 Systems Integration Branch within J4. Park [3]performed comprehensive study of U.S. and ROK C^3interoperability and studied the survivability of the theater-level combined command and control equipment and the ADP systems in detail. Morris and his coworkers [4]studied Systems of Systems Interoperability (SOSI) and Levels of Information System Interoperability (LISI) focusing on the increasing levels of sophistication of system of systems interoperability. Also they proposed Levels of Conceptual Interoperability (LCIM) model and NATO C^3Technical Architecture (NC3TA) reference model for interoperability. Lorraine Prior and his coworkers [5]studied the self-forming nature of MANETs(Mobile Ad-Hoc Networks) which has advantageous in a tactical military network and proposed the Tactical Network Integration Test Framework which is composed of three separate test environments, simulation, high fidelity emulation, and scalable emulation. Park[6] studied interconnection of joint tactical communications systems between U.S. TRI-TAC/MSE (mobile subscriber equipment) and ROK Army SPIDER system. The compatibility of the NAI (NATO Analog Interface) and SAI (SPIDER Analog Interface) based on STANAG 5040 and SPIDER network architecture were described in the paper. Hillestad and Moore[7]presentedTheater Level Campaign (TLC) model to improve analysis of theater-level joint-force issues for better simulation of C3I systems. This model is capable of examining the current security environment of analyzing C^3I capabilities and considering

broad scenario uncertainties in which our forces might be initially out numbered. For this work they used graphical user interfaces and state-of-the-art object-oriented simulation software.

III. ADP SYSTEMS

In this paper we propose three types of interface according to levels between two ADP systems, manual interface, partially automated interface and automated interface. Manual interface is one in which information must be manually extracted from one computer system and entered into a database of another computer system. Partially automated interface is one in which selected and predetermined data from a computer system may be automatically extracted or summarized for incorporation into a formatted report. Once the report is received by another system, corresponding data elements in the recipient system's databases may be automatically updated. Automated interface is one in which information exchange between two systems or components of a system can be accomplished without operator intervention. A human operator can still be involved and should select the proper input/output information.

A. Theater-Level Interfaces

Within the combined forces command structure, a variety of command and control information such as force status, orders, situation reports, order of battle, and intelligence reports must be exchanged between CFC and its component commands, between the theater-level and tactical-level commands, and between the combined and national commands. Figure 1 shows the most important systems interfaces and compares their existing interface capability with the needs. This figure is a symmetrical matrix. The first two columns list, respectively, the major theater-level commands and principal ADP systems available at each commands. An ADP system is considered to be accessible to a command organization if any part of the system such as mainframe processor and a workstation is available. The same information is repeated across the top of the matrix. The matrix cells indicate the interface capability between the corresponding ADP systems. Each cell is divided into two parts. The top part indicates the existing interface capability between existing systems or currently planned interface capability when a pending system for near-future fielding is involved. For interfaces involving a potential longer-future system such as ROK command and control ADP, the top part of the cell is left blank. The bottom part of a cell indicates the level of interface potentially needed to support the operational interface. Different patterns explained in the legend, indicate the specific level of interface. The intra-facility interfaces are enclosed in the bold-edge triangles.

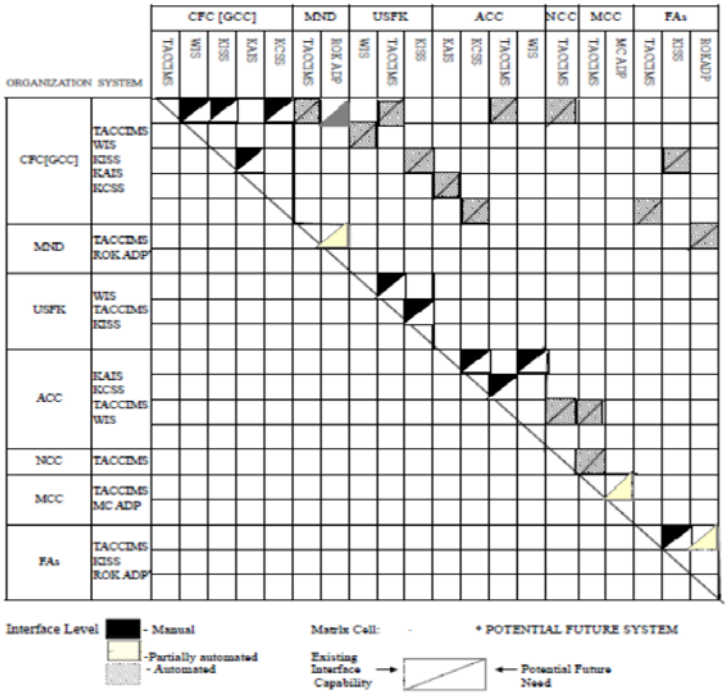

Figure 1: Capability and Need of Principal Bilateral ADP Interfaces- Theater-Level

The inter-facility interfaces are outside of the bold-edged triangles. The inter-facility interfaces involve interactions between components of the same system and therefore are already capable of automated interface. For example, information exchange between CFC (Combined Forces Command) and ACC (Air Component Command) can be accomplished over an interface between the TACCIMS workstations located in CP (command Post) TANGO, which is a U.S. military bunker complex in South Korea, and HTACC (Hardened Tactical Air Control Center). Similarly, an interface between the KCSS (Korea Combat Support System) computer in KCOIC (Korea Combat Operations Intelligence Center) and the KCSS remote terminal in CP TANGO can also support information exchange between ACC and CFC. A key consideration is determination of the specific types of information such as reports, messages and orders to be transferred over each interface. As shown in the matrix, an overall unified command and control system for the combined CINC (Commander in Chief) such as TACCIMS, while not precluding interfaces of other systems, would be the most logical means to support the overall coordination and information exchange among the theater-level commands. Such a system is where the cross-section of information covering operations, intelligence, and logistics matters is brought together. The availability of the system at almost all of the key commands also makes it logical choice to support coordination among the component commands, in addition to support CINCCFC (Commander in Chief, Combined Forces Command) interfaces with the component commands. To enable this, the unified command and control system must be able to effectively interact with thevarious command and functional systems such as KISS (Korean Intelligence Support System), KAIS (Korean Air Intelligence System), and KCSS. Most intra-facility interfaces are currently limited to manual interactions. Although messages or reports prepared on one system can be exported as an ACSII file and then imported toanother system for viewing (commonly referred to as the air-gap method of information exchange), manual method is still required to extract pertinent information from incoming messages and reports to update the resident databases or to prepare messages and reports using information from the database. A partially automated capability to perform these tasks, referred to as parsing, would significantly reduce time required for the maintenance and utilization of up-to-date information and preparation of messages, reports, and briefings. The parsing capability will facilitate coordination between separate commands as well as functional elements within the same command. To acquire this capability, pertinent information between the interfacing systems' databases needs to be identified, standard messages/report formats need to be established, and operating procedures for information exchange and database update need to be agreed on. A structured message format such as the U.S. MTF (Message Text Format) is of particular importance in the Korean theater because of its potential in reducing the language difficulty in voice, record, and computer-to-computer communications between U.S. and ROK commanders and their staffs. The MTF can also be complementary to the automated Hangul-English translation capability under development in the TACCIMS program by harnessing the scope of the vocabulary and phrases that would require bilingual translation. A bilateral ROK and U.S. MOU (Memorandum of Understanding) has been executed to address, among others, the MTF.

B. Combined Ground Operations

The timely exchange of plans, orders, reports, fire support requests, and boundary and target information is essential between adjacent U.S. Army and Marine Corps and ROKA ground units, or between a unit and its superior command. Figure 2 summarizes the identification and assessment of principal bilateral ADP interfaces for ground operations. Although only a few matrix cells are marked as potentially needing ADP interfaces, it should be remembered that each cell represents a large number of real-world interfaces when considering the multiple units and echelons involved in each functional operation.Because CFC and GCC (Ground Component Command) are supported by the same theater-level command and control ADP systems, the only interface involving existing or pending systems is between the theater-level TACCIMS supporting CFC, CFA (Combined Field Army), and ROKFA (Republic of Korea Field Army), and MCS for U.S. Army tactical units. As currently planned, this interface in intended to be manual. However, for the same reasons discussed above concerning the theater-level interfaces, a semi-automatic interface with a parsing capability should be considered. Other interfaces to be most important involve future systems. Among them, the ROKA fire support (FS) and ROKA air defense (AD) systems are merely generic names. There is no evidence that such systems are being developed or planned by the ROK government at present. However, given the trend towards automated support and the need for real-time information exchange between the fire support units and between the area air defense units, the systems are included here as a reminder of the need to bilateral automated interfaces if such systems were to be developed or planned.

IV. SURVIVABILITY OF COMMAND AND CONTROL FACILITIES

This section discusses the survivability of potential of the principal theater- and tactical-level command and control facilities. These include fixed-site installations as well as transportable command posts (CPs) that support combined U.S. and ROK organizations. The physical characteristics of the primary wartime command and control facilities are listed in Table 1. CP Seoul and the new CC (Command Center) Seoul appear on the list because they are the major command centers during the process of transitioning from peace to a wartime posture. The table characterizes physical survivability in terms of structure hardness and transportability. Other considerations include the distance from DMZ (Demilitarized Zone) and potentially significant vulnerabilities of communications ingress and egress.

A. Fixed-Site Facilities

The semi-hardened and hardened facilities need to be discussed individually. The new CC Seoul is semi-hardened. It is vulnerable, for example, to air attack and sabotage, but the facility would allow the main command and control center to remain at Yongsan longer than would otherwise have been possible during the transition period before CP TANGO is fully operational. The main wartime site for CFC staff and certain USFK elements is CP TANGO. The facility should be able to withstand any direct attack by conventional air- or ground-delivered weapons that depend on blast, fragmentation, or penetration for their destructive mechanisms. The third tunnel incorporates a biological-chemical protection and overpressure capability. However, CP TANGO could still be vulnerable in two Areas.

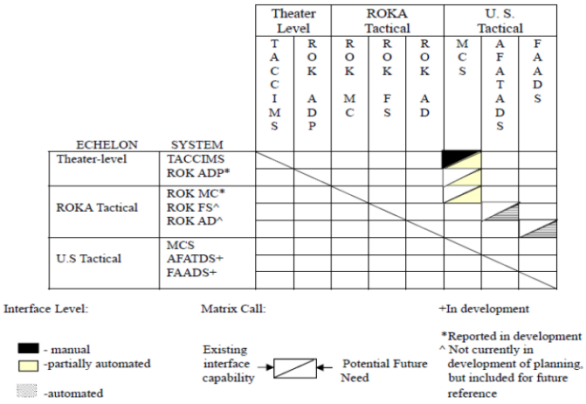

Figure 2: Capability and Need of Principal Bilateral ADP Interfaces - Tactical Ground Operations

Table 1: Summary Assessment of C2 Facility Survivability

Command	Peace	Main	ALT	Facility	Physical Hardness	Bio-Chem Protection	Over Pressure Protection	Distance Form DMZ	Communications Outlets
ROK MND	x			B2Bunker	Soft	No	No	45km	
		x			Hardened	No	No	60km	
USFK	x			Now CCSeoul	Soft	No	No	45km	
		x		Camp walker	Soft	No	No	28km	
CFC(GCC)	x			NowCC Seoul	Soft	No	No	45km	Twoentry points
		x		CP TANGO	Very Hard	3rd Tunnel	3rdTunnel	60km	Road Warrior
			x	Alternate CP	Transport	No	No	280km	
ACC	x	x		HTACCKCOIC	Very Hard	Yes	Yes	90km	Few entry points
NCC	x	x	x	CNCC Bunker	Semi Hard	No	No	355km	
CFA	x	x		CFA Bunker	Hardened	No	No	60km	
F/T RPKA	x	x		Garrisons	Soft	No	No	60km	
			x	Alternate CP	Transport	No	No	60km	

The first is the lack of a chemical and biological button-up capability for the first two tunnels. These tunnels are highly vulnerable to chemical attack through their own ventilation system because the air intakes

are just inside the main entryways where chemical weapons could be readily delivered by aircraft or mortar. The second potential vulnerability is in the outlets to the communications transmission system or other command and control organizations outside of the TANGO facility. The fiber optics cables enter the facility at one of the tunnels. Although the cables are buried underground they can be served by hostile actions. The satellite and microwave terminals outside of the facility are exposed in an open area and are therefore vulnerable. The HTACC (Hardened Tactical Air Control Center) and KCOIC (Korean Combat Operations Intelligence Center) were built to be highly survivable facilities in a nonnuclear war. They were designed to withstand a direct hit by a 2,000-lb bomb. The HTACC facility is equipped with a button-up capability for up to 14 days to provide protection against the immediate and delayed effects of chemical attack. However, the entry and exit of the communications cables for the facility are centered at few locations. Being a key facility only 90 km from the DMZ, the HTACC is expected to be heavily targeted by the North Korean forces. Resulting attacks could seriously damage primary communications connectivity. Virtually all of the other KTACS facilities, including the ROK CRCs (Control and Reporting Centers) and CRPs(Control and Reporting Posts) are housed in soft facilities. The NCC (Navy Component Command) command bunker at Chinhae (where is located in the province of Kyong Sang Nam Doo on the southeast coast of the Republic of Korea)is a converted ammunition bunker dating from World War II. Although it can only be considered to be semi-hard against conventional general purpose bombs, its extreme southern location makes a North Korean air attack unlikely; on the other hand, its proximity to the coast increase the likelihood of attack by SOF (Special Operational Forces) personnel inserted from the sea.

B. Transportable CPs

The survivability of transportable command and control facilities varies with the level of HQs supported and the tactical situation. The transportable CPs are soft against a direct attack, but frequent relocation makes them difficult to target. The existing configurations of most theater-level CPs are not agile enough to maintain a high degree of uncertainty in the enemy's knowledge of their positions, but the multiplicity of vehicles in each CP and local dispersion would lessen the odds of catastrophic loss graceful degradation under attack. The CFC Alternate CP is a combination of vehicles, equipment, and personnel for CINCCFC and a small battle staff to move out CP TANGO and operate from the Daegu (where is located in south-eastern Korea about 80 kilometers from the seacoast)area or another suitable field location if situation warrants.

V. CONCLUSION

In this paper, we described specific operational need-lines for tactical communications interoperability and also tactical level ADP system and fixed-site installations as well as transportable command posts (CPs) that support combined U.S. and ROK organizations. We found that the existing theater-level transportable command and control facilities are considered to be semi-survivable. The tactical-level CPs are designed to be as survivable as the forces they control. A key element of the Alternate CP is the transportable Road Warrior communication equipment, which provides CINCCFC with connectivity to other key commands and facilities.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Perception of Art Therapy in Adults through Concept Mapping

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Abstract---

Background/Objectives: This study aimed to investigate the perception of art therapy in adults through concept mapping.

Methods/Statistical analysis: Therefore, the researcher selected 15 adults from Jeollabuk-do province, and their statements were obtained through an interview. Furthermore, 20 adults residing in Jeollabuk-do were tasked with classifying and rating the collected statements. Data from the classified statements were subjected to multidimensional scaling and a hierarchical cluster analysis. The rating data were examined to evaluate the importance of each question and cluster.

Findings: The following concept map was developed from the findings of the study: firstly, there were two dimensions ("effects of the concept of art therapy" and "social expectation - personal expectation"); secondly, within these two dimensions, a total of 6 clusters (a general idea, a subject needing help, personal exploration and acceptance, improving relationships and growth, feeling and conflict resolution, and therapeutic relationships) were found.

Improvements/Applications: Results of the study suggested that the adults recognized art therapy as a necessary treatment to resolve personal problems or concerns.

Keywords--- Art Therapy, Perception of Art Therapy, Concept Mapping, Multi Dimensional Scaling, Hierarchical Cluster Analysis.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Art therapy utilizes the medium of art to safely and effectively explore psychological problems[1]. Some forms of art therapy utilize paintings. Utilizing paint media in psychological therapy has the advantage of being easy for all ages to approach, as it reduces burdens and repulsions. Moreover, painting exercises can be utilized for the emotional control, self-realization, and self-acceptance of clients in a therapeutic manner [2].Art therapy is also utilized to develop psychological stability in clients, as well as to improve their quality of life. Such therapeutic effects indicate that art therapy can sufficiently be used for normal adults [3]. However, research into the necessity of art therapy revealed that 83.3% of those studied responded that art therapy was "not necessary."As such, exploring the perception and the need for art therapy for normal adults seemed to be a necessary stage in the growth process of art therapy[4].

With reference to the studies on the perception of art therapy carried out in Korea, Cho [5]examined the perception of elementary school teachers and students to develop an art therapy program for elementary school students. Paik[6] conducted a study on the status of art therapy with art therapists and centre directors in the regional children's centers in Metropolitan Seoul. Baek[7]conducted a study on the perceptions of university students on art therapy. Lee [8]examined the level of perception and expectations of middle school students to apply art therapy within the school system. Shin [9] conducted a study on the perceptions and requirements for art therapy in parents of young children, elementary school students, and therapy experts. Majority of the studies examining the perception of art therapy have focused on parents, to apply art therapy to normal and disabled children, or have focused on the perceptions of teachers, to apply it in the field of education. Currently, there is a lack of studies researching the perception of adults regarding applying art therapy for them[5,6,7,8].

Current perception studies have reported that most people consider children with special-needs, and those with disabilities or psychological handicaps to be the targets of art therapy. These results indicate that the general public does not view adults as targets of art therapy [7]. As such, the objective of this study was to examine the perceptions of adults on art therapy through concept mapping. It is expected that the findings of this study could be utilized to provide art therapy programs to a diverse range of targets including children, young adults, and psychologically handicapped and disabled individuals. The following were the research questions:

What are the classifications of art therapy as perceived by adults?

What is the level of importance of art therapy as perceived by adults?

II. THEORETICAL BACKGROUND

A. Understanding Art Therapy

Art therapy is a psychological therapy that utilizes visual art and the creative process inherent in such activities to engage in communication and catalyzing clients [10,11]. Art therapy aims to utilize art media to allow the client to experience the creative process, aiding him/her in true self-exploration and self-expression. Through such a process, the client is able to overcome psychological problems from a therapeutic or preventive perspective, achieving a state of rest [12]. Art therapy is useful in conscientizing the unconscious. Art therapy has the effect of morphing various emotions in a method that is socially acceptable within the creative exercise. These functions allow the client to revisit their emotions, and experience change and growth within the self. Moreover, it also catalyzes communication and interaction with others[13].

III. STUDY METHOD

A. Study Participants

This study recruited adults aged between 19 to 60 years, with no problems in cognitive function, to identify their perceptions of art therapy. Moreover, in consideration of the possibility that the interview may not proceed as expected, one criterion was that the target has at least heard of the term "art therapy" or those with interest in art therapy.

Ultimately, 15 individuals living in Jeollabuk-do participated in the idea extraction process. The basic information of people participating in the interviews has been displayed in Table 1.

Table 1: Interview Participants

Participant	Gender	Age range	Occupation
A	F	20s	Office work
B	F	20s	Post-graduate
C	M	20s	Student
D	M	20s	Student
E	F	20s	Service sector
F	F	20s	Looking for work
G	F	50s	Full-time housewife
H	M	30s	Professional
I	F	20s	Social worker
J	F	20s	Kindergarten teacher
K	F	20s	Public service
L	M	20s	Student
M	F	20s	Student
N	M	40s	Architecture
O	M	20s	Post-graduate

Out of the 15 participants who were a part of the idea extraction process, 13 were involved in classifying and ordering the ideas. Subsequently, 7 participants who did not participate in the idea extraction process were included. Thus, the statement classification process included 20 adults residing in Jeollabuk-do, composed of 7 males and 13 females. The age ranges of the participants were 11 individuals in their 20s, 4 individuals in their 30s, 2 individuals in their 40s, and 2 individuals in their 50s. While this study attempted to select adults belonging to different age ranges, the proportion of individuals in their 20s was relatively higher.

B. Study Process

The concept mapping methodology utilized in this study refers to a series of processes and steps that explore and document the structure of one phenomenon or experience that is known or experienced by a certain group or an individual[14]. One characteristic of the concept mapping methodology is that the study participants directly participate in the study, which is followed by interviews, data construction, and classification. Moreover, the following statistical analysis allows for the visualization of constructs and cognitive structures contained within the data in the form of pictures or maps. This study has utilized the 5 stages of concept mapping suggested by Kane &Trochim[15].

C. Concept Mapping Preparation

This stage involves the development of focus questions for the interview and selecting appropriate participants for the study. While the methodology does not limit the number of participants [14], they are formed with a minimum of 8 to a maximum of 40 participants[16].In the present study, the researcher constructed several examples of focus questions, and identified the following single focus question by consulting the guiding professor: “What expectations would you have when receiving art therapy? Please specify the kind of help you wish to receive.”

D. Idea Extraction

In the idea extraction stage, interviews were conducted with the participants to form idea statements around the focus question. The interviews were conducted through a brainstorming method to allow the study participants to freely speak about various thoughts while minimizing the opinions of the researcher. Prior to the interview, the study participants were briefed on the purpose and methodology of the study. The interviews were about 10 to 30 minutes long, with an average of 20 minutes, and were conducted over 2 weeks, from January 23 to February 6, 2016.

The interviews were recorded after receiving the participants’ approval prior to the interview, and the recordings were transcribed verbatim. To extract the idea statements, the 4 stages of qualitative analysis suggested by Giorgiwas utilized. First, the recorded data and transcripts were examined considering the overall scope of the study. Second, the semantic units were identified with a focus on the study purpose. Third,

the extracted semantic units were examined again and reworded to best reflect the participants' ideas. Fourth, they were reconstructed into sentences by reflecting on the thoughts of the study participants to the maximum extent possible, and repetitive content was merged[17]. This stage was monitored by the guiding professor to increase the reliability of the study, and resulted in a total of 65 idea statements.

E. Structuralizing Statements

In this stage of statement structuralizing, the researchers met the study participants separately, to engage in the classification and rating of the statements. Each of the 65 idea statements regarding the perceptions on the art therapy were displayed on a card. In the classification process, the study participants read the statement cards and classified them into groups that they thought were synonymous. Certain restrictions were provided, namely that one could not classify all cards into one group and each group should contain more than two cards, and the participants were free to form their own card groups[18].

After the statements were classified, the participants wrote down the names of the classification groups. The statement rating process was completed to identify the importance of the statements. For the rating process, a pre-constructed survey with a 5-point Likert scale was used. The scale ranged from 5 points, where the participant strongly agreed with the card, 4 points for agreeing, 3 points for neutral, 2 points for disagreeing, and 1 point for strongly disagreeing. The classifying and rating process took 30 minutes to 50 minutes, with an average duration of 40 minutes. It was carried out over 2 weeks, from March 1 to 14, 2016.

F. Analysis of Concept Maps

During this stage, the statistical program SPSS 23.0 was utilized for multi-dimensional scaling and cluster analysis. Prior to the multi-dimensional scaling process, the statement classifications were coded. The coding method was such that the sentences grouped together were coded as 1 and those not grouped together were coded as 0, resulting in a 65×65 similarity matrix for each study participant.

When the individually constructed similarity analyses are added and are subject to the multi-dimensional scaling process, statements are located as points on a table. The location of the points becomes closer for sentences that are more frequently grouped together and farther away for those that are not [15]. Next, with the resulting x and y values from the multi-dimensional scaling, hierarchal clustering was conducted to examine how the sentences were grouped. This study also calculated means and standard deviation values for the data from the statement ratings to examine the importance of the art therapy perceptions.

G. Interpreting Concept Maps

Lastly, this study utilized the idea statements, the results of the multi-dimensional scaling, the results of the cluster analysis, and the statement ratings to interpret the concept maps. This study examined how the statements relating to the perception of art therapy reported by adults residing in Jeollabuk-do and the relationships between these statements.

IV. STUDY RESULTS

To identify how normal adults perceive art therapy, interviews were conducted in the present study, resulting in 65 statements. The extracted statements were then classified and subject to multi-dimensional scaling. In the process of multi-dimensional scaling, it is important to fully reflect the information from the original data in the lowest and the most simplified dimension to visualize the data. The 2-dimensional measure of agreement utilized in this study was .32(R^2=.61), and it met the standards of the measure of agreement suggested by Kane &Trochim[15] from .205–.365. Then, cluster analysis was conducted with the X and Y coordinates created from the multi-dimensional scaling. Based on the dendrogram and the cluster schedules derived from the analysis, similarities within the clusters were confirmed. Lastly, a total of 6 clusters were selected considering the contents of the statements contained in the clusters. A concept map of the participants' perceptions of art therapy has been presented in Figure 1. This study analyzed adults' perceptions of art therapy from a two-dimensional perspective to construct the concept map. As a result, left-hand side was termed "art therapy effects" and right-hand side was termed "art therapy concepts" in the first dimension. In the second dimension, the lower portion was termed "social expectations" and the higher portion was termed "individual expectations."

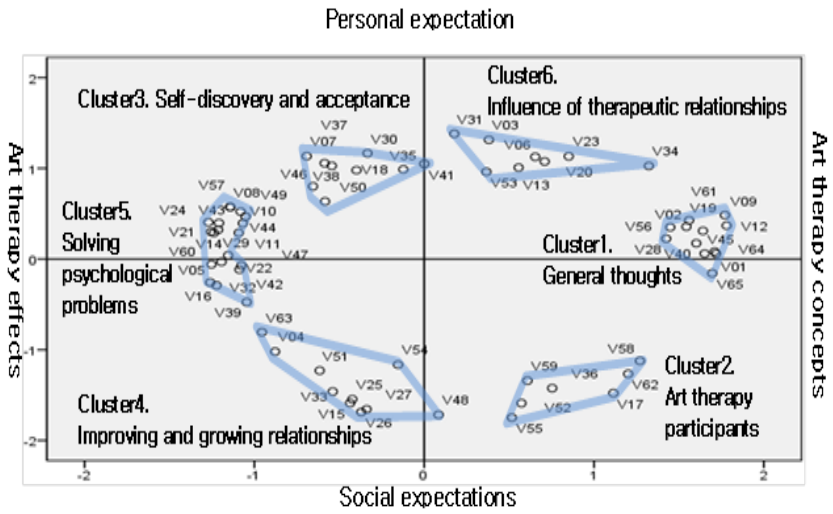

Figure 1: Concept Mapping

There were 6 statement clusters within the two dimensions, namely, “Cluster 1. General thoughts,” “Cluster 2, Art therapy participants,” “Cluster 3.Self-exploration and acceptance,”“Cluster 4.Improving and growth in relationships,” “Cluster 5, Solving psychological problems,” and “Cluster 6. Influence of therapeutic relationships.” The clusters, statements within the clusters, and the averages of the clusters have been shown in Table 2.

It is possible to view the characteristics of each group when the 6 clusters are examined on a two-dimensional map.

Cluster 1 and Cluster 6 showed characteristics relating to art therapy concepts–individual expectations. Cluster 2 showed characteristics relating to art therapy concepts–social expectations. Cluster 4 showed characteristics relating to therapeutic effects–social dimension. Cluster 3 showed characteristics relating to art therapy effects–individual expectations. Lastly, Cluster 6 was located in the middle of the two characteristics of art therapy effects–social expectations and art therapy effects–individual expectations.

Table 2: The final Statement

Art therapy statements perceived by Jeollabuk-do adults		Importance	
		M	*SD*
Cluster 1. General thoughts (12)		3.86	.36
1	I think that it is one of the various methods of psychological therapy	4.10	.85
2	As it uses pictures, I would think that people who reject psychological therapy would approach it better	3.90	1.07
9	I think that it would give insights about the psychology of the person who drew the art	3.65	.48
12	I think that it is a method of counseling that utilizes art as a medium	3.85	1.09
19	I think that it would be less burdensome than talking as the participants talk via paintings	4.10	.64
28	I think that it would be fun because the participants paint and talk about it	3.90	1.02
40	I think that working on art would help the participant focus	3.65	.99
45	I think that the therapy would be more effective when participants enjoy art	3.80	1.20

56	I think that it would help the participant to engage in proper expression through painting	3.35	1.04
61	I think that it would entail drawing and talking, as directed by the therapy administrator	3.05	1.15
64	I think that it would be good if the therapy administrator puts their heart on it	4.45	.89
65	I think that it would be beneficial if people expertly trained in art therapy would engage in therapy	4.50	.83
Cluster 2. Art therapy participants (7)		3.59	.46
17	I think that it is effective in reducing the problematic behavior of normal and disabled children	3.60	1.27
36	I think that it would help people with psychological diseases live a normal life	3.25	.97
52	I think it is useful in preventing dementia	3.70	.92
55	I think it is beneficial in child rearing or raising	4.00	.73
58	I think it is necessary for adolescents to tend to rebel	3.65	.93
59	I think it could be good if I do it with the people around me	4.15	1.04
62	I think it is beneficial for people who need to stay away from alcohol or cigarettes	2.75	1.25
Cluster 3. Self-exploration and acceptance (9)		3.87	.18
7	I think it is possible to explore the part of me that I didn't know	4.05	.76
18	I think that I'd feel consoled during the therapy	3.90	.79
30	I think that it is easier for me to accept myself through it when compared to other people talking about me	3.95	.94
35	I think that it could counsel me during problems	3.55	.89
37	I think that I could express the real me	3.65	.88
38	I think that I can understand what my character is like	3.70	.80
41	I think I would like it as it gives me someone to listen to my stories	4.05	1.05
46	I think that it presents an opportunity for me to understand my psychological state	4.00	.79
50	I think that I could reveal the negative feelings that I cannot display normally during therapy	4.00	.97
Cluster 4. Improving and growing relationships (10)		3.45	.31
4	I think it cures broken hearts	3.90	.91
15	I think that it solves difficulties stemming from human problems	3.15	.93
25	I think that it teaches methods of communicating with people	3.30	.86
26	I think that this creates an opportunity to have deep conversations with family	3.45	1.00
27	I think that I will realize the importance and the value of family	3.15	.93
33	I think that I could solve various conflicts (with family, friends, religion, etc.)	3.25	1.07
48	I think that I will have a better time adjusting to the society	3.20	1.01
51	I think it helps individuals to grow independent when the individual is dependent and without an opinion of his/her own	3.30	1.22
54	I think that it provides psychological support for those that are intimidated	3.90	.85

63	I think that it provides incentives for me to move forward	3.85	.81
Cluster 5. Solving psychological problems (19)		3.59	.23
5	I think it will change my character	3.30	.98
8	I think it would remind me of the problems that I have	3.85	.67
10	I think it will tell me how to solve the problems that I have	3.35	.93
11	I think it will resolve my stress	3.85	.81
14	I think it will let me know of things I truly want to do	3.45	.89
16	I think it will be beneficial in displaying emotions	3.80	1.01
21	I think it is beneficial in achieving psychological stability	3.85	.67
22	I think it will change my negative thoughts to positive	3.60	.94
24	I think it will improve my self-worth	3.60	.82
29	I think it teaches methods to healthily address my emotions	4.00	.73
32	I think it would fix my problematic behavior or erroneous living patterns	3.50	1.05
39	I think it helps in living a stable life	3.15	.88
42	I think it helps in correcting my skewed ways of thinking	3.20	1.01
43	I think it teaches me to value myself	3.50	.95
44	I think it helps me escape the trauma that haunts me	3.70	.92
47	I think that it helps to overcome the psychological difficulties I face	3.50	.83
49	I think that it helps attain a balance between the inner and the outer me	3.50	.76
57	I think that it frees the portion that is suppressed within me	3.70	1.08
60	I think it would help me to have a lighter heart	3.80	.83
Cluster 6. Influence of therapeutic relationships (8)		3.79	.35
3	I think that the therapist would understand me even if I do not say anything	3.60	.94
6	I think that I can express my heart through pictures	3.95	.83
13	I think I can unload all the things that I haven't been able to tell before	3.60	.99
20	I think that I feel a sense of achievement by completing the art	4.10	.64
23	I think the therapist will understand me	3.55	1.10
31	I think my unconsciousness would show in the art	4.40	.68
34	I think the therapist will see right through me	3.30	.80
53	I think I will feel warmth during therapy	3.85	1.09

V. DISCUSSION AND RECOMMENDATIONS

This study examined the perceptions of adults on art therapy through the concept mapping method. The statements contained in the cluster "General thoughts" mainly constituted assumptions on the content of art therapy and shed light on what the adults though about art therapy. Statements with high importance included, "I think that it is one of the various methods of psychological therapy (*M*=4.10)," "I think that it would be less burdensome than talking as the participants talk via paintings (*M*=4.10)," "I think that it would be good if the therapy administrator puts their heart to it (*M*=4.45)," and "I think that it would be beneficial if people expertly trained in art therapy would engage in therapy (*M*=4.50)."As such, the adults perceived art

therapy as psychological care or counseling. In keeping with the findings of Yoo[19], the above results are in line with the results of previous studies that the expertise and reliable attitude of the therapy administrator is valued in art therapy. These results indicate that, as the adults perceive art therapy as psychological care or counseling, the expertise and the reliability of the therapy administrator are relevant.

The "Art therapy participants" included those who the study participants considered art therapy beneficial for. Statements with high importance included, "I think it is beneficial in child rearing or raising (*M*=4.00)" and "I think it could be good if I do it with the people around me (*M*=4.15)."These results indicated that the adults considered specific groups to be predetermined targets of art therapy. Go's[20]study indicated that art therapy is currently carried out with children or adolescents. Moreover, studies on the perception of art therapy indicate that people perceive art therapy as something received by children or adolescents[9,19]. As such, it can be seen that the adults perceived art therapy as a method of child rearing rather than being used directly on adults.

"Self exploration and acceptance" was rated as the most important among the 6 clusters. Major statements included, "I think it is possible to explore the part of me that I didn't know (*M*=4.05),""I think I would like it as it gives me someone to listen to my stories (*M*=4.05),""I think that it presents an opportunity for me to understand my psychological state (*M*=4.00)," and "I think that I could reveal the negative feelings that I cannot display normally within therapy (*M*=4.00)," indicating that the study participants expected to understand the self and undergo relevant changes through art therapy. Baek[7] indicated that majority of university students regarded art therapy as being useful in advancing self-expression or individual change. These results indicate that the adults view the effects of art therapy as the process of self-change through the stage of self-exploration and acceptance within art therapy, and consider such effects to be of importance.

"Improving and growing relationships" included statements on expectations regarding resolving problems found in interpersonal relationships through art therapy. The importance rating of this cluster was low. While the majority of studies on the perception of art therapy reported that art therapy was considered useful in interpersonal relationships, the level of perception regarding art therapy as being useful in individual change was higher [7, 8]. As such, it shows that the adults placed higher importance on self-exploration rather than on receiving help on interpersonal relationships from art therapy.

"Solving psychological problems" included statements relating to the expectation of adults to recognize and resolve individual psychological problems, which would eventually lead to a stable lifestyle. Specifically, statements such as, "I would think it teaches methods to healthily treat my emotions (*M*=4.00)" and the content of the statements in other clusters indicated that the average adult sought assistance and depended on art therapy for leading a stable life. These results indicate that exploring the psychological and emotional problems of adult participants and helping them to resolve these problems are important in art therapy.

In the cluster "Influence of therapeutic relationships," the study participants thought that there would be therapeutic effects in the relationship with the therapy administrator or an individual piece of art in art therapy. Specifically, statements such as, "I think that I feel a sense of achievement by completing the art (*M*=4.10)" and "I think my unconsciousness would show in the art (*M*=4.40)" indicated that the average adults perceived that the experience of therapeutic relationships with the work of art and the therapy administrator would have healing effects. Choi [21] emphasized on the importance of therapeutic relationships between the visual media, the client, and the therapist act as a factor that maximizes therapeutic effects. These results show that art therapists must recognize the importance of the art and the therapist within therapy sessions, and it is important to forge stable therapeutic relationships.

Lastly, a comprehensive examination of the perceptions regarding art therapy through idea statements showed that majority of the statements viewed the art therapy as a form of therapy beneficial for self-exploration or for resolving negative emotions and conflicts. These ideas showed no difference to those generated from perceptions of other psychological care or counseling methods [22, 23]. However, this perception included statements that mentioned art as being beneficial in therapy and that it would reduce burdens. This indicates that the average adults regarded art therapy as being less burdensome and fostering talkingabout their problems freely, and eventually, solving their problems and issues, because art therapy utilizes art as the medium. Based on the considerations and the discussions of the findings of this study, the following studies are recommended in future. First, as this study limited its participants to adults residing in Jeollabuk-do, it poses restrictions in extrapolating the results to the perceptions of all adults. As such, studies involving participants from various regions are required.

Second, this study has only examined the aspects relating to the expectations of art therapy; however, the interview content also contained rejection or concerns regarding art therapy. These have been excluded as they were not sufficient to be included in the study. However, it would be beneficial to understand the reasons why one would not want to receive art therapy, to subsequently use these reasons to improve adult perceptions on art therapy.

Third, as the statements in this study began with “I think …,” they represented the participants’ guesses regarding art therapy. As such, this study could examine the perceptions of adults on art therapy, but could not accurately portray what adults wanted from art therapy. As such, through comprehensive and accurate study formation, follow-up studies exploring the demands of adults from art therapy are required.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

RMS-ME: A Real-Time Remote Monitoring System for the Multiple Elevators

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Abstract---

Background/Objectives: Traditional elevator monitoring and maintenance has not changed at all over time. Furthermore, small and medium elevator companies have been made lots of difficulties due to technical issues.

Methods/Statistical analysis: We propose the RMS-ME system capable to real-time remote monitoring and maintenance for the multiple elevators. The proposed RMS-ME system is to integrate, manage and process many events coming in real time through various sensors from the multiple elevators for the safe operation of elevators.

Findings: The RMS-ME system provides monitoring and recoding for all events, status monitoring of each elevator, search for any events, the impact level detection by the gyroscope sensor per each elevator, emergent voice recognition. To do this, we analyze the extended communication protocol of elevator. This protocol defines the TCP/IP communication protocol between the set-top box within each elevator and the monitoring server to transmit and receive all state information including sensor information as well as any error codes of the multiple elevators. It transmits to the monitoring server via the network after a set-top box within each elevator collects any error codes and sensor information of each elevator. Therefore it is able to support fault monitoring, remote maintenance, emergency detection as well as fundamental operation state information of the multiple elevators.

Improvements/Applications: In future, the proposed RMS-ME will be a valuable application cooperating with the IoT for elevator maintenance and monitoring of the small and medium elevator companies

Keywords--- Remote Monitoring System, Multiple Elevators, Elevator Safety, Emergency Voice Detection, Internet of Things.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

With the development of industries, higher requirements are placed on the safety, security, reliability and complexity for elevators[1,2,3,4].

But, except for the multinational elevator enterprises such as Schindler, ThyssenKrupp Elevator(TKE), Otis, Hyundai elevator, most of domestic small and medium elevator manufacturers have been made lots of difficulties due to technical issues of government regulations[1,4-8].

So, this paper proposes the RMS-ME as a real-time remote monitoring system for the multiple elevators. The proposed RMS-ME system is to integrate, manage and process many events coming in real time through various sensors from the multiple elevators for the safe operation of elevators[4]. To do this, it provides monitoring and recoding for all events, status monitoring of each elevator, search for any events, the impact level detection by the gyroscope sensor, any emergent voice recognition.

Therefore it is able to support remote maintenance, fault monitoring, emergency detection as well as fundamental operation state information of the multiple elevators[1-3,9,10].

In the near future, the proposed RMS-ME system will be a valuable application cooperating with the IoT(Internet of Things)for elevator monitoring and maintenance of the small and medium elevator companies[1,4,10].

II. RELATED WORKS

Traditional elevator monitoring and maintenance has not changed at all over time[1,2,10]. At best, in the late 1980s,remote monitoring of elevators appeared. While remote monitoring would alert the elevator manufacturer when an elevator had a breakdown, it did not in and of itself reduce the number of breakdowns. A decade later in the 1990s, the model evolved to usage-based maintenance : a concept based around modificatory the level and frequency of repairs dependent on each elevator's usage. In the elevator industry, the methodology covered the way for gradual progression towards more condition-based repairs[2,10].

While these systems were in line with the technology and services available at the time in which they were introduced, fast forward 30 years and the evolution of cities has rendered these methods unsuitable and ineffective for modern-day building needs. A powerful new methodology to take the learnings of these earlier maintenance method and incorporate the benefits of the new technologies and systems was needed to create a new efficient and effective practice for elevator repairs to enhance wholly building efficiency.

As a representative case, TKE Americas is the largest manufacturer of elevators in the Americas, servicing and maintaining more than one million elevators around the world. TKE's data-driven maintenance technology, MAX, incorporates the efficiency targets and operational learnings of prior repairs processes, and consolidates them with newly available technological solutions to create an advanced system capable to transition to a more proactive and predictive maintenance approach driven by real-time data and rich, valuable insight. At present, TKE is implementing the IoT to remotely manage and monitor more than 70,000 elevators in the U.S. and more than 200,000 worldwide[10].

By contrast, most of domestic small and medium elevator and lift manufactures have been made lots of difficulties due to technical issues of government regulations[1,4].

III. THE RMS-ME DESIGN

The proposed RMS-MEis a real-time remote motoring system for the multiple elevators that are able to integrate, manage, and process any real-time multiple signal sources incoming through the various sensors at each elevator. Therefore it can provide current operation status, emergency voice detection, monitor of operation failure as well as the original operation information for the multiple elevators.

The whole system model for constructing the RMS-ME consists of the multiple elevators, one database server, Web-based client/server system, and a set-top box per each elevator, as shown in Figure 1[4].

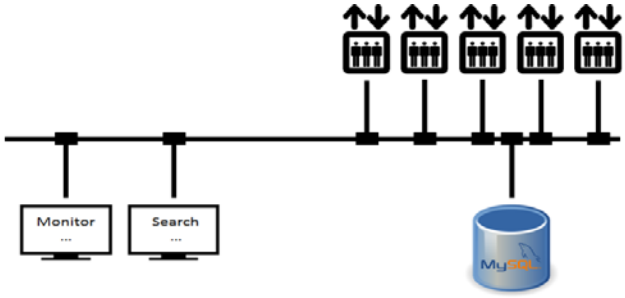

Figure 1: Design of the RMS-ME

To do the proposed RMS-ME, we analyze the extended communication protocol of elevator. The following Figure 2shows a structure of the extended communication protocol for elevator.

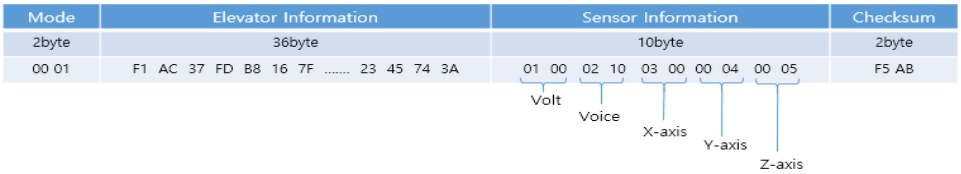

Figure 2: A Structure of the Extended Communication Protocol

This protocol defines the TCP/IP communication protocol between the set-top box within each elevator and the monitoring server to transmit and receive all state information including sensor information as well as any error codes of the multiple elevators[1,10]. It transmits to the monitoring server via the network after a set-top box within each elevator collects any error codes and sensor information of each elevator.

The 2 bytes of the Mode as shown in figure 2 is a unique hexadecimal code number of elevator manufacturers. And, the Elevator Information means all the information relating to the operating status of each elevator. For example, one word at the address 2302 indicates the operation mode. Which the mode value is 1 means the manual operation mode. Also, the value of automatic operation mode is 5, the value 10 is the fire operation, the value 12 is the fire control operation, and the value 17 means the generator operation mode, and so on. The first 2 bytes of the Sensor Information mean the intercom volt(0~18.2 volt). The next 2 bytes is the ratio of voice level (0~100%). The rest X, Y, Z-axis values of the gyroscope have a degree value from 0 to 360 respectively.

Due to the result of analyzing and managing the protocol, the main functions and roles of the proposed RMS-ME are depicted as follows:

1) Monitoring and recoding for all events.
   - Transferring the events by the set-top box within each elevator whenever any errors occur.
   - Recording the events in a database by the server.
   - Displaying on the client web browser the values corresponding to the events.

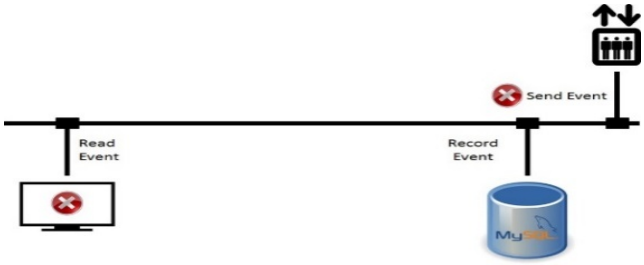

Figure 3: Monitoring and Recoding for All Events

1) Status monitoring of each elevator.
   - Requesting the status of the desired elevator by the operator.
   - Transmitting the current state information to the server by the selected elevator.
   - Displaying the status to the client web browser.

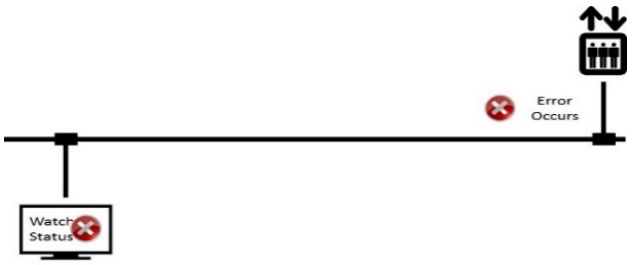

Figure 4: Status Monitoring

1) Search for any events.
   - Requesting the recorded events corresponding to the desired elevator.
   - Searching the events in a database by the server.
   - Displaying the retrieved events list to the client web browser.

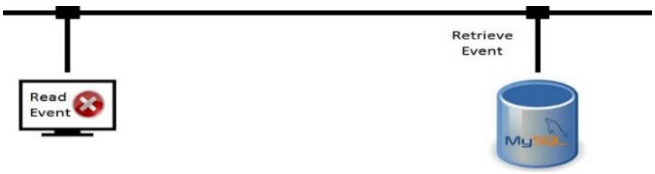

Figure 5: Search for Any Events

1) Impact level recognition by the gyroscope sensor per each elevator.
   - Transmitting the gyroscope sensor level(x-axis y-axis, z-axis).
   - Displaying the gyroscope sensor level(x-axis y-axis, z-axis)value.
   - Notifying the specific event of the gyroscope sensor.

1) Emergent voice recognition.
   - Transmitting any sound/voice level in the elevator.
   - Displaying any sound/voice level values display inside the elevator.
   - Notifying the specific event of sound/voice inside the elevator.

IV. EXPERIMENTAL RESULTS

For real-time remote motoring, we proposed the RMS-ME system with various features for the multiple elevators. To implement the proposed RMS-ME, we considered the Web-based service system capable of remote sensing remote managing.

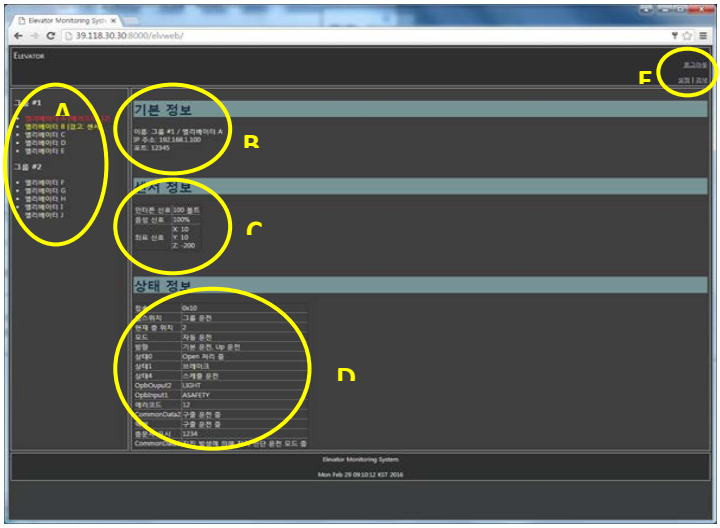

Figure 6: A Main Screen of the Proposed RMS-ME

The following figure 6 shows the main screen of the proposed RMS-ME. Basically, it serves menu-driven logging, environment setting, and searching (circle E area). As representing the group tree for the multiple elevator, circle A in figure6 is the registered elevator list, and displays a warning colored text on occurring any special events. Circle B shows the original information for the elevator when the manager chooses an elevator of the group tree in circle A. In addition, circle C indicates any emergency situation. It shows inclination and acceleration of the elevator by the earthquake or disaster. Circle D shows operation status such as connection code, dip-switch, current operation information, operation mode, up/down direction, error code for the selected elevator among the group tree, and can updated if the elevator is out of order or fixed.

Figure 7: A Screen of the Elevator Management

Figure 7 shows the elevator management screen. Elevator can manage the elevator that is currently being managed, and add, modify, and delete, change the group. If the manager select the settings menu at the top right of this screen(circle A), he can manage and set the elevator group and an elevator within the group. Circle B as the elevator group management can insert, update, delete to the multiple elevators. In addition, the role of circle C shows TCP/IP network information for the individual elevators in the group, and can manage all about the group for each elevator.

V. CONCLUSION

The major elevator enterprises still need the integrated safety technologies of elevators combined with a variety of IT services such as transmission and measurement of customer's ride quality, disaster and crime prevention. But, conventional research and development have been developed separately for elevators.

In this paper, we proposed the RMS-ME system capable to real-time remote monitoring and maintenance for the multiple elevators. The proposed RMS-ME system is to integrate, manage and process many events coming in real time through various sensors from the multiple elevators for the safe operation of elevators. To do this, we analyzed the extended communication protocol of elevator. The extended TCP/IP protocol is communication protocol between the set-top box within each elevator and the monitoring server to transmit and receive all state information including sensor information as well as any error codes of the multiple elevators. It transmitted to the monitoring server via the network after a set-top box within each elevator collects any error codes and sensor information of each elevator. Therefore, the RMS-ME system provided fault monitoring, remote maintenance, emergency detection as well as fundamental operation state information of the multiple elevators.

In the near future, we expect that the proposed RMS-ME will be a valuable application cooperating with the IoT for elevator monitoring and maintenance of the small and medium elevator companies.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology (NRF-2014R1A1A2058667).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Design and Performance Evaluation of a Storage Cloud Service Model over KREONET

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Abstract---

Background/Objectives: In this paper, we propose our storage cloud service model based on Research and Education network. It is designed to ease the collaboration between research communities utilizing high volume of data.

Methods/Statistical analysis: The main idea is to support simultaneously two kinds of users who want to access a storage cloud according to user's requirements over R&E networks. We prototype our service model utilizing multiple proxy controllers of Open Stack Swift service in order to deploy several regions which are connected via experimental backbone networks. As for validation of our service model, we simulate various experimental environments based on Swift-bench and TC tools.

Findings: Compared to the commercial networks, R&E networks have the strength such as flexible network engineering and design. Based on those features of R&E networks, our service model supports general-purpose network users in a central region and experimental network users in distributed regions simultaneously. The evaluation for several experiments has shown that the location of a swift client and whether or not there is a load balancer is not critical factor to the performance. In addition, our experiments on the influence of the network latency and the size of data to be transmitted show that the bigger size of data is preferable to the smaller size of data in an experimental backbone network where the network latency increases because the rate of throughput decline in the bigger object is comparatively small. It means that our service model is appropriate for experimental network users who directly access the service in order to move intermittently high volume of data as well as normal users in the central region who access the service frequently.

Improvements/Applications: Our service model is able to efficiently support normal users and advanced application scientists over R&E networks. Consequently, it would be useful to make advanced research environment for data sharing.

Keywords--- Storage Cloud, Swift, R&E Network, Multiple Proxies, OpenStack.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Cloud computing, which has been recently paid attention to in ICT filed provides resources for users based on the "Pay as you go" concept by utilizing virtualization technique. As a result, it makes to reduce cost and time required for the construction of IT infrastructure. This concept of cloud computing has also been applied to advanced science application filed that requires high performance computing, storage and network resource together. It has helped to improve research environment for application scientists[1,2]. In reality, it makes experiments in advanced science application field such as LHC(Large Hadron Collider) and STAR(Solenoidal Tracker at RHIC)possible through "On-Demand Science" similar to "Pay as you go" concept, which were impossible to be performed because of limited resource capacity and difficulty of building a collaborative research environment[3,4]. In particular, the sharing and transmission of high volume of data through the support of network resources in a collaborative research environment is considered as very important research area in order to provide cloud storage resources efficiently in research network communities[5].It enables collaborative researches of advanced science application communities by procuring their own cloud storage. Consequently, application science users are able to reduce time and cost needed for building individual data storage and solve the problem of securing skilled operators who deal with their own IT infrastructure.

In accordance with these kinds of research network trends, there have been practical approaches to support a collaborative research environment for advanced science application utilizing cloud services in KREONET(Korea Research Environment Open NETwork), one of Korean research networks. According to the service types and properties, these services are able to be categorized into ICT Software tools and virtualized resource infrastructure services in the view of SaaS (Software as a service) and IaaS (Infrastructure as a service) concept[6]. Especially, as there have been frequent collaborations based on high volume of data between research communities, the research issues concerned with network performance have been considered as important factors to support more stable storage cloud service[7].In that sense, our research is also focused on network issues for storage cloud service in research network domains. We analyze the requirements for data sharing and transmission service model over KREONET. Based on those analyses, we propose an appropriate service model in order to support general-purpose network users in a central region and experimental network users in distributed regions simultaneously. After that, we describe the design of our storage cloud service utilizing OpenStack Swift component. In addition, we build the experimental test bed and validate our model through various experimental scenarios. Finally, we discuss the result of experiments performed.

The rest of the paper is organized as follows. In Section 2, we describe the related work including cloud services in research network communities. Section 3 presents our service model designed for the requirements for a storage cloud service over KREONET. Section 4 shows the organization of experimental test bed and scenarios. In Section 5, we analyze and discuss the result of experiments. We conclude in Section 6.

II. RELATED WORK

The international research network communities have recently studied network technologies and structures in order to solve the problems concerned when providing cloud services based on their own networks.

OpenCloud project in Internet2 of U.S. aims at providing "Value-Added" cloud services over the research and education network with the collaboration of Internet2 and membership institutes[8]. Especially, XOS which is a new cloud operating system has been studied on the basis of resource virtualization and SDN (Software Defined Networking). It defines its service management toolkit which simplifies the process of creation, operation, management and composition of services.

GEANT, the research and education network of EU proposes the gOCX(GEANT Open Cloud eXchange) concept [9] and intends to provide necessary network frameworks and functions for support of high quality cloud services between cloud service providers and research network users.

S. Yokoyama and N. Yoshioka [10] point out the weakness of collaboration framework through the federation of multiple clouds in the previous cloud service standardization and studies. They propose the on-demand cloud architecture for cloud collaboration over a community cloud environment which has been studied in NII and SINET, Japan. In this proposal, multiple private clouds are able to be federated horizontally and the utilization rate of cloud resources is maximized by sharing their resource.

Magellan project[11] analyzes the unique requirements of science applications through the DOE(the Department of Energy) ASCR (Advanced Scientific Computing Research) program in US and lists the expected problems when clouds are applied to scientific applications. Especially, the limitations of cloud software such as Eucalyptus, OpenStack and Hadoop are discussed in detail. The experiencesin operating a cloud test bed are also provided and the gaps between resource providers and science applications are discussed additionally.

On the other hand, there has been an effort to indicate a limit to the internal network performance of public cloud and to improve overall performance of science applications through network performance testing[12].Namely, they propose network health parameters and metrics for network connection between cloud instances and apply their proposed model to pCT(proton computed tomography), a medical imaging modality application of e-Science. Finally, they validate their model through a performance evaluation.

A. Melekhova and V. Vinnikov[13,14] survey the generalized grid models, cloud models and grid-cloud integration paradigm. The study reveals that the virtualization is considered as one of key factors to achieve converged model. Based on the detailed study, the up-to-date efficient management techniques of virtual resources are also provided. Additionally, the algorithmic ideas on memory workload estimation are proposed for nested virtual machines.

N. Nagar and U. Suman[15] propose comparative parameters which are considered when clouds are applied utilizing cloud software such as Eucalyptus, OpenNebula, Nimbus and OpenStack. They provide guidelines for choosing a proper cloud technology according to the application requirements by comparative study based on selected comparative parameters.

III. PROPOSED SERVICE MODEL AND USE CASES

Before we propose our service model, this section describes the requirements for a storage service over R&E network. According to our survey including review of related works in section 2, there are two important requirements. First, it should be highly available, distributed and scalable service. Besides, customizable cloud software is required because we need to consider various user requirements from diverse advanced science user communities. Second, we have to consider R&E network features. Compared to storage cloud services in normal networks, services in R&E networks can distinguishingly utilize the strength of R&E networks such as flexible network engineering and design. Actually, domestic networks in KREONET are composed of a general-purpose network for normal users and an experimental backbone network for advanced application scientists. Regarding general-purpose network users, there is a pattern to frequently access the service in a central region. Compared to them, experimental network users in other regions access the service remotely anticipating high performance networking.

Figure 1 shows a conceptual service model that reflects the requirements mentioned above. As for the first requirement, it should provide the data control service for a storage cloud including the functionalities such as storing, synchronizing and duplicating of data. OpenStack Swift service can be utilized in order to meet all of these needs. Open source cloud OS, OpenStack software [16]controls pools of compute, storage and networking resources. Major services of OpenStack are Nova computing service and Swift storage service. In particular, Swift service is highly available and scalable storage service for large file sharing and transmission. It also provides metadata which is information about the object and deals with user authentication based on Keystone service. Regarding the second requirement, we support load balancing mechanism in a central region for general-purpose network users. Additionally, we deploy multiple proxy servers of swift service in other regions. It enables high performance guaranteed storage service due to friction-free backbone network.

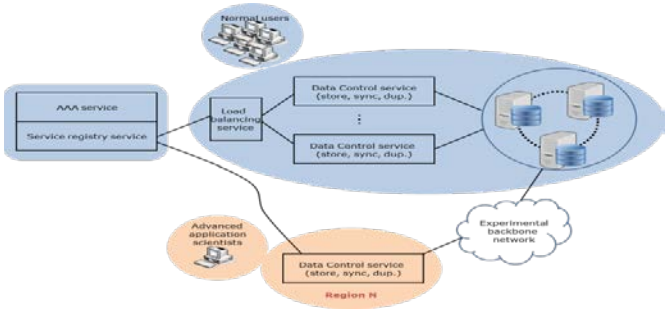

Figure 1: Conceptual Service Model

Based on our solutions to main requirements, figure 2 shows the organization of our proposed system which is composed of four main parts. As for backend storage nodes, they keeps at least three replicas for high availability. As more storage capacity is required, additional storage nodes or disks in each node will be easily added and expanded. A proxy server provides a public interface of Swift service. It contacts to a Keystone server to deal with authentication process before entering a Swift service. Each region operates its own proxy server independently and it is registered in the Keystone server that is located in the central region where all storage nodes are deployed. In that case, users of the Swift service in that region do not need to access a load balancer or proxy servers in the central region. The reason why it is possible is that storage and replication networks extended to each region are friction-free and single-hop networks. All storage nodes in figure 2are located in a single domain and several proxy servers work together with them. On that point, a load balancer that coordinates multiple proxy servers is necessary. In most of the use cases, clients will use one of several proxy servers via a load balancer. Therefore, it is configured to distribute requests from clients according to its ownload balancing policy such as round-robin, static-rr and least-connection.

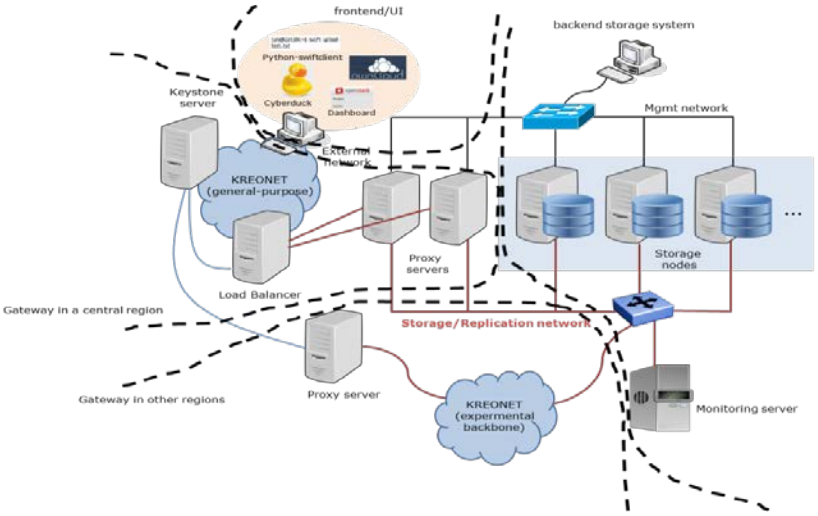

Figure 2: Proposed Service Deployment

Figure 3 shows captured image performed by OpenStack Swift CLI in order to explain the use cases of our proposed system. There is multiple endpoints list of a Keystone service in the central site in figure 2. Two endpoint entries have the same service id and they belong to different regions respectively. In detail, first entry represents a service id of a load balancer in the central site and the other one is a service id of a proxy server in a remote site. Regarding the first scenario for normal users in the view of service users, they contact a load balancer via a Keystone server in the central site. According to the policy of load balancer, the requests are transmitted to one of proxy servers which were already registered in the Keystone server. After that, that proxy server does CRUD(Create, Read, Update and Delete) actions through backend storage nodes and returns the result. On the other hand, regarding the second scenario for scientific application users in other regions, they access a Swift service via an experimental backbone network and contact a proxy server which is located in their region. They do not suffer from the last one mile problem if only they are able to directly access their nearby regional networks. Even if backend storage nodes are not located in their region, their requests are transmitted within a very short time. In reality, the RTT(Round-Trip Time) between Seoul and Daejeon is less than 3ms.

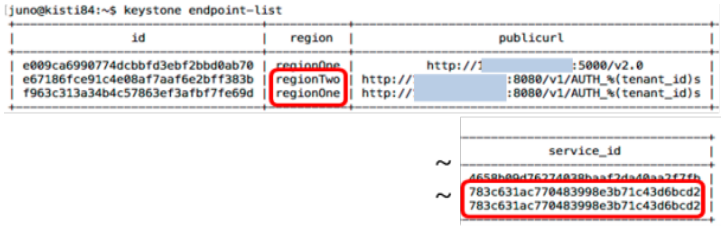

Figure 3: Multiple Swift Service Endpoints

IV. EXPERIMENTS

In this section, we perform two kinds of experiments in order to verify our proposal. First, according to the location of a client and whether or not a load balancer exists, we estimate the performance of our proposed system. Second, we examine the performance degradation in accordance with the network latency between aproxy server and storage nodes. The second experiment is related to simulate the situation that the network delay might happen when a proxy server is connected to storage nodes via an experimental backbone network.

With regard to building the experimental test bed, we use OpenStack Juno version which was released October 2014.Different from other sub projects in OpenStack, Swift service is relatively independent of others. In order to authenticate Swift users, Keystone component is usually used together with a Swift service. A proxy server connects between swift service and clients. When uploading and downloading object files, it identifies which drives belong to which Swift partition. As fora storage node server, it keeps account, container and object ring files which relates to information that will be stored for accounts, containers and objects. All object servers which create 1024 partitions have 12 Intel Xeon E5-2620 cores running at 2.40GHz, 96GB of main memory and two 6TB disk drives for three replicas.HAProxy[17] is used to support load balancing function for multiple connections. It is a popular open source program which distributes TCP/HTTP workload among several servers. Swift-bench[18]plays a role in a benchmarking tool for swift cluster. It generates workload of PUT, GET and DEL operations and estimates the number of average requests per second per operation. It also provides various configuration parameters such as total client concurrency, the size of objects, the number of objects and the number of GETs that we can create different experimental scenarios.

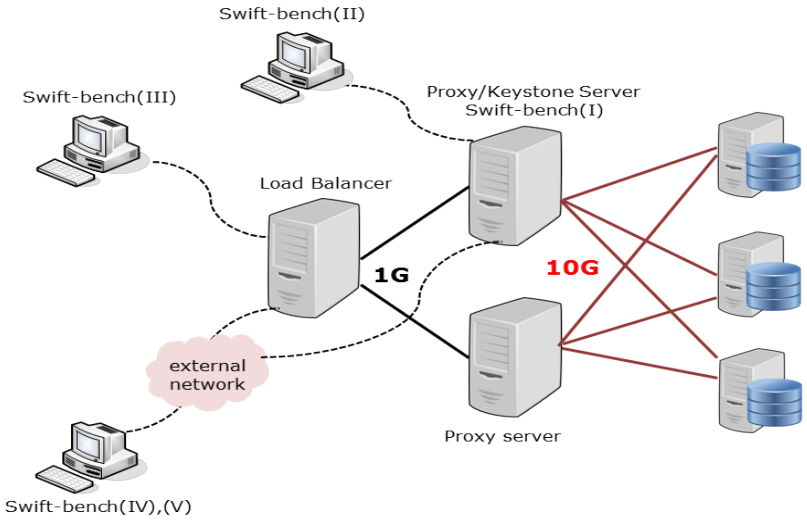

Figure 4: Experiment-I Testbed Topology

(Experiment-I) Figure 4 shows the test bed topology for the first experiment. There are several experimental scenarios depending on the location of a client, namely a swift-bench process and whether or not a load balancer is.

In more detail, we can categorize the experimental cases as shown in table 1.In this experiment, we assume that a keystone server exists with a proxy server machine and there are all OpenStack components including a load balancer are deployed in the same network. Additionally, a client is located in a proxy server, in the same network with a proxy server or in the different network with a proxy server. According to the combination of them, we can get five different experimental cases. As for each case, we generate workload of PUT/GET/DEL operations while changing the object size from 10 bytes to 100Mbytes.The requests from the process of swift-bench are generally handled as follows: First, when the request is executed, a keystone server authenticates that request. After that, a load balancer accepts it and it is continuously sent to one of proxy servers. The selected proxy server propagates operation commands to three storage nodes and returns the result in reverse.

Table 1: Categorization of Experimental Cases

	Client in a proxy server	Client in the same network with a proxy server	Client in the different network with a proxy server
No LB exists	(I)	(II)	(IV)
LB exists	n/a	(III)	(V)

(Experiment-II)Figure 5 shows the test bed topology for the second experiment. Compared to the first experiment, the second one is performed in a relatively simple way. This experiment simulates the decrease in performance in proportion to network latency between a proxy server and storage nodes over an experimental backbone network. We need to do these kinds of experiments in a similar environment before real deployment. The important parameters to give influence to the performance of swift cluster if deployed over the experimental backbone network are network latency and the data size of object files to be moved.

We utilize swift-bench and TC tool in order to make the simulation environment. In a real deployment, the network delay occurs in the connection between a proxy controller and storage nodes because that connection is created in a long distance network. As though it is quite long distance between two regions over KREONET, the RTT between them has been known as within 10 milliseconds.TC tool [19] makes network delay artificially and adds rules to netem which is a kernel component for simulating the properties of WAN(Wide Area Network). In our experiment, it is used to simulate the network delay between two regions which will be deployed in experimental backbone networks. Similar to the first experiment, swift-bench is used to generate PUT/GET/DEL operations over the test bed as shown in figure 5. Different from the first experiment, we fix the location of swift-bench as where the proxy server is. We can get various experimental results depending on the combination of the object size and network latency.

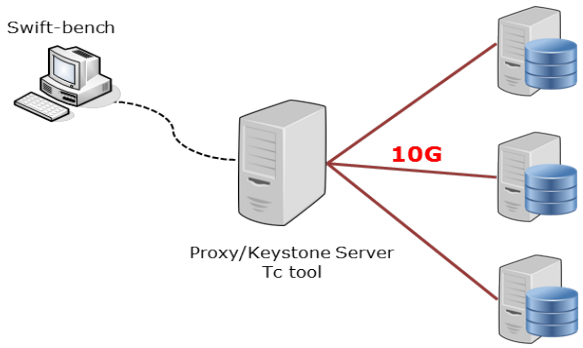

Figure 5: Experiment-II Test Bed Topology

V. ANALYSIS AND DISCUSSION

In this section, we present the results of experiments mentioned in a previous section and discuss the meaning of them.

(Experiment-I) We performed several kinds of experiments to verify the influence of the location of a swift client and whether or not a load balancer is. Because a swift-bench program is selectedas a client tool, we can get the result of PUT/GET/DEL operations sequentially. Based on the categorization in a table 1, each experimental case is repeatedly executed with the different size of objects from 10bytes to about 100Mbytes. The other parameters which are used in a swift-bench are as follows: The number of objects is 100 and the number of GETs is200.

Overall, the performance of all cases is almost identical as shown in from figure 6 to figure 8 as for PUT/GET/DEL operations. If observed more closely, we can see better performance of Case (I)than other cases regarding GET/DEL operations. Intuitively, it is able to be explained by the fact that the client request is created in the nearby location from a proxy server and storage nodes, namely in same network boundary. As for the performance degradation of PUT/GET operation in the sixth stage (1Mbytes), it means that the performance of our test bed decreases sharply from about 1Mbytes, the data size of object. On the other hand, regarding DEL operations, there is no influence from the data size of object in all cases.

In PUT operations, the best performance occurs in the fourth and fifth stages (10Kbytes and 100Kbytes). It means that the proper data size which is not too small is rather helpful to improve the throughput of a swift cluster system because the performance is directly related to the frequency of the generation of requests to proxy servers or load balancers.

In short, several experimental cases based on where a swift client is located and whether or not a load balancer is show that a load balancer for the distribution of workload is not critical to the performance of our swift cluster test bed and the location of a swift client such as a swift-bench program could have an effect on the throughput of GET/DEL operations.

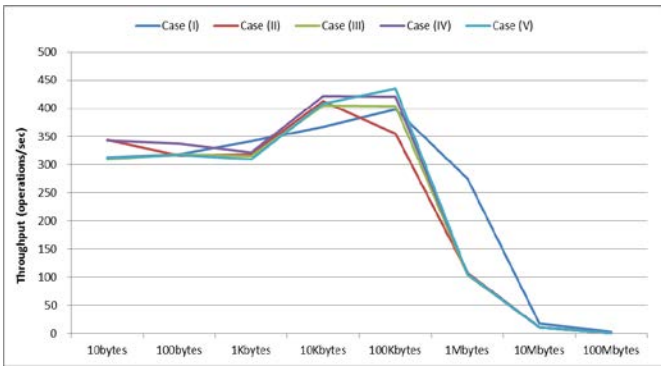

Figure 6: Throughput of PUT Operation in Experiment-I

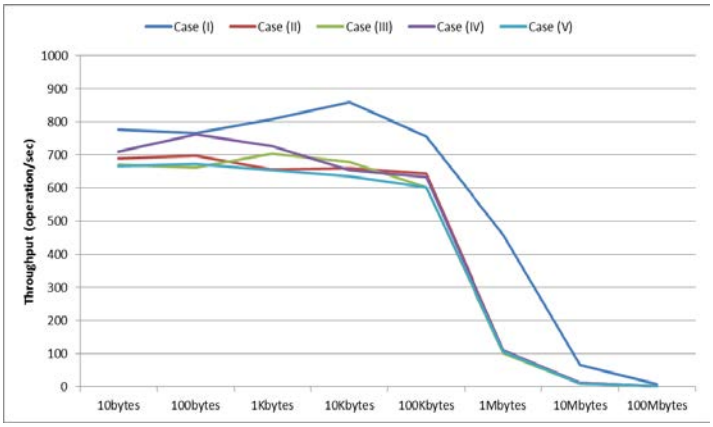

Figure 7: Throughput of GET Operation in Experiment-I

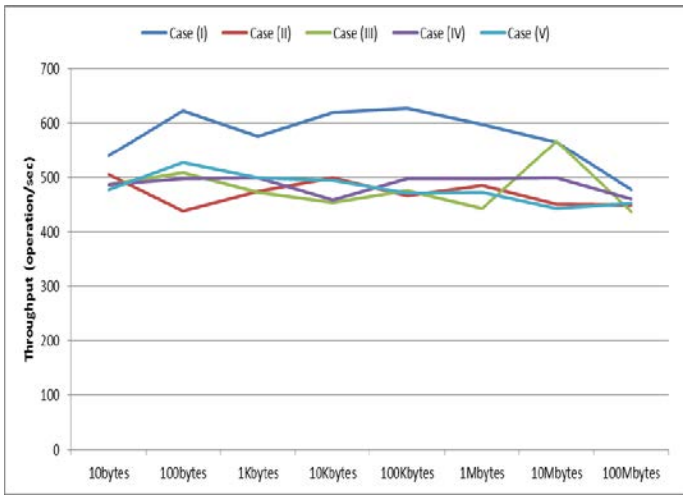

Figure 8: Throughput of DEL Operation in Experiment-I

(Experiment-II)In this subsection, we analyze the result of experiment-II. In order to investigate on the influence of network latency and the data size of object files, each experimental case is repeatedly performed with the different network latency per the different size of objects from 100Kbytes to 100Mbytes. The other parameters which are used in a swift-bench are as follows: The number of objects is 100. The number of GETs is 200.

Figure 9,10 and 11 show the throughput of PUT/GET/DEL operations in the different data size of objects whiles wift-bench is executed with the different network delay values from 0ms to 50ms. As the network latency increases, the throughput of all operations decreases as expected. As for PUT/GET operations, the rate of throughput decline in the first and second cases (100Kbytes and 1Mbytes) is bigger than that in the third and fourth cases (10Mbytes and 100Mbytes).It means that as the network delay in the smaller size of object files increases, the throughput of swift cluster system has more influence than in the bigger size of object files. Based on that observation, we can find out that the bigger size of object data is preferable to the smaller size of object data in an experimental backbone network where the network latency increases. As for the fourth case (100Mbytes),we could not get the meaningful throughput of operations from more than 15ms network latency because the swift-bench was not executed well in that condition. On the other hand, the ratio of throughput decrease of DEL operation is smaller than that of PUT/GET operations in the size of all objects. It means that DEL operation is less sensitive to network latency than PUT/GET operations. It can be inferred that the DEL operation require less traffic volume than PUT/GET operations without regard to the object size.

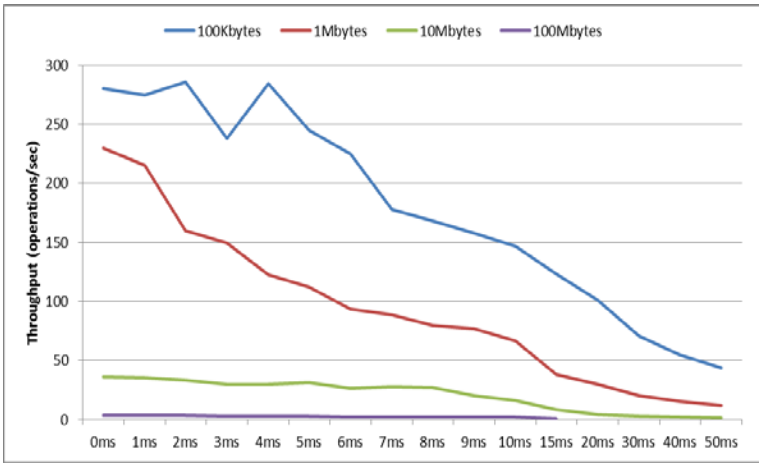

Figure 9: Throughput of PUT Operation in Experiment-II

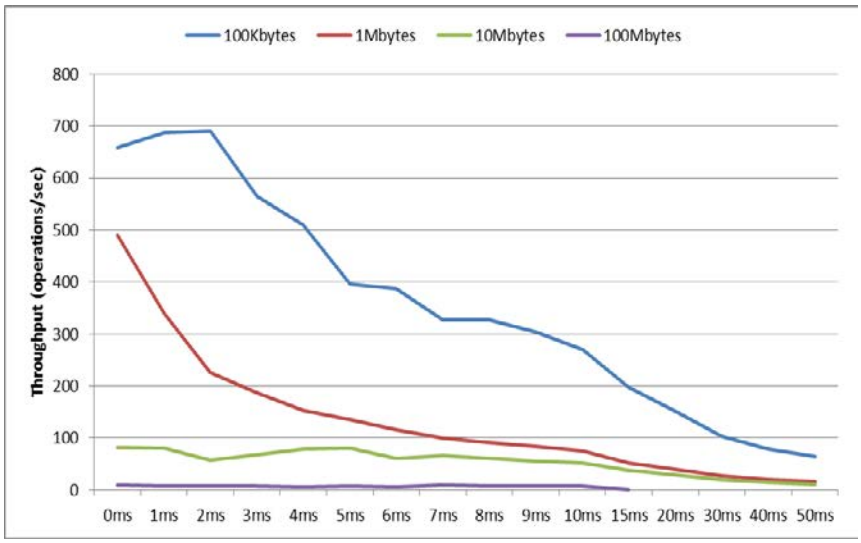

Figure 10: Throughput of GET Operation in Experiment-II

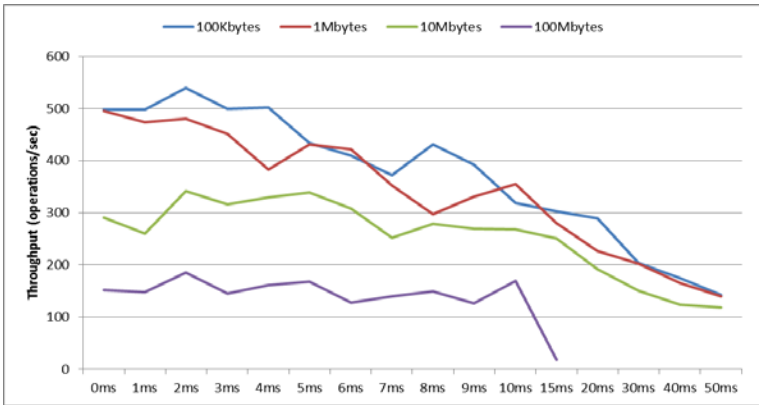

Figure 11: Throughput of DEL Operation in Experiment-II

VI. CONCLUSION

As the collaboration between research communities utilizing high volume of data is frequent, to support storage cloud service has been a very important role in R&E networks. In this paper, we propose our storage cloud service model based on the requirements for a storage service over R&E network. Compared to storage cloud services in normal networks, services in R&E networks can distinguishingly utilize the strength of R&E networks such as flexible network engineering and design. Utilizing those features of R&E networks, it is designed to support general-purpose network users in a central region and experimental network users in distributed regions simultaneously. It is based on load balancing mechanism and multiple proxy servers of OpenStack Swift service that enables highly available, distributed and scalable service.

We have built the experimental test bed for our service model and evaluated it with several experimental scenarios. Our evaluation has shown that the location of a swift client and whether or not there is a load balancer is not critical factor to the performance for our storage service. In addition, our experiments on the influence of network latency and the size of data to be transmitted show that the bigger size of object data is preferable to the smaller size of object data in an experimental backbone network where the network latency increases because the rate of throughput decline in the bigger object is comparatively small. It means that our service model is appropriate for experimental network users who directly access the service via their remote backbone network in order to move intermittently high volume of data as well as normal users in the central region who access the service frequently.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on the Link Key Distribution Method of ZigBee Wireless Sensor Network

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Abstract---

Background/Objectives: Standard Link Key distribution method operates FC in order to duplication of messages. However, if the size of FC is not sufficiently large, thus vulnerable to message re-common-use attack by an attacker, especially vulnerable to impersonation attack disguising itself as a proper device as each step for a device a is skipped. This thesis proposes Link Key Distribution Method preventing message duplication and including authentication procedures of each device.

Methods/Statistical analysis: When device A has transferring data to device B, A requests TC a LKAB, and the Link Key distribution procedure is initiated. The proposed Link Key Distribution Method utilizes random number R to prevent message duplication for all messages used during distribution. Furthermore, all messages used for distribution include MIC values of pre-shared Link Key and use the values for each device authentication procedure. TC, device A and device B distributes their necessary data for LKAB generation through five times message transmissions. Device A and B proceeds descrambling and encryption and generates LKAB by means of the received encrypted data.

Findings: The proposed Distribution Method in this thesis, to start with, allows taking actions against an attacker's impersonation attack by making each device include authentication procedures during Link Key Distribution stages. Second, the significant information generated during LKAB generation is encrypted with safely pre-shared Link key so that counteracting against an impersonation attack with unidentifiable cryptic codes is possible. Third, by utilizing safely pre-shared cryptic codes, man-in-the-middle-attack which intercepts important data from information being transmitted can be dealt with. Lastly, when the session is over, the used LKAB is abolished for no future usability, thus, prediction upon current LKAB with former-LKAB is impossible.

Improvements/Applications: The proposed Link Key Distribution Method assume the stable sharing of Link Key between TC and each device, therefore, if the pre-shared Link Key exposed, the whole system can be easily attacked. Hence, additional research upon a safe storing of pre-shared Link Key is necessary.

Keywords--- ZigBee Wireless Sensor Network, Link Key, Key Distribution, MIC, Man-in-the-Middle Attack.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

ZigBee Wireless Sensor Network is established based on IEEE 802.15.4 and low cost of network establishment, high connection stability, high expansion of network and multiple accessibility to network with only little electricity usage are the advantages. However, due to low capacity of devices constituting network, dealing security issues with high level of encryption is impossible [1,2].

ZigBee Wireless Sensor Network encrypts transferring data between the two devices with different Key depending on the type of Security module. Master Key is pre-shared between each device, thus, allowing transmission and encryption of necessary data for Link Key generation. Link Key is utilized for encryption of unicast data between two devices and Network Key is used for encryption of any data transmitted between the devices. Particularly, distribution and management of each Key and authentication procedures are taken by TC. Methods to produce three different Key types are Key-Transport that is an acquisition from another device, Per-Installation pre-storing the Key within the device and Key-establishment which produces Key by utilizing the transferring data between two devices during authentication process.

This thesis would like to propose Link Key distribution via ZigBee Wireless Sensor Network. Organizations of this thesis are followings. Chapter 2 explains ZigBee Wireless Sensor Network and Chapter 3 propose Link Key distribution method for ZigBee Wireless Sensor Network. Chapter 4 analyzes the proposed Link Key distribution protocols and the last, chapter 4 suggests a conclusion and a prospective future research project.

II. BACKGROUND AND RELATED WORK

A. Characteristics of ZigBee Wireless Sensor Network

ZigBee Wireless Sensor Network is a IEEE 802.15.4-based international standard of short distance personal wireless communication, devised for supplementation of problems such as cost originating from excessive electricity consumption and network establishment.

ZigBee Wireless Sensor Network has traits of cheap IC, high communication stability, high level of network expandability due to diverse topology methods support and multiple device accessibility even with low electricity power consumption. Each component device comprising ZigBee Wireless Sensor Network is not high-functional, but is sufficient for message transportation for sensor linkages.

ZigBee Wireless Sensor Network involves 4~39Kbyte protocol stack and requires a 300byte~4Kbyte memory. When the device is not being operated, the device status turns into Idle, and when the device is being operated, the status turns into Wake-up position, thereby reducing electricity power consumption.

ZigBee Wireless Sensor Network stack is based on OSI(Open System Interconnection) 7-class model[3].

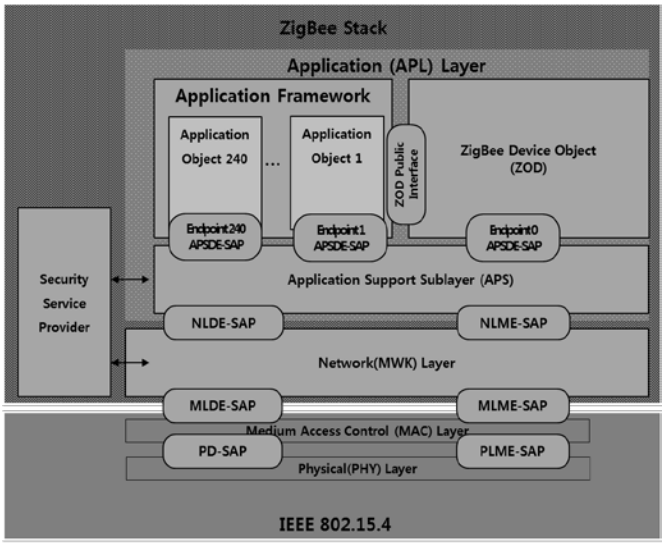

Figure 1: ZigBee Stack Architecture

ZigBee Wireless Sensor Network device is differently identified among Full Function Device(FFD) and Reduced Function Device(RFD) depending on its performance. FFD can be utilized for all-purposes and is able to establish all topologies. RFD cannot function as Coordinator or Router, but only can be operated as ZED as it is composed of simple functions, and can only establish Star topology.

Segments such as ZC(ZigBee Coordinator), ZR(ZigBee Router) and ZED(ZigBee End Device) are categorized according to their functions in ZigBee Wireless Sensor Network devices.

Only one ZC exists in the network and it manages data of all devices and takes responsibilities for communication between different networks. ZR functions transportation of collected data of ZED that has small transmission range within the network. ZD does not require diverse functions, thus, needs small memory proportion, reducing the relative cost of a terminal. ZED is a set of devices at the bottom class of the network, measuring and transporting data. ZED cannot communicate with ZC or ZR, do not required large functions, thus its terminal cost is cheap[3].

B. Security of ZigBee Wireless Sensor Network

Security Module of ZigBee Wireless Sensor Network is divided into Standard Security Mode and High Security Mode. Standard Security Mode, Residential Security Mode in general, provides low level of security and High Security Mode, known as Commercial Security Mode, offers high security level[4].

ZigBee Wireless Sensor Network operates ACL(Access Control List) to approach devices, MIC(Message Integrity Code) and AES-128 type-based symmetric code encryption method to execute functions such as Data Integrity, Device Authentication and Key setting between two devices.

ZigBee Wireless Sensor Network operates transporting data between two devices by means of three types of Keys such as Master key, Link key and Network key according to the security modules.

Master Key is pre-shared between devices or transferred with a secure method, thus, allows transmissions of encrypted data required for Link Key generation of each device. Link Key is used for encryption of unicast data between two devices and, the last, Network Key, taking in charge of network security, is used for encryption of transporting data between device sets. At this point, distribution and management of keys and authentication of devices are performed by TC(Trust Center). Function of TC is in responsibility of ZC(ZigBee Coordinator) among three ZigBee Wireless Sensor Network devices.

There are three different methods to acquire each key used for data encryption at each device. First, it is Key-transport, receiving the key from the other device in the network. This is the most common method, however, if any tapping attempt is made, a problem, which the key may be exposed, arises, hence, requires encryption during key transportation processes. Second method is Per-installation which performs pre-storing of the usable key in the device within the network. Third method is Key-establishment, producing new key with exchanged data during authentication procedures after identifying mutual reliability through authentication processes between two devices[5].

Table 1: How to Get the Key Type[6]

	Master Key	Link Key	Network Key
Key-transport	YES	YES	YES
Pre-Installation	YES	YES	YES
Key-establishment	NO	YES	NO

III. THE PROPOSED METHOD

Chapter 3 proposes Link Key distribution method involved in encryption of transporting messages between two devices.

The proposed method of this thesis deals with Key-establishment, hence, produces Link Key by utilizing exchanging data between two devices.

Standard Link Key distribution method operates Key-Transport type, hence distribution of Key is initiated when device A requests LK_{AB} which is a Link Key shared between device A and B to TC[3].

Standard Link Key distribution method uses three command messages to distribute Link Key. All command messages of Standard Link Key distribution method includes FC to prevent any message

duplication issue, and all command messages being transported keeps its Confidentiality by encrypting itself with pre-shared Link Key with TC and authenticates itself to the other device using MIC value from a shared-Link Key[7,8,9].

Standard Link Key distribution stages as follows.

1) Device A transmits a requesting message to TC for LK_{AB}, the Link Key, which will be shared with device B.

$$\text{Request-Key}\{B, FC_A, MIC(LK_A)\}$$

2) TC, received a message upon LK_{AB} from device A, transfers LK_{AB} to device A.

$$\text{Transport-Key}\{B, FC_{TC}, [LK_{AB}]LK_A, MIC(LK_A)\}$$

3) TC also transfers LK_{AB} to device B.

$$\text{Transport-Key}\{A, FC_{TC}, [LK_{AB}]LK_B, MIC(LK_B)\}$$

Device A utilizes the received LK_{AB} from TC for encryption and device B use the received LK_{AB} from TC for descrambling.

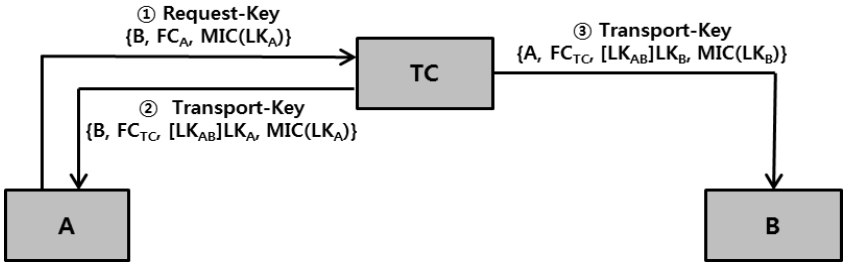

Figure 2: Link Key Distribution Protocol

Standard Link Key distribution method utilizes FC to prevent any message duplication, however, the size of FC is not large enough, hence, vulnerable to message reuse attack from an attacker disguising as TC. Furthermore, standard Link Key distribution method does not include authentication procedures for each device.

The proposed Link Key distribution method, first, a random number R is used for a message duplication prevention measure like Yuksel-Nielson in lieu of FC[10]. Second, the proposed distribution method involves authentication procedures for all devices, including TC, to the other devices. Third, the proposed distribution method operates Key-establishment method for authentication utilizing encrypted data from exchanged messages.

The proposed Link Key distribution method as follows.

1) Device A requests data about device B to TC. Data requesting message includes a random number, R_A, from the device A encrypted with LK_A, communication target device B designation, and authentication information of device A.

$$\text{Request_Info}\{(R_A)LK_A, B, MIC(LK_A)\}$$

2) TC requests device B, the communication target of device A, for an authentication. Authentication request message includes a random number R_{TC} from TC encrypted with LK_B, communication target A designation and authentication information of TC.

$$\text{Request_Auth}\{(R_{TC})LK_B, A, MIC(LK_B)\}$$

3) Device B respond to the authentication request by TC. The responding message for authentication include a random number R_{TC} from TC encrypted with LK_B, a random number R_B from device B encrypted with LK_B, designation of device A which requested communication and authentication data of device B.

$$\text{Response_Auth}\{(R_{TC})LK_B, (R_B)LK_B, A, MIC(LK_B)\}$$

4) TC, which received authentication message from device B, transmits necessary information messages for LK_{AB} generation for communication with device A to device B. The transferred information message includes a random number R_{TC} from TC encrypted with LK_B, designation of device A, a random number R_A from device A encrypted with LK_B and information for self-authentication.

$$\text{Trans_Info}\{(R_{TC})LK_B, A, (R_A)LK_B, MIC(LK_B)\}$$

5) TC transfers necessary information messages to device A for LK_{AB} generation. The transferred information includes a random number R_{TC} from TC encrypted with LK_A, a random number R_B from device B encrypted with LK_A and self-authentication information.

$$Trans_Info\{(R_{TC})LK_A, B, (R_B)LK_A, MIC(LK_A)\}$$

6) Device A and B connects their random numbers received from each other, hence, generates LK_{AB}.

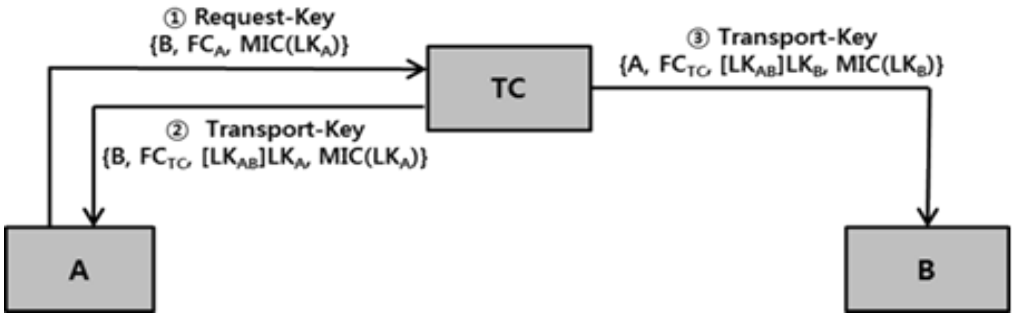

Figure 3: Proposed Key Distribution Protocol

IV. SECURITY ANALYSIS

Chapter 4 analyzes the security of the proposed Link Key Distribution method.

When device A and B requires LK_{AB} for communication, the proposed Link Key distribution method is initiated by requesting information for a LK_{AB} generation to TC.

The proposed Link Key distribution involves authentication procedures of all devices to communication targets prior to distribution of important information needed for a LK_{AB} production. That is, when device A asks data for LK_{AB} generation aiming at communication with device B, the device A authenticates itself to TC by including MIC value in pre-shared LK_A. All devices including TC authenticate themselves by involving their MIC values in pre-shared Link Key between two devices in transmitting messages. Any attacker is not able to impersonate as a proper device since the pre-shared Link Key is unidentifiable.

Second, all messages transferred between TC and a device are encrypted by the pre-shared Link Key between TC and the other device. When the encrypted message is received, the device descrambles the message with the pre-shared Link Key. Those attackers who do not know any content of Link Key used for descrambling, cannot descramble the message, and as they are not able to descramble, modulation attack is unavailable since inside authenticator is unchangeable. Furthermore, if the pre-shared Link Key is unidentifiable, encryption of counterfeit messages is impossible, thus, no impersonation attack is available.

Third, a man-in-the-middle-attack is an acquisition of hidden data intercepted from necessary messages for Link Key distribution data or device authentication by an attacker. However, messages used for the proposed Link Key distribution method is encrypted with the pre-shared Link Key only between the two devices, hence, without the Link Key, no data is obtainable.

Fourth, LK_{AB} is generated by means of encrypted messages used for each device authentication for the proposed Link Key distribution method. Device A encrypts data with the generated LK_{AB} and send it to device B, B descramble the transmitted data received from A by using the LK_{AB}. Once used LK_{AB} is abolished and can no longer be used, prediction, assumption or production of new LK_{AB} with former LK_{AB}s is inapplicable.

V. CONCLUSIONS AND FUTURE CHALLENGES

Establishment of ZigBee Wireless Sensor Network is available at low cost, with high stability level, can easily expand the network and multiple accessibility even with low electricity power consumption. However, due to low capacity of constituting the network, resolving security problems with high level of encryption is unavailable. Thus, ZigBee Wireless Sensor Network keeps the data confidentiality by utilization of symmetric-key system and secure authentication and integrity by applying MIC upon data transmission.

This thesis proposed a Link Key distributing method which is required for transferring data encryption between two devices. Link Key from the proposed distribution method is generated via encrypted data that is used for authentication of each device to TC.

The proposed Link Key distribution method prevented any message duplication by using random numbers and made all devices including TC involve authentication procedures before any significant information distribution for a Link Key production. Moreover, LK_{AB} between device A and B is generated by connection of random numbers, R, of each device and any used LKAB is abolished as soon as a single session is completed.

The proposed Link Key distribution method, first, including authentication process between communicating devices in advance to distributing important data allows taking actions against an attacker's impersonation attack. Second, when LK_{AB} is generated for use of connecting two devices(A and B), significant information is encrypted with safety pre-shared Link Key, thereby, dealing with an attacker's impersonation attack. Third, by utilizing safely pre-shared cryptic codes in consideration of any possible man-in-the-middle-attack which intercepts important data from information being transmitted, hence, any man-in-the-middle-attack is nullified. Lastly, when the session is over, the used LK_{AB} is abolished for no future usability, thus, prediction upon current LK_{AB} with former-LK_{AB} is impossible.

The proposed Link Key Distribution Method assume the stable sharing of Link Key between TC and each device, therefore, if the pre-shared Link Key exposed, the whole system can be easily attacked. Hence, additional research upon a safe storing of pre-shared Link Key is necessary.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on Crime Prevention of Dating Violence Based on IOT

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Abstract---

Objectives: Recent Dating Violence, which is coming into the fore as a serious social problems, is no longer a simply love quarrel between individuals, but is being developed into violent crimes such as an assault and a murder, constantly increasing secondary damage.

Methods/Statistical analysis: In order to minimize any Dating Crime of Violence and any secondary damage by recognizing the current severity of Dating Crime of Violence, this thesis will suggest precautionary measures for Dating Violence utilizing IOT-based sensory detectors in smart devices with speech, vibration and body motion approaches.

Findings: The system in smart devices has built-in speech, vibration and body motion module sensors using integrated operating systems, which detect any possible changes in body motion and physical symptoms from an occurrence of Dating Violence to gather separate data. The collected data from individual sensor modules is transferred to Analysis Modules after being identified if it is a causal factor of Dating-Violence. Based on the analysis and the risk according to the data transferred through Signal Discriminators into Analysis Modules, circumstantial judgment is executed, determining which type of Safety Modules among pre-programed Safety Modules should be set. That is, the analyzed data is re-identified into Safety Module phase 1, Safety Module phase 2 and Safety Module phase 3 from Protective Safety Module and appropriate type of safety module is operated depending on how many risk data has been collected from the detected voice, vibration and body motion data during a Dating Violence and how severe they are.

Application/Improvements: Compared to the existing park crime system utilizing IoT, the proposed model enables simultaneous data collection using multi-sensors and is useful for pre-analysis and crime prediction. Also, Protective Safety Module is not always operated in a lump but gradually operated that is situationally appropriate to crimes and it has a feature that a tailored responses upon the crimes is available.

Keywords--- Dating Violence, Analysis Module, Safety Module, Situation Modules.

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I. INTRODUCTION

Dating Violence has come to a hot potato as its damages including a murder and a violence are increasing. Considering such a crime injury ratio and the seriousness of Dating Violence, the National Police Agency constituted a specialized task force for Dating Violence eradication from 2016 February 2 to March 2 to operate 'Intensive Reporting Period for Dating Violence' and it resulted in discovering 868 people being charged with an offense(61 placed under arrest) out of 1,279 cases received in total. 'Assault/Injury' was the largest, 61.9%, and 'Arrest Confinement/Threat', 'Sexual Abuse', 'Murder' and other types followed. Among the criminals from Dating Violence crimes, 58.9% were ex-convicts, taking larger proportion than the rest 41.1%, non-ex-convicts, and the ex-convicts were consists of mostly those with less than 4 previous convictions(31.2%) and even 11.9% with over 9 previous convictions[1].

Therefore, Dating Violence is beyond a personal issue and is an issue which nations should be in charge of and intervene to solve. However, at present conditions, there will be limitations executing appropriate precautionary prevention measures only by increasing the number of police human resources upon constantly increasing Dating Violence. In consideration of such a circumstance, this paper suggests an effective operation of limited police human resource, simultaneously dealing with situations entailing phase-in operation of sensors including IOT-based speech, vibration and body motion detectors and Safety Modules to minimize damages from Dating Violence.

The system has in-built speech, vibration and body motion sensors; hence, allowing each sensor to detect abnormal symptoms and probable changes during Dating Violence and the collected data is transmitted into Analysis Module after Dating Violence-related risk factors are identified through a Signal Discriminator. Circumstantial judgement is preceded according to the level of urgency and significance of analyzed information of voice, vibration and body motion sensor data that has been transferred. The analyzed data is distributed from Protective Safety Module into Safety Module phase 1, phase 2 and phase 3 depending on how many parts of analyzed data from the speech, vibration and body motion sensor data during Dating Violence are identified to be fulfilling the phase requirements.

The result of this system operation will be minimized cost for crime prevention and successful precautionary prevention of possible Dating Crimes such as violence a murder and a rape through rapid apprehension of location of victims for crime responses.

Accordingly, this thesis insists IOT-based Dating Violence Crime-Precautionary-Prevention system which can prevent and respond to Dating Violence crimes by operating appropriate Safety Module upon different situation, analyzing any data and changes through each sensor installed in Smart Devices when Dating Violence occurs.

II. BACKGROUND AND RELATED WORK

A. Conception and Features of IOT

IOT is a combined conception of existing ICT (Information and Communication Technologies) and new notions of "Any TIME communication" and "Any PLACE communication", as presented in Figure 1. "Things" in IOT signifies each object that can communicate through network environment and it includes the notions of Physical World/Physical Things and Information World/Virtual World. In addition, "Things" is a notion entailing both static information that does not change and dynamic information that changes every moment. Physical Things are objects that exist in reality, they can be detected by other objects, operate other objects and access to other objects. Examples of Physical Things are a system, industrial robots and electronic devices that detect surrounding environment. Virtual Things is a notion that exists in information/virtual world, they can be stored in virtual world, be calculated and be used by other objects that access to it. Examples of Virtual Things are multimedia contents and application programs[2].

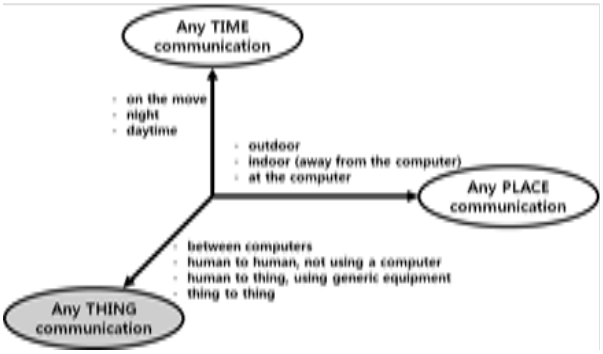

Figure 1: Conception and Features of IOT

B. Conception and Actual Conditions of Dating Violence

Dating Violence is defined as any physical, psychological, mental and sexual behavior intended to harm the other without any agreement during association period including engagement and living together between men and women who have no marriage experience[3]. In short, any psychological, verbal and physical violence between lovers or a couple is referred to Dating Violence and such behaviors are mostly justified as, not love, but obsession which largely caused by inferiority and mental immaturity of doers.

Generally, Dating Violence is easily misunderstood to have sexual and physical threats only. However, many kinds of little batteries or verbal violence causing offense and humiliation that easily and frequently occurs during Dating are also under Dating Violence[4].

According to the recent 5-years data of South Korean Dating Violence conditions, 36,362 have experienced a violence from their lover, meaning 7,200 in approximation by year and 20 in average by day are suffering from Dating Violence, and over 50 are dying from the Dating Violence by year[5]. As described in Table 1, the number of Dating Violence in 2011, 7,292 cases, increased to 7,692 in 2015 and most of the cases involved physical violence such as an assault and an injury. Especially, 'Assault' increased from 2,633 in 2011 to 3,670 in 2015, rose by 39.3%, it is foreseeable that most Dating Violence are involving physical violence. The cases related to rape and forced indecent act have been also increasing over the previous 5 years, from 390 in 2011 to 509 in 2015, rose by 30.5% compared to 2011.

Table 1: Conditions based on types of Dating Violence by year

Year	Total	Injury	Assault	Law Violation on Punishment of Violent Acts	Murder	Rape and Indecent assault
2011	7,292	3,074	2,633	1,068	127	390
2012	7,584	3,028	2,822	1,226	99	409
2013	7,237	2,571	2,848	1,179	106	533
2014	6,675	2,273	2,702	1,109	108	483
2015	7,692	2,306	3,670	1,105	102	509

C. Utilization of IOT and Crime Prevention

Crime Watch System DAS(Domain Awareness System)

DAS can rapidly analyze synthetic data from surveillance camera, license plate recognizer, 911 reporting calls, police database and other resources when a crime occurs, allowing simultaneous or instant real-time pursuit of a crime suspect or suspected car.

This system is composed of approximately 3,000 CCTVs and is able to thoroughly analyze all crime-related information further into geographical and locational information through continuous real-time inputs for large data of types of crime, videos, police radios and 911 calls. The crime spot and services which allow recognition of crime type are available[6].

Shot Spotter

In order to cope with gun crimes, sound sensitive devices are installed in places and they detect gunshots instantly, identifying an accurate location. If police reaches the spot of any incident within a few minutes, the number of gun crimes can be dramatically reduced[7]. Looking into the Shot Spotter system, installation of

sensors, telephone poles and structures in places at center of a city enables sound detection and locational information with record files stored in a situation room computer as soon as gunshot occurs. The situation room staff judges whether the detected record files are the sounds of gunshots, inform police and are dispatched to the scene of incident.

At present, 80 regions in United States of America including Milwaukee, Richmond, San Francisco, Washington DC, Massachusetts and Boston have adopted this system in practice to deal with gun crimes[8].

Yardarm System

Yardarm System strengthens security and safety of police, eradicates all doubts upon firearm usages by police as it constantly tracts the exact time of discharge and targeting point with sensors and location chase functions, and automatically informs other police officers when and where a support/backing is required. Collected data through sensors and location chase functions is encrypted, is transferred to Yardarm Cloud and is processed by customized software for intended uses by police.

This Smart pistol, grafted with IoT, is already being technologically tested in police stations in Santa Cruz, California and Carrollton, Texas[9].

III. ORGANIZATION AND APPLICATION OF SYSTEM

A. System Structure

Examining this research, the system is composed of 5 segments: Detecting Sensor Module, Signal Discriminator, Analysis Module, Safety Module and Situation Module. Above all, Detecting Sensor Module collects expectable conversation and motion data through speech, vibration and body motion sensors. Then, the Signal Discriminator identifies all data received from the sensors into abnormal symptoms and the others, transferring the abnormal symptoms of speech, vibration and body motion data to Analysis Module. The Analysis Module analyzes the received danger factors of speech, vibration and body motion in depth, sending to Safety Module. The risk factor data analyzed in depth invokes gradual operations for Safety Module phase 1, phase 2 and phase 3. Lastly, according to the phase of operated Safety Module, Situation Module executes processes in order, warning, contacts to family and acquaintances and then, police reporting calls. Therefore, through such a system structure and process procedures, this paper suggests IOT-based Dating Violence Prevention System as presented in Figure 2.

B. Function Process Procedures of Proposed System

This system mainly collects voice, vibration and body motion data through sensor modules, the gathered data is identified into Dating Violence-related risk factors via Signal Discriminator, the identified data from the Signal Discriminator is deeply analyzed through Analysis Module with voice, vibration and body motion analysis, being sent to Safety Module at last. According to the risk conditions and the number of risk data, the Safety Module performs warning, contacting and police mobilization with a phase-in operation, managing the risks of Dating Violence crimes through situational selections

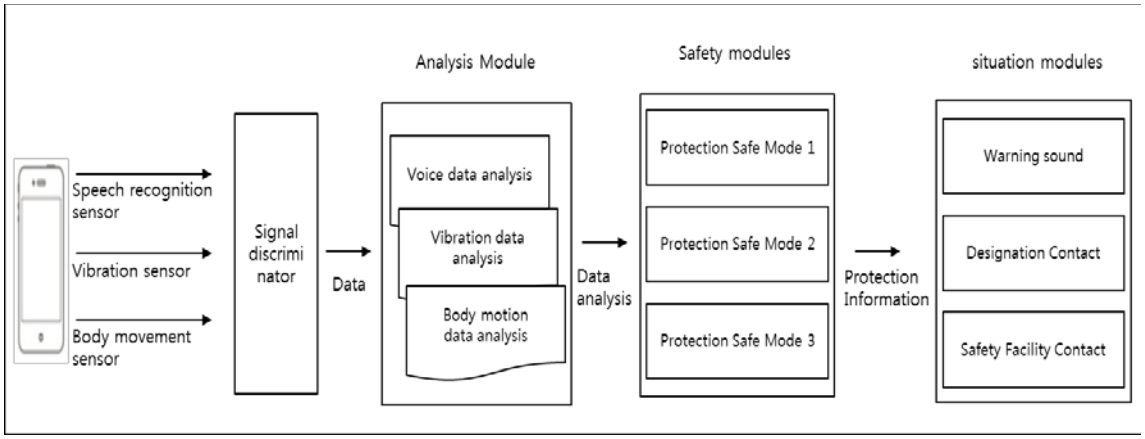

Figure 2: Proposal Model SYSTEM of Crime Prevention of Dating Violence Based on IOT

To establish an IOT-based Dating Violence Crime Prevention System, types and causes of domestic Dating Violence in South Korea are analyzed and the following model solution sample has been suggested through studies upon IOT for enhancement of original Dating Violence Crime Response System and its operation methods.

To start with, as speech recognition sensor, vibration sensor and another sensor which detects body movement are in-built within Smart-phone devices, they record the voice, vibration and body motion data during Dating Violence. Speech recognition sensor is designed to collect voice-related data including voice and language from conversations in consideration of possible linguistic violence, vibration sensor gathers physical vibration and movement data that may occur when a person receives a physical violence during Dating Violence. In addition, body motion sensor deals with abnormal or uncommon data which is beyond the behaviors which people usually present during normal lives and activities, that is, the physical symptoms such as changes in heart-beating, sweating and breathing when violence is committed.

Secondly, data collected and recognized through each detecting sensor is sent to Analysis module which analyzes the data as Dating Violence-related or non-related factors via Signal Discriminator. In other words, Signal Discriminator identifies risk data that are relevant to any voice, vibration and body motion with physical, linguistic, sexual and other types of violence from the data received from detecting sensors. Thanks to this procedure, time for data analysis distinguishing unnecessary information can be shortened by having only Dating Violence-related data to Analysis Module, allowing time minimization for Dating Violence responses.

Third, the Dating Violence-related data transferred via Signal Discriminator is identified into data which displays voice, vibration and body motion symptoms. Each speed of speech, tone of speech and suitability of vocabulary selection are comparatively analyzed whether it is relatively faster or louder than normal voice volume and whether consistent use of offensive words is observed or not, in terms of possible voice data from Signal Discriminator. Moreover, the data transferred regarding vibration analysis is comparatively analyzed with its intensity, speed, type and frequency, and symptoms such as dramatic increase in pulse frequency and sudden temperature decrease in terms of abnormal changes in pulse, blood pressure, heart rate, temperature and sweating from body motion analysis data. Thus, the Analysis module analyzes possible risk factors for Dating Violence into voice, vibration and body motion data in depth and gradually operates Safety Module phases or directly reports police without operating any Safety Module steps when urgent circumstantial measures are required by means of the deeply analyzed probable risk factor data for Dating Violence.

Fourthly, Protective Safety Module operates its Safety Module phases when any of voice, vibration and body motion data with abnormal symptoms related to Dating Violence is observed, based on the analyzed data from Analysis Module. At the Safety Module phase 1, a report to police is performed if Safety Module is not dismissed for a certain given amount of time with warning sound from Smart-phones when at least a single abnormal symptom and crime-related data. If there are at least two changes or symptoms in data related to Dating Violence, Safety Module phase 2 is operated, automatic emergency contacts to close friends, relatives registered within Smart-phone devices is performed, and the most proximate police receives a report with analyzed data and location information for an actual dispatch if the module is not dismissed for a given time. At last, if there are over 3 analyzed data related to Dating Violence, Safety Module phase 3 is operated and the analyzed data and risk conditions are informed to the most proximate police for a dispatch. However, even though the Safety Module is programed to operates different phases, 1, 2 and 3 in order, based on each risk factor data, among the analyzed data from the Analysis Module, if any of the data requires urgent management, a direct and immediate operation of Safety Module phase 3 is performed, acquiring police dispatch, rather than gradual phase-in operation of Safety Modules.

Fifthly, Situation Module is initiated from the Safety Module by utilization of gradual Safety Module phases. That is, Safety Module phase 1 creates warning sound, Safety Module phase 2 activates automatic contacts to family, colleagues and other acquaintances for situation management and Safety Module phase 3 makes an instant or immediate dispatch of police forces. However, if gradually operated Safety Module is not dismissed for a certain given period of time or none of family, colleagues and other acquaintances are unavailable for a contact, the circumstance is immediately turned into Safety Module phase 3, mobilizing a police dispatch to the operated device location.

Therefore, this paper expects the proposed model, managing risk situation with gradual Safety Module phases with analyzed voice, vibration and body motion data and with Dating Violence risk factors identified through Signal Discriminator after the data is collected via various sensors installed in Smart-phone devices, contributes to reducing the crime frequency and damages from the crimes as the system enables rapid analysis and procedures, and quick management upon risk circumstances.

IV. ASSESSMENT OF PROPOSED MODEL

This chapter reviews the efficiency of the original model and of the proposed IOT-based Dating Violence Crime Prevention System, and the difference between the two models in functional and operational manners.

The existing park crime system utilizing IoT collects data in the process of operating intelligent sensor and sound sensor independently. The analyzed data is useful later in predicting park crime prevention10. Whereas, the proposed model in this study proposes an easier way to collect various data by using a multi-sensor. In result, it can analyze the crime situation beforehand to put protection safe mode into action gradationally and gain predominance in crime prevention over the existing system. (Table 2)

Table 2: Evaluation of the Difference between Two Models

Category	Existing system	Proposed system
Data Collection	Independent data collection	Simultaneous data collection via multi-sensors
Analysis and Response	Post-Analysis and Limited Precautionary Prevention	Pre-Analysis and Crime Forecast
Safety Module Operation	Gradual Operation and Management Unavailable	Gradual Operationand Management Available
Situational Response	Responding in a lump	Situational and Gradual Response

The original model and the proposed IOT-based Dating Violence Crime Prevention System model, both, correspondingly aim at preventing crimes, establishing a social security system and improving the life qualities of people in communities. However, the two have following differences in establishing a social security network and preventing Dating Violence.

First of all, while the original social security system to prevent crimes requires long time to gather and integrate data as it utilizes independent sensor operations to collect data, the proposed model can collect large amount of data in a short period of time as it utilizes multi-sensors which consists of more than 3, speech, vibration and body motion sensors, being operated simultaneously.

Secondly, in terms of detecting and analyzing data, the original model collects data after occurrences of crime cases and analyzes the post-gathered data, however, the proposed model enables real-time data collection at the point of actual Dating Crime via detecting sensors and pre-analysis that permits crime forecast.

Thirdly, in the manner of Safety Module operation, the existing model does not operate automatically and gradually the security safety of victims such as a warning sound and a direct contact to police by victims during crime occurrences, bringing serious damages from the incidents, on the contrary, the proposed Safety Module provides the level of risk situationally identified and the number of data related to Dating Violence, allowing gradual operation of Safety Module phases and allows an immediate reporting calls for police dispatch in an urgent situation.

Lastly, from the perspective of situational condition management, the original system cannot gradually deal with different situation by phases in order, but only can manage various crime conditions at once, on the other hand, the proposed model can gradually manage crimes with appropriate measures through situational phases of operation, leading to a successful, flexible and quick management and prevention of Dating Violence Crimes.

V. CONCLUSION

Among 20,000 arrested in approximation, 313 cases were ‘Murder’ or ‘Attempted murder’, and the victims were not even reporting properly due to the fear of retaliatory crimes. The continuous increase in Dating Violence Crime is no longer a private issue or a love quarrel, but one of serious social problems that need to be regarded as crimes and requires urgent precautionary prevention measures. Nevertheless, due to lack of human resources in public order and limitation in voluntary crime prevention, organization of a special task

force towards Dating Violence Crime Prevention to reduce Dating Violence cases is currently unaffordable, and in view of the situation, this paper suggests utilization and establishment of an IOT-based Dating Violence Crime Prevention System which can minimize damages from Dating Violence Crimes by detecting and analyzing risks of the crimes in advance.

An IOT-based Dating Violence Prevention System collects various data such as voice, vibration and body motion that occurs during Dating Violence by means of detecting sensor modules, Dating Violence-related data from the collected data through sensors is transferred to Analysis Module via Signal Discriminator. Analysis Module analyzes urgency and significance of types and contents of each Dating Violence risk factor. After the analyzed data is transmitted to Safety Module, each risk factor and changes in data gradually causes gradual Safety Module phases operation and according to the phase level of Safety Module, Situation Module creates situationally appropriate management.

However, only if urgent situational data is identified and analyzed, even it is simply a single data, the gradually operated Safety Module system is automatically converted into the highest level of Safety Module, phase 3, to mobilize a police dispatch or safety facility forces, minimizing possible damages from Dating Violence Crimes.

Thus, establishment of such an IOT-based Dating Violence Crime Prevention System is expected to minimize damages from Dating Violence and to contribute to reduction in the number of Dating Violence Crime cases by real-time data collection and detailed data analysis.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Develop a Automation Program of Quality Control Standard Phantom of Mammmography Using Digital Image Processing Technology

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Abstract---

Background/Objectives: Quality control for phantom in mammography depends on visual inspection. Deviation can occur depending on the evaluator's subjective decisions. Therefore, automated detection program needs to be developed to minimize errors.

Methods/Statistical analysis: A total of 165 phantom images from 74 hospitals nationwide from May 2015 to April 2016 that passed special medical equipment test by Korean Institute for Accreditation of Medical Image were used in this study. We analyzed the intra-rater reliability and the inter-rater reliability of these images. Using Matlab, a new automated quantitative analysis program was developed. To find out if there were differences between the automation program method and the visual inspection method, paired t-test was performed for verification.

Findings: The intraclass correlation coefficient (ICC) values for fiber, specks, masses, and total lesions with visual inspection were 0.349 (95% CI: 0.287-0.419), 0.265 (95% CI: 0.209-0.331), 0.212 (95% CI: 0.162-0.274), and 0.378 (95% CI: 0.316 -0.449), respectively. Thus, visual evaluation of test objects among the 11 evaluators was not reliable. When the same images were evaluated by visual evaluation, for each test object evaluated by the 11 evaluators, there were various variations for fiber, specks, masses, and total lesions (3.83~4.67, 2.90~3.78, 3.25~4.09, and 10.45~12.11, respectively). The mean ICC values of fiber, specks, masses, and total lesions between evaluation and evaluation were 0.693, 0.655, 0.667, and 0.684, respectively. Therefore, visual evaluations of test objects between evaluation and reevaluation by the 10 evaluators had medium degree of reliability. In fiber, the automated detection method showed 0.83 more superior results compared to the subjective evaluation method. In specks, there was no statistically significant difference between the two methods. In masses, the automated detection method showed around one more superior result compared to the visual inspection method.

Improvements/Applications: The automated detection program can overcome the biases caused by the visual inspection method. It can improve the reproducibility of results. Therefore, the automated program can be used for quality control system with consistent results. It is simpler than the visual inspection method. In addition, it can correctly produce results within a short time.

Keywords--- Mammography, Phantom Radiography, Quality Control of Image, Visual Inspection, Quantitative Analysis, Automation.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Mammography images are stored in Picture Archiving and Communications System (PACS). After passing the era of analog images of film systems, it is changing into digital images[1]. Mammography images with patient information and various image information's are stored in international standard Digital Imaging and Communications in Medicine (DICOM) files for transfer and storage. Header information section of DICOM files have information about the size of each pixel that compose the image as well as grayscale that provides useful information for digital image processing[2].

While all other items (personnel inspection, quality control inspection, phantom imaging and clinical imaging inspection) of mammography equipment among quality control inspection are digitalized and objective evaluation is possible, items that must depend on subjective evaluation by humans are phantom image inspection and clinical image inspection. In phantom image inspection, inspectors (radiology specialists of Korean Institute for Accreditation of Medical Image) need to visually observe a total of 10 or more test objects, including 4 or more fibers, 3 or more specks, and 3 or more masses among 16 test objects (6 fibers, 5 specks, and 5 masses) within phantom image before the equipment can receive usage approval. However, there could be deviations due to subjective elements of inspectors. Among inspectors, the rate of replication for measurement has been low. Therefore, the objective of this study was to develop an automated detection program to minimize such error. The automated quantitative analysis method was compared to the manual inspection method. In addition, a new quantitative analysis index was created.

II.RESEARCH METHODS

Research Phantom

For mammography, American College of Radiology (ACR) certified phantom Nuclear Associates Model 18-220, RMI Model 156, CIRS Model 015 or phantoms with identical certifications are used. Five are within the phantom was composed of nine and fibers. Microcalcification was simulated using Al2O3. Masses were simulated using a lens-shaped mass, shown in Figure 1.

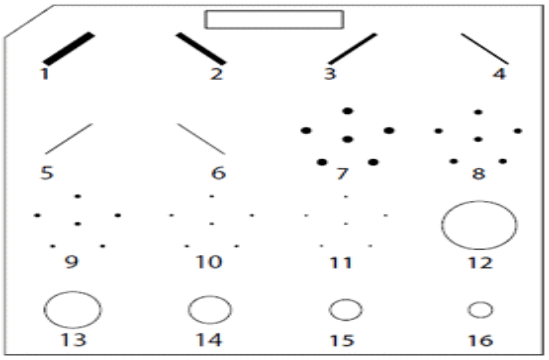

Figure 1: Location of the Test Objects in the Wax Insert

Test objects were composed of fibers in six locations (from 1 to 6) with diameters of 1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm, 0.54 mm, and 0.40 mm, respectively. Specks were in five locations (from 7 to 11) with diameters of 1.56 mm, 1.12 mm, 0.89 mm, 0.75 mm, 0.54 mm, and 0.40 mm, respectively. Masses were in five locations (from 12 to 16) with diameters of 2.00 mm, 1.00 mm, 0.75 mm, 0.50 mm, and 0.25 mm, respectively[3,4],shown in Table 1.

Table 1: Test Objects Sizes Contained within the Mammography Accreditation Phantom

	Fibers(diameter, mm)	Specks(diameter, mm)	Masses(thickness, mm)
1	1.56	0.54	2.00
2	1.12	0.40	1.00
3	0.89	0.32	0.75
4	0.75	0.24	0.50
5	0.54	0.16	0.25
6	0.40	-	-

Phantom Image Acquisition and Data Collection Methods

By obtaining image with ACR phantom, images were transferred to PACS and stored as DICOM files, shown in Figure 2.

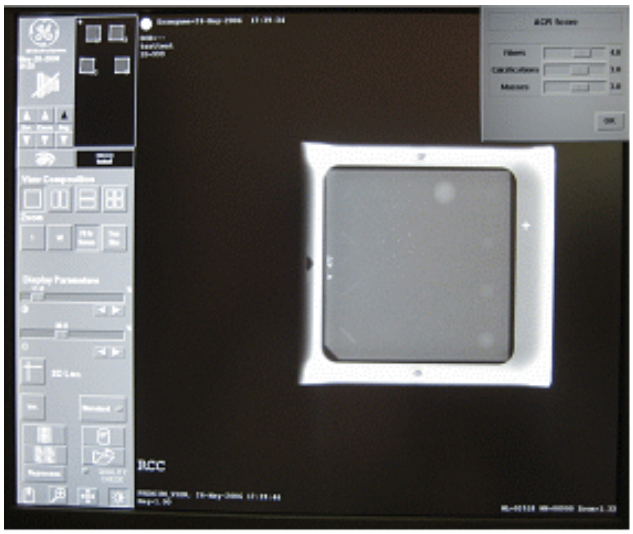

Figure 2: Image Acquisition

According to the decision of the Minister of Health and Welfare, hospitals should conduct phantom image evaluation every six months. Because they must conduct document inspection for Korean Institute for Accreditation of Medical Image as a registered quality management inspection institution, visual (qualitative) evaluation figures of the phantom and images are usually obtained by a radiology specialist. The study subjects were 165 phantom images in 74 hospitals nationwide that passed the test of the special medical equipment required by Korean Institute for Accreditation of Medical Image from May 2015 to April 2016.

Automated Quantitative Analysis Program Development

Using Matlab R2010a (The Mathworks Inc., Natick, MA, USA), a new automated quantitative analysis program was developed. After obtaining the original image, original ROI image was extracted. The shape of the image to be analyzed was placed in 4 phantom location settings rotated by 90° each. It was always fixed as an image with arrangement angle of 0°. By obtaining negative image using brightness invert function, the entire matrix was divided into 16 pixel coordinates to separate areas of test objects arranged 4 × 4. It was divided into 3 object areas (fiber, specks, masses). After applying normalization technique after designating test object area, binary image was created through applying median filtering technique and adaptive threshold technique. By applying the labeling technique, automated quantitative index was analyzed.

Assessment Methods

1. Inter-rater Reliability

Blind experiment was conducted by 10 radiology specialists to cross evaluate these images. To familiarize the phantom image analysis manual, training was conducted for 30 minutes to evaluators before the evaluation. Training was conducted by evaluating ideal valuation standards. A total of 11 evaluations per image were conducted, including 1 evaluation based on Korean Institute for Accreditation of Medical Image submission and evaluations by 10 evaluators. Fiber, Specks, Masses, and Total lesions were evaluated to calculate ICC (intra-class correlation coefficient). For ICC value, 0.80 to 1 indicates excellent reliability, 0.60 to 0.79 represents acceptable reliability, and under 0.59 represents poor reliability[5].

2. Intra-rater Reliability

After conducting primary evaluation by 10 radiology specialists, secondary evaluation was conducted with a four-week interval. To measure reliability within evaluators, the first evaluation must be erased from memory. To remove this memory effect, at least four weeks' interval is needed before evaluation[6]. Mean ICC was calculated to analyze the reliability between evaluation and reevaluation.

3. Comparison of Qualitative Analysis and Quantitative Analysis

To provide descriptive statistics on the difference between test objects detected by the automation program and by visual inspections for fiber, specks, and masses, mean values and standard deviations were calculated to determine if there were differences between the two methods. Paired t-test was conducted for verification. Analysis of data was done using SPSS 21.0 (Statistical Package for Social Science for Window TM release 21.0 SPSS Inc, Chicago, U.S.A.). Statistical significance was considered when P value was less than 0.05.

III. RESULTS

Inter-rater Reliability

The ICC values for fiber, specks, masses, and total lesions were 0.349 (95% CI: 0.287-0.419), 0.265 (95% CI: 0.209-0.331), 0.212 (95% CI: 0.162-0.274), and 0.378 (95% CI: 0.316 -0.449), respectively. Thus, visual evaluation of test objects among the 11 evaluators was not reliable, shown in Table 2.

Table 2: Inter-rater Reliability (n=165)

lesions	ICC	95% Confidence Interval	p
Fiber	0.349	0.287 - 0.419	<0.001
Specks	0.265	0.209 - 0.331	<0.001
Masses	0.212	0.162 - 0.274	<0.001
Total lesions	0.378	0.316 - 0.449	<0.001
* ICC : Intra-class Correlation Coefficient			

For visual evaluation of each test object by the 11 evaluators, although the same images were tested, there were various variations (fiber: 3.83~4.67, specks: 2.90~3.78, masses: 3.25~4.09, and total lesions: 10.45~12.11), shown in Table 3.

Table 3: Visual Assessment of Imitation Lesions of the Rater (n=165)

Rater	Fiber		Specks		Masses		Total lesions	
	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD
1	4.67	± 0.49	3.72	± 0.44	3.74	± 0.44	12.04	± 1.09
2	4.59	± 0.56	3.62	± 0.46	3.59	± 0.48	11.79	± 1.27
3	4.61	± 0.54	3.42	± 0.47	3.25	± 0.45	11.28	± 1.13
4	4.27	± 0.36	3.56	± 0.39	3.70	± 0.34	11.52	± 0.80
5	4.46	± 0.54	3.16	± 0.42	4.09	± 0.41	11.70	± 1.09
6	4.16	± 0.27	3.39	± 0.41	3.89	± 0.42	11.43	± 0.68
7	4.57	± 0.49	3.01	± 0.53	3.78	± 0.42	12.11	± 0.95
8	3.85	± 0.56	2.90	± 0.53	3.78	± 0.53	10.45	± 1.64
9	3.83	± 0.62	3.78	± 0.36	3.89	± 0.47	10.65	± 1.52
10	3.98	± 0.72	3.00	± 0.46	3.99	± 0.59	10.85	± 1.61
11	4.30	± 0.51	3.36	± 0.45	3.77	± 0.46	11.38	± 1.18

Intra-rater Reliability

Between evaluation and re-evaluation, the mean ICC for fiber was 0.693 (min.: 0.568, max.: 0.919) and mean ICC for specks was 0.655 (min.: 0.339, max.: 0.916). Mean ICC for masses was 0.667 (min.: 0.415, max.: 0.840) and mean ICC for total lesions was 0.684 (min.: 0.482, max.: 0.881). The average degree of reliability for all test objects was statistically significant. Thus, visual evaluations of test objects between evaluation and reevaluation by the 10 evaluators had medium degree of reliability, shown in Table 4.

Table 4: Intra-Rater Reliability (n=165)

lesions	rater	ICC	mean ICC
Fiber	1	0.568[a]	0.693
	2	0.729	
	3	0.636	
	4	0.570	
	5	0.785	
	6	0.635	
	7	0.678	
	8	0.919[b]	
	9	0.659	
	10	0.746	
Specks	1	0.814	0.655
	2	0.740	
	3	0.489	
	4	0.446	
	5	0.339[a]	
	6	0.768	
	7	0.846	
	8	0.916[b]	
	9	0.553	
	10	0.642	
Masses	1	0.611	0.667
	2	0.690	
	3	0.829	
	4	0.829	
	5	0.796	
	6	0.522	
	7	0.415[a]	
	8	0.840[b]	
	9	0.555	
	10	0.584	
Total lesions	1	0.840	0.684
	2	0.810	
	3	0.618	
	4	0.680	
	5	0.482[a]	
	6	0.541	
	7	0.511	
	8	0.881[b]	
	9	0.692	
	10	0.787	
* ICC : Intra-class Correlation Coefficient a. lowest b. best			

Comparison of Qualitative Analysis and Quantitative Analysis

For fiber, the automated detection constitutive analysis method showed 0.83 more superior result compared to the subjective evaluation method. For specks, there was no statistically significant difference between the two methods. For masses, the quantitative analysis method showed around one more superior result compared to the subjective evaluation method.

Compared to the subjective visual evaluation method, the quantitative automatic method was superior. There was statistically significant difference between the two methods, shown in Table 5.

Table 5: Comparison of Visual Evaluation and Proposed Algorithm

Variable	Visual evaluation	Proposed algorithm	t	p*
Fiber	4.59 ± 0.55	4.97 ± 0.71	-2.61	0.013
Specks	3.56 ± 0.50	3.56 ± 0.56	0.00	1.000
Masses	3.79 ± 0.41	4.79 ± 0.41	-9.67	<0.001

* by paired t-test to $p<0.05$.

IV. DISCUSSION AND CONCLUSION

In case of specks, it has a dot in the middle. It is surrounded by six dots in a star-shape which is difficult to distinguish from artifact. The brains of human can recognize such test objects even though they cannot classify between noise and test object by predicting the star shape. This is the same for fiber and masses. These are the disadvantages of visual evaluation.

According to a research by Park[7], the average numbers of recognizable fibers, specks, and masses in phantom images are 4.0 ± 0.5 (range, 2.7 ~ 5.0), 3.0 ± 0.3 (range, 2.0 ~ 3.7), and 3.5 ± 0.4 (range, 2.3 ~ 4.0), respectively. However, in this study, the range of difference in recognition was narrower. In this study, the numbers of fibers, specks, and masses were 3.83 ~ 4.67, 2.90 ~ 3.78, and 3.25 ~ 4.09, respectively. Although the range of difference in recognition was narrower in this study, satisfactory result between evaluators or within the evaluators was not obtained. This could be due to subjective application of each different standard and differences in innate visual ability. Therefore, Park[7] has suggested a measurement standard for software that can evaluate resolution by visualizing optical density of mammography and the necessity for the development of a quantitative program to replace the visual evaluation.

Based on the comparison results for test objects using the existing visual inspection method and the automated detection program developed in this study, the latter method was found to have higher reliability as a new analytical method for the standardization of standard phantom quality control. It can detecting 0.38 unit more of fiber (4.97 - 4.59) and one unit more of mass (4.79 - 3.79).

According to studies by Larissa Cristina dos Santos Romualdo[8], Douglas[9], and Hunt[10], microcalcification with diameters between 0.2 mm to 0.5 mm can be used to diagnose breast cancer early. For this reason, the detection ability of the visual inspection method for specks was found to be better than that for fiber or masses. However, there is no need to decrease the value of microcalcification diameter due to the lower evaluation reliability of the visual evaluation method. Furthermore, the automatic program has similar or better evaluation results with superior detection capacity.

In summary, the automated detection program developed in this study can overcome the biases caused by manual processes among inspectors and within inspection committee members. It can improve the reproducibility and automate the quality control system consistently, simply, and correctly within a short time period compared to the existing visual inspection method. Therefore, the automated detection method is expected to improve the efficiency of quality control for phantom in mammography by multiple inspectors. In addition, the convenience of its training might enhance human resource management for special medical equipment managers.

ACKNOWLEDGMENT

This study was funded by a 2016 Academic Research Support Project of Hanseo University, Republic of Korea.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on the Optimization of Manufacturing Process through Motion Analysis and Virtual Reality

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Abstract---

Background/Objectives: For manufacturing industry to achieve efficient manufacturing process, improving a company's productivity and reducing cost is a required task of the current manufacturing companies.

Methods/Statistical analysis: For design of efficient manufacturing process and improvement of productivity, efficient manufacturing process method is studied through removal of unnecessary elements analyzing motions and using test-bed linkage system based on virtual reality.

Findings: When building process line after verifying optimization through virtual process arrangement simulation in advance, it is available to save additional cost for process modification or supplement to result in practical effects of improving a company's manufacturing competition.

Improvements/Applications: Reducing design period, improving equipment, making automation, realizing ergonomics, and improving process through this study, it will be available to achieve improvement of productivity, enhancement of quality, cost reduction as well as employees' satisfaction for safety and health.

Keywords--- Virtual Reality, Motion Study, Process Analysis, Process Design, Image Process.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The paradigm of manufacturing industries are changing globally toward flexible production methods with low cost and multi-items such as spreading convergence between manufacturing industries, IT SW service, and other industries, 3D printing, and smart factory, and the government is pursuing the project of Manufacturing *Innovation 3.0* in order to responds to these changes.

This study is about building smart factory based on IT for *Manufacturing Innovation 3.0*'s strategies to create new convergence-type manufacturing industries. [1]

For building smart factory, work line system should be done first, and these management systems have been pursued by various academic and industrial organizations. However, they are not applied easily to the entire industries due to the actual problems caused by differences in use, type, or process even if they are identical products, and these work management systems have been run mainly by large-scale enterprises or middle-standing enterprises because of costly burden to install and run test-bed, and most of small and medium-sized enterprises just apply redesigned process without physical test or even cannot try it.

In this study, based on process improvement data for process analysis and design system not simple manufacturing process simulation the optimal process is designed, VR-based test-bed is offered, and work methods are improved by workers' direct management on each process and discernment of inefficient work order, batch, and line. It also aims at designing and verifying the optimized process with low cost and high efficiency by decreasing T/T(Tact Time) in weak process, improving hourly productivity by line and enhancing process continuously with consideration on workers' characteristics. [2] (Figure 1)

Figure 1: Scheme of the System

II. CURRENT STATUS OF THE RELATED TECHNOLOGIES

With introduction of 'Industry 4.0' leading the 4th industrial revolution in the world, it is to concentrate on development of basic technologies such as IoT. CPS, and sensor for achieving 'smart factory' in order to integrate and manage production process, procurement/logistic and service.[3]

According to the research expert in industrial sector, Frost and Sullivan's *Analysis of the Global Digital Manufacturing Market* published in 2013, which search for the optimized production scenarios by finding and improving various problems in virtual factory through production simulation in advance., continues to grow and it is expected that the size of digital manufacturing market will be about USD 928 million in 2016.[4]

There is no case of development of a technology to link motion analysis and virtual reality system in this study, yet, and automobile companies, which should change design and modify production equipment whenever new types of automobiles are produced, lead to build digital manufacturing process. For overseas cases, automobile manufacturers such as BMW, Mazda, and Chrysler apply Technomatix solution and reduce product period, work time, development cost, and investment cost. (Figure 2)

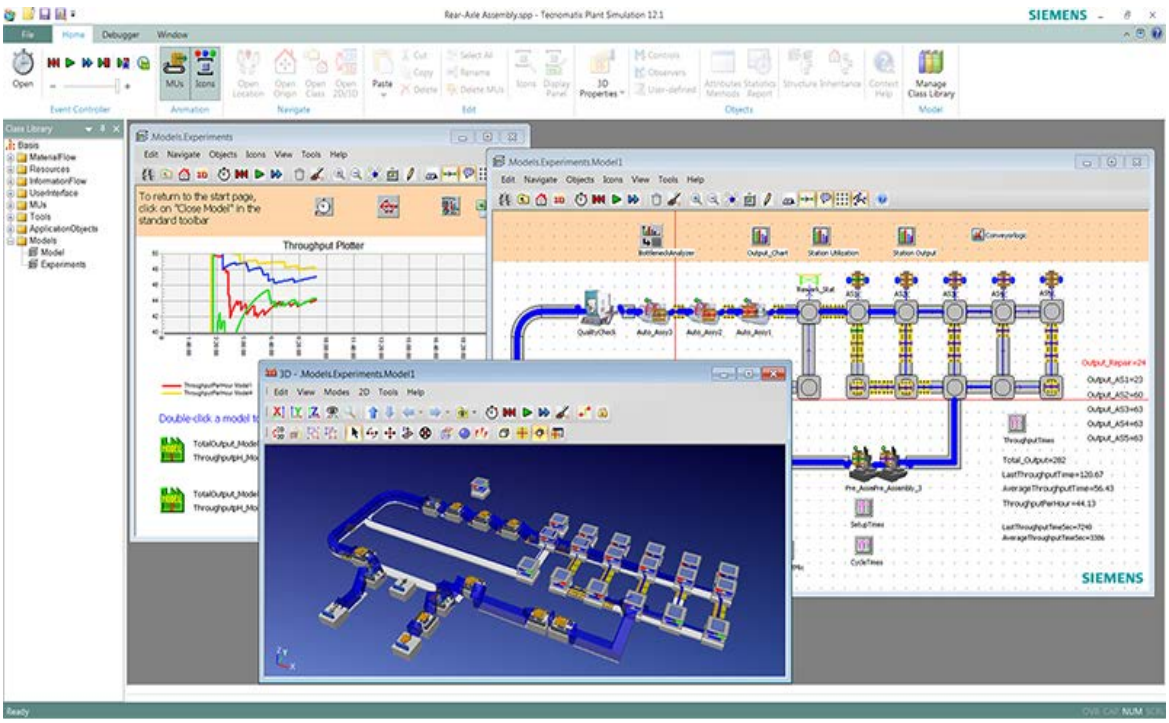

Figure 2: Design and Simulation of Process for Siemens Technomatix

For the domestic cases, Seoul National University and Samsung Heavy Industries built a system to simulate every process for innovating shipbuilding yard's process in virtual space. In addition, ETRI developed a virtual production process verification platform through R&D to mingle the actual space and virtual space of VR technologies and to apply mixed reality for making users experience it.

For the current status of the domestic and overseas technologies in production training simulation, it is available to prevent safety accident during technical training and to conduct sufficient training without wasting expensive resources, and multiple-to-one training can be applied, resulting in quick acquisition of sophisticated skills. Therefore, various sectors such as automobile, ship, and nuclear plant conduct R&D on it and introduce it.

III. Limitations in Conventional Activities of Process Innovation

Process innovation (activity) conducted currently in manufacturing sector is done in the form of redesigning process removed its risk and waste elements based on motion analysis system and verifying it through realization of test-bed in physical space. These process innovation activities are usually conducted intensively for some education time according to standard work guideline to apply it on the site. [5]

Field training requires lots of time from field to effect due to temporal and spatial limitations. That is, it takes huge cost and lots of time to find various variables which cannot be expected in design phase such as characteristics of suitable workers in real-time, to feedback them in process analysis and design system immediately, and to design and verify optimized production manufacturing process, and it is available for large-scale enterprises or some middle-standing enterprises. Therefore, 99% of Korean manufacturing sector, small and medium-sized enterprises have the actual limitations to introduce it. [6]

IV. Demand on a Low-Cost and High-Efficiency System for Validating a Process Design

Recently, VR technologies have been considered as those to replace physical test-bed in process innovation activities, and education and training simulation systems related to them are being developed.

The systems until now, have been partially applied to research or large-scale equipment industrial factors focusing on automobile, shipbuilding, universities, or large-scale enterprises, and these systems are for education and training to exchange designers' thoughts and to deliver skilled workers' know-how in specific

process, different from systems to figure out characteristics of workers by process and to design optimized production manufacturing process.

About 99% of Korean manufacturing sector, small and medium-sized enterprises have usually process to assembly parts according to work order focusing on workers with vulnerability in funding. Therefore, for process innovation in small and medium-sized enterprises, it is necessary to study optimized process design and verification system with low cost and high efficiency available for applying on the site of most of manufacturing enterprises not simulation system for designing products or educating and training. [7]

V. ECONOMIC AND SOCIAL ASPECTS

Development of IoT. M2M, and big data, sensor, and ICT leads to the 4th industrial revolution through smart factory and competition among manufacturing enterprise will be deeper in future. Also, Open Source Hard Ware(OSHW) and 3D printing technologies are shaking the ecosystem of the existing manufacturing industries through digital manufacturing.

The core management technology of smart factory, Cyber Physical System(CPS) pursues convergence of cyber-world consisting of systematic objects such as sensor, actuator, embedded-system and physical objects co-existing with human in physical world, with core concepts of 3 elements of communication, operation, and control. Objects in physical world mean all the things and natural environment which can interact with human, and USA leading in CPS sector, suggested 7 core utilized sectors of CPS, and the first one is 'smart production process system'. [8, 9]

This study will maximize production efficiency of enterprises and contribute greatly to leading to convergence of ICT based on smart factory by reviewing efficiency of resources through pre-simulation and End-to-End engineering as technologies required for surviving in these competitions, and providing optimized test-bed of production process using VR technologies.

VI. TECHNOLOGICAL RIPPLE EFFECTS

Through reducing design period, improvement of equipment, automation, realization of ergonomics, and enhancement of process, it is available to achieve a company's competition indices, production improvement, market release interval reduction, enhancement of quality, and cost reduction as well as customer's satisfaction in design and service, and employees' satisfaction in safety and health. In addition, when verifying optimization through virtual pre-process arrangement simulation and building work line, it can remove cost for additional process modification or supplement, and it will result in practical effects of production cost reduction and improvement of company's competing power. [10]

VII. DIVERSIFICATION OF APPLICATIONS

As different industries such as defense and medicines provide test-bed based on simulation and virtual reality, it is available to develop diversified derivative products, and it is possible to apply 3D objects from various sectors to contents service available for purchasing and using according to needs after manufacturing them. It can be extended to education and training system using virtual reality.

VIII. CONCLUSION

In order to survive in the global competing era, it is necessary to conduct continuously the most effective time management system and the standardization of improved work management system for achieving it.

For designing effective time management system and manufacturing process and improving productivity, this study aimed at removing waste of weak process and improving hourly productivity by line through improving work methods by removing waste of unnecessary elements using motion analysis system and virtual reality, seeking the most reasonable manufacturing process, discerning inefficient work order, batch, and lines.

This study is about development of process design verification system with optimized low cost and high efficiency for most of Korean small and medium-sized enterprises, and it is manufacturing process simulation available for simulating the entire manufacturing line in virtual reality and suggesting process improvement effect with quantitative values. In addition, it aims at providing remarkable improvement in productivity and competing power of companies by removing uncertainty against dynamic analysis system and suggesting

optimal alternative of equipment investment cost for test-bed. Accordingly, the system developed by this study is required for leading investment from most small and medium-sized companies which are negative to invest process improvement due to uncertainty and economic reasons and for strengthening the domestic and international competing power in manufacturing industries.

ACKNOWLEDGMENT

This research was financial supported by Han-Sung University

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Brand Invasion into Unconscious by Branded Content: Based on Event-Related Potential (ERP) Analysis

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Abstract---

Background/Objectives: The intent of this paper is to measure how the branded content (story-related PPL) affects to users through the analysis of electroencephalography (EEG).

Methods/Statistical analysis: Thirty subjects (10 females) participated in this experiment. Materials were composed of three sequential snapshots of a movie clip. Because there were 160 trials, total 480 snapshots were used in this experiment. EEG data were amplified with a BrainAmp amplifier system and collected from 16 electrodes that were mounted in an actiCAP. For each window, a repeated-measures ANOVA was performed.

Findings: The most important finding of the present study may provide greater empirical results of branded content effectiveness in the entertainment programs than the measures proposed by previous studies. In order to uncover how users watch the video screen including product placement, an EEG analysis was conducted to investigate their awareness by their brain waves toward branded content, story-related PPL. A repeated-measures ANOVA was performed, including three factors: PPL types (story-PPL, normal-PPL, and unrelated-PPL), electrode region (anterior, central, and posterior), and laterality (left, middle, and right). As behavioral and event-related potential (ERP) results of the experiment, the story-related PPL has most positive effect more than the other conditions of PPL.

Improvements/Applications: With the neuroscience approach, this research aims to find the possibility of indirect advertising as a new revenue model of the smart media environment.

Keywords--- Smart Media, Information Communication Technology (ICT), Branded Content, Story-Related PPL, Electroencephalography (EEG), Event-Related Potential (ERP).

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

As users' consumption patterns for media content have changed with a media convergence trend, the attention about new marketing communication strategies also has been raised both academics and industries. According to the change, especially, product placement (PPL) has been used as a comprehensive term, branded content or branded entertainment on marketing landscape. Branded content is described as a fusion of advertising and entertainment into one marketing communications product that is integrated into an organization's overall brand strategy intended to be distributed as entertainment content with a highly branded quality[1]. However, academics have yet to conceptualize branded entertainment and document its impact on the marketing landscape[2].

As a number of media contents have been poured out and already released contents have been reused as diverse formations, one-source multi-use trend has been accelerating in a smart media environment. On the trend, branded content with PPL as a center has been suggested as an alternative for new marketing strategy. It may be because existing TV commercials having a positive role to form brand image have faced with the advertising clutter according to increase of the TV advertising exposure. Advertising clutter is defined as the amount of advertisements in a given advertising medium[3]. In addition, the increase of media channels may bring out users' advertising zapping phenomenon and it deflated the role of existing TV advertising. Zapping refers to the practice of viewers of changing channels while watching television programs[4]. Branded content has been proposed as an alternative solution to this problem. By exposing a particular brand naturally or developing a storyline around the brand, advertisers try to foster brand recognition among users through entertainment content.

In the last few decades, product placement has also become variously advanced. Products are placed or embedded, woven into storylines of shows, films, songs, novels, and games, which presumably makes a stronger emotional connection with the consumer than traditional product placement[5]. Different from pure product placement, the current PPL representing the concept of the branded entertainment or content is described by using a continuum that expresses the level of brand integration with the storyline or plot. Now, advertising deals happen alongside the creative development, a practice that has been labeled as branded entertainment[2]. From the perspective, the influence and effectiveness about branded entertainment have highlighted and discussed. In addition, both academics and industries have begun to demand more practical and empirical measurements related with the effectiveness of the branded entertainment than them of pure PPL. The important management issues related to branded entertainment are considered, issues related to measurement, control, and ethics[2]. Even though PPL has taken the spotlight as an alternative means of attracting consumers' attention in the concept of the branded entertainment, most studies about the effects of product placement have some limitations in that they depend on explicit memory tests and surveys. Previous studies have examined the effectiveness of product placement in television and movies in which the focus was mostly on cognitive and affective measures, such as recall, recognition, attitudes, and purchase intentions[6].

With the change of media environment, there is a need for a new approach about the branded entertainment that could increase the accuracy and objectivity of the analysis by directly observing the changes in the human body thereby differing from existing methods that depend on post-surveys based on participants' memories or attitudes. The intent of this paper is to measure how the story related PPL or branded entertainment affect to users through the analysis of electroencephalography (EEG) in order to study the attentional processes involved in a task. It provides useful information on the electrical activity from the brain when users are exposed to branded entertainment. With the neuroscience approach, this research aims to explore the potential of branded content as new marketing strategy in today's brand management environment.

II. LITERATURE REVIEW

A. The Evolution of Product Placement: Branded Content/Entertainment

Before product placement was given a formal business model for both advertisers and producers of electronic content to work with in the mid-1980's, the strategy to give characters more credibility to

audiences in television programs or movies by showing them using real brands was more artistic driven than sales driven[1]. As an initial concept, along the line, Balasubramanian[7] defined it as the planned entries of products into movies or television shows that may influence viewers' product beliefs and/or behaviors favorably. Ever since, the placement of products in movies and television has become an important element of consumer marketing programs[8].

As media environment has dramatically changed, the concept of product placement become more sophisticated and paranoid. Spurred by the diminishing effectiveness of television advertising and other traditional techniques, product placement has seen considerable growth in recent years[9]. It would appear that the advertising industry has created a new term to define the more contemporary use of product placement[2]. Alongside, Hudson[2] explained product placement as the integration of advertising into entertainment content, whereby brands are embedded into storylines of a film, television program, or other entertainment medium. It was close to the concept of branded content or entertainment. This involves co-creation and collaboration between entertainment, media and brands. The level of brand integration into the plot may be difference between product placement and branded entertainment. Pure placement is a traditional cameo of a product whereas, branded entertainment incorporates a brand into the storyline of the entertainment content. At a basic level, a branded entertainment strategy is similar to a slice of life advertising strategy because the brand plays an integral role within the storyline[1].

New technology also encouraged the evolution from pure PPL to branded content/entertainment. Now, many of users consume diverse media contents by internet based platforms such as smart phone, internet protocol television (IPTV), and virtual reality (VR) devices. As product placement in entertainment media has become more common, examining how people process the brand messages that are embedded in such entertainment media has emerged as an important research topic in advertising and information-processing literature[10]. Marketers realize that communications via branded entertainment can be more sophisticated, more targeted, and more widely seen than traditional advertising methods[8].

Even though the concept of PPL has become more sophisticated and evolved as branded content/entertainment over the years, basic concept of them is the inclusion of brand identifiers in entertainment media programs as the marketing strategy. With development of entertainment and technological environment, brand management via the placement activities into media contents has gained momentum and become more coordinated with overall brand strategy. It holds placement activities to a higher brand standard and seeks to capitalize on new technologies that are creating new avenues of communication distribution – a sort of blurring between mediums[1].

As the media environment currently faces a variety of challenges, the intent of this paper is to demonstrate how branded content enables strategic exposure in the entertainment environment differently from pure PPL and to explore the possibility of branded content as today's strategic brand management tool. Specifically, using a neuroscience method through EEG analysis, we have attempted to provide empirical evidence rather than the hitherto indirect evidence including the assessment of the memorability of advertisements through direct memory tests or self-reporting measures.

B. ERP (Event Related Potential) Analysis

Electrical activities in a human brain produced by the firing of neurons can be safely recorded through electrodes distributed over the scalp. Such recordings are termed as electroencephalography (EEG)[11]. In analysis techniques for EEG, ERP is computed by averaging brain potentials induced by specific events. Although there are some limitations of ERPs, such as interpretational issues, A lot of researchers have been used ERPs because of the advantage of ERPs. Among other things, the first advantage of ERPs is that there is an considerable and decades-long literature of ERP findings. So we can contextualize and interpret our findings. And the other advantage is that ERPs have high temporal precision and accuracy[12]. Therefore, ERP data present on-line process of brain when we process a target item.

III. PROPOSED WORK

In order to recognize and memorize some objects, human must firstly assign attention to those. Although the results from the survey about PPL effects cannot provide the information about whether the object (or product) lead attention of viewers (or customers) or not directly, ERP results having high temporal resolution can provide the answer. In particular, ERP components related to the attention, such as N1 and N2, inform when and how viewers pay attention to the product during watching a scene[13].

The first ERP component to be related to the selective attention is the N1 component of which negativity peak is evoked around 150 and 200 ms after stimulus onset, which appears to reflect the spatial attention and discrimination processes in form and color[14 15]. The amplitude of N1 is increased when subjects allocate attended-location stimulus rather than unattended-location stimulus and when subjects are required to differentiate between two classes of stimulus as compared with no discrimination.

The second, but more important ERP component in the present study is the N2 of which negativity peak is shown around 180-325 ms after stimulus onset, and it reflect the next processes of attended stimuli. Although the N2 in auditory oddball detection task reflect disparity between the deviant stimulus and a sensory memory representation of the standard stimulus[16], the N2 that is not depended on modality reflect to detect attentional deviation or novelty in the stimulus list[17] and the size of the N2 amplitude is closely linked to the difficulty of target discrimination among attended stimulus [18 19 20]. So researchers called the N2 in auditory modality as mismatch negativity (MMN) and another N2 as N2b, and they agree that MMN and N2b are different ERP components to be associated with distinct cognitive functions.

To detect a product in a visually presented scene may not be related to MMN because this process is not to compare the input with the stored representation in the sensory memory. But the present study believes that the N2b may be affected by this situation. It is because the modulation of N2b waveform is affiliated with general detection process and the difficulty of target discrimination. Unlike the N2b, the N1 effect seem to be irrelevant to this study because the task of present study does not require for subjects to allocate selective attention and to discriminate a target in a stimulus array.

Therefore, if the product in story PPL lead more consumers' attention than other kind of PPL, N2b to be directly associated with the detection will be generated larger than others but N2a will not be modulated by the kind of PPL.

IV. METHODS

A. Participants

Thirty (10 female) undergraduate students from the Korea University participated in this experiment. All of them who had no history of neurological impairment had normal or corrected vision. They were right-handed. Averaged age of them was 23.8 (19-34). And they received 15000 won (about 12 US dollar) for their participation.

B. Materials

One trial was composed of three sequential snapshots of a movie clip. Because there were 160 trials, total 480 snapshots were used in this experiment. The first and second snapshots in each trial were previous scenes of the third scene that was used as the target. The third snapshot in story-PPL and normal-PPL condition included a trademark of a product, but the snapshot in unrelated-PPL condition didn't any trademark. The third snapshot in story-PPL had a close relationship with previous snapshots, such as an actor in the first and second snapshot goes to the bath room, and he squeezes the toothpaste onto the toothbrush. However, there was no relationship between previous snapshot and the third snapshot in normal-PPL. For example, the actors discuss some issues around a table in the first and the second snapshot, and in the third snapshot, the clothes brand that is unrelated to the given context displayed on the wall as a background. The third snapshot in unrelated-PPL was actually not advertising. It means that there was no trademark of a product. This condition was used as the baseline condition. Forty trials were assigned into the story-PPL and normal-PPL condition respectively, and 80 trials were assigned into the non-PPL condition.

C. Procedures

Participants were seated comfortably in a darkened, sound attenuated room. The task was a kind of categorization task for the product. Participants were asked to look the product in the third snapshot followed by two snapshots, and they were asked to select a class among several choices as quickly and correctly as possible when a question ("If you catch a product at the last scene, what is the category of the product?") and choices was shown on the computer monitor.

After all participants experienced 10 warm-up trials if they understood the task in this experiment, they entered into the main trials. Each trial started from a fixation mark ("+"), which displayed on the center of screen during 1000 ms. After the mark disappeared, the first and the second snapshot were presented sequentially. The duration of the first and the second snapshot was 1000 ms. And another mark ("++") which participants could distinguish the second snapshot and the third -target- snapshot presented on the center of screen for 1000 ms. The target snapshot replaced the second mark and this was remained for 2500 ms. After the target disappeared, 5 categories of products presented by multiple-choice with the question. For example, 1-furniture, 2-electronics, 3-clothes, 4-food, and 5-nothing. Participants were instructed to press a number button on the keyboard indicating the category of product in the target snapshot as quickly and correctly as possible. When participants pressed a button, a blank screen was presented during 2500 ms.

In order to reduce eye-blink artifacts, participants were asked to avoid eye movements and blinks during stimuli presentation and there was a break every 60 trial. To remove response strategy, the order of choices was changed systematically in each trial. All trials were presented randomly. Stimuli presentation and recording response times and errors were controlled via E-prime software (ref). EEG data were recorded via Brain vision recorder software. The experiment took about 40 minutes.

D. EEG Recording and Analyses

EEG data were amplified with a BrainAmp amplifier system and collected from 16 electrodes that were mounted in an actiCAP. The two mastoids were used as reference. Eye blinks were detected with VEOG channel that placed below the right eye. The sampling rate was 500Hz and the impedance level was kept below 10kOhm during recording. An analogue band-pass filter of 0.01-100 Hz was used while EEG recording, and a digital 0.01~30 Hz band-pass filter was applied before analysis.

Epochs from 100 ms before the target onset to 500 ms after the onset were selected from continuous EEG data. The 100 ms before target onset was used as the baseline. Averaged ERPs across three conditions were calculated from correct trials free of muscular and ocular artifacts (less than 14% of all epochs). Based on the clean epochs, mean amplitude values in two time windows (N1: 50-200 ms, N2b: 200-400 ms) were computed in F3, Fz, F4, C3, Cz, C4, P3, Pz, and P4. (Figure 1)

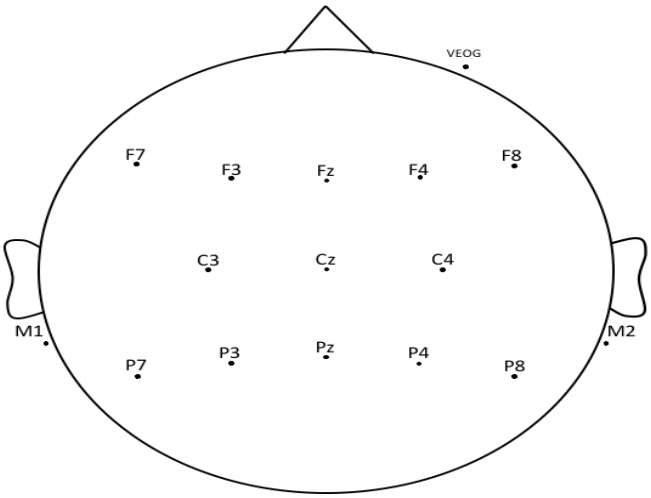

Figure 1: Electrode Montage and Nine Electrodes (F3, Fz, F4, C3, Cz, C4, P3, Pz, and P4) used for ANOVAs

For each window, a repeated-measures ANOVA was performed, including three factors: PPL type (story-PPL, normal-PPL, and unrelated-PPL, electrode region (anterior, central, and posterior), and laterality (left, middle, and right).

V. RESULTS

A. Behavioral Results

In response time analysis, RTs over 2SD (less than 7 %) were excluded from the analysis, and the analysis of variance (ANOVA) was performed on the correct trials. Table 1. shows mean RTs and error rates of conditions. The difference between conditions is significant ($F(2, 58) = 22.84$, $p < .001$). In post-hoc analysis with bonferroni correction, although there was no difference between RTs of story-PPL and normal-PPL, RT of story-PPL was longer than RT of unrelated-PPL ($p < .001$), and RT of non-PPL was longer than unrelated-PPL ($p < .001$). In error rate analysis, the difference between conditions was significant ($F(2, 58) = 3.16$, $p < .05$). In post-hoc analysis, story-PPL showed a lower error rate than unrelated-PPL ($p < .05$), but there was no significant difference between other comparisons (ps > .5).

Table 1: Mean Response Times (ms), Error Rates

	RT (SD)	Error rate (SD)
Story PPL	1395(261.5)	9% (5.5)
Normal PPL	1399 (257.7)	11%(6.1)
Unrelated PPL	1192 (200.1)	14%(9.9)

B. ERP Results

The grand averaged ERPs in 9 electrode sites showed N1 and N2 (Figure 2). Visual inspection of Figure 2 reveals clear N2 difference between branded content and other conditions.

- N1 effect

As can be seen in Figure 2, there was no significant difference between conditions in all electrode sites ($F(2, 58) = .03$, $p = .96$). But the 3 way interaction (PPL type ✕anterior-to-posterior regions ✕ hemisphere) was significant ($F(8, 232) = 4.30$, $p < .001$). Although following up analyses for this interaction were conducted, there was no significant effect in all six electrode sits (all ps > .5).

- N2 effect

The main effect of PPL type was not significant ($F(2, 58) = 1.05$, $p = .35$). However, the 2 way interaction between PPL type and anterior-to-posterior region was marginally significant ($F(4, 116) = 2.16$, $p = .07$). And the PPL type ✕ anterior-to-posterior region ✕ hemisphere interaction was significant ($F(8, 232) = 3.79$, $p < .001$). In pairwise comparison with bonferroni correction for PPL type effect at each electrode site, the mean amplitude of story-PPL was larger than that of unrelated-PPL significantly at only Fz ($p < .05$). (Figure 2)

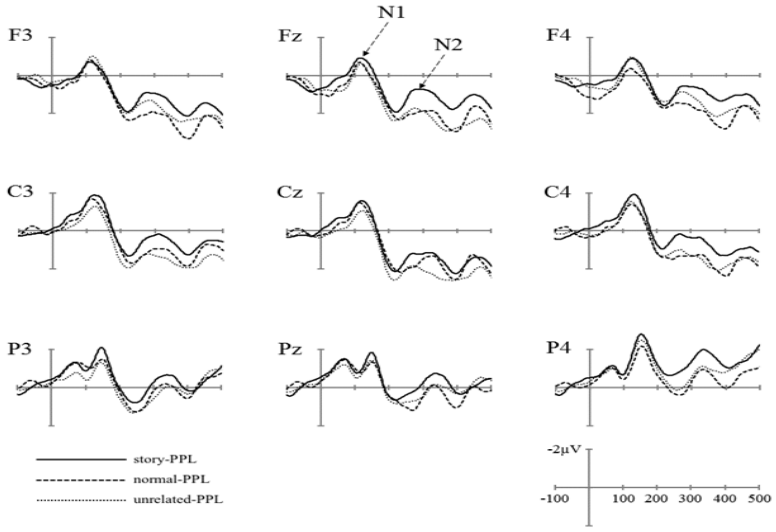

Figure 2: Grand Averaged ERPs of the Branded Content(story-PPL), Normal-PPL, and Non-PPL

VI. CONCLUSION

As users' entertainment content consumption patterns have been changing in accordance with the advances in various media formats, the brand management strategy faces new challenges. With the change, Internet users tend to skip or avoid looking at advertisements. Branded content has been proposed as an alternative solution to this problem. By exposing a particular brand naturally or developing a storyline around the brand, advertisers try to foster brand recognition among users through entertainment content.

As we expected for the ERP effect, there was no significant effect in N1 but N2b showed large differences across PPT types. In particular, story-PPL generated largest N2b effect rather than other PPL-types. ERP results indicates that all participants pay attention to all PPL-types, and in next cognitive processing step, participants discriminate differently story-PPL from other PPL type. Moreover, the N2b effect generated by story-PPL was concentrated in Fronto-central electrode (Fz). Although we did not conduct source analysis to find a brain area to generate the N2b, many researches have been thought that the anterior cingulate cortex (ACC) might play an important role in cognitive function, working memory[21]. Thus, we suggest that the story-PPL may more activate working memory over other PPL types irrespective of attention level, and it implicates that story-PPL may have advantage in work memory processing not in attention processing in human cognitive processes at least[22] also predicted that if branded contents of demonstration phase about the particular product is materialized, viewers' recall and recognition effects would be more positive.

Perhaps the most important finding of the present study may provide greater empirical results of branded content effectiveness in the entertainment programs than the measures proposed by previous studies. In order to uncover how users watch the video screen including product placement, an EEG analysis was conducted to investigate their awareness by their brain waves toward branded content, story-related PPL. The results of this study highlight a brand positioning strategy to maximize users' unconscious attention with branded content.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

SSD Bandwidth Distributing I/O Scheduler Considering SSD Garbage Collection

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Abstract---

Background/Objectives: Thanks to its fast performance and low power consumption, a solid-state drive (SSD) has recently been distributed at a rapid pace. With decrease in SSD price, it's been widely used in the server to provide better information services. However, it's been hard to find a study on service level agreement (SLA) when an SSD is shared by several virtual machines.

Methods/Statistical analysis: This study aimed to improve the distribution of an I/O scheduler for the SLA of the SSD. The previous Linux I/O scheduler 'completely fair queuing (CFQ)' is adjusted to allow the dynamic distribution of bandwidth.

Findings: Different bandwidth distribution performances when garbage collection occurs (or does not occur) in an SSD have been observed, focusing on the latest storage device. To improve this problem, a completely fair queuing-time slice control (CFQ-TSC) I/O scheduler designed by adding the time slice controller (TSC) to the conventional CFQ I/O scheduler has been proposed.

Improvements/Applications: CFQ-TSC I/O scheduler has been implemented by adjusting the conventional Linux I/O scheduler 'CFQ.' The CFQ-TSC has improved the I/O bandwidth distribution performances of the conventional CFQ by observing if the I/O bandwidth is well distributed up to a user-wanted level and adjusting the I/O time slice of virtual machine dynamically based on the I/O bandwidth.

Keywords--- I/O Scheduler, Bandwidth Distribution, SSD, Garbage Collection, CFQ, SLA.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The flash memory-based storage device 'SSD' has been distributed at a rapid pace thanks to its fast performances and low power consumption. However, current operating systems and system software programs have developed for a hard disk which has long been used as a storage device. Instead, they have failed to consider the characteristics of the latest device 'SSD' in many aspects.

Among several server systems, it is cloud server and virtual server systems that have emerged recently[1,2]. Because several virtual machines can be operated in a single system, they can utilize hardware resources efficiently by minimizing their wasteful consumption. If an SSD is used under this kind of virtualized server environment, resources should be shared efficiently. Therefore, SSD sharing by several virtual machines is essential unless SSDs substitute all hard disks.

The biggest difference between the SSD and hard disk exists in garbage collection arising from the physical features of the SSD. In case of hard disks, they can be overwritten, allowing data deletion. In an SSD, in contrast, data can be read and written by page and deleted by block. If certain data are deleted, therefore, they are marked as 'invalid' in the flash translation layer (FTL) and left undeleted in many cases. As write and delete are repeated, invalid pages are generated in the flash. If a space in the SSD flash becomes narrow due to too many invalid pages, the following process occurs: delete invalid pages in the block; collect valid pages only and move them to other blocks to secure the pages to be written; delete the blocks. This process is called "garbage collection." If several processes write in a single SSD because of garbage collection, the write bandwidth of each process can be influenced by the garbage collection. Therefore, there should be studies on an I/O scheduler for an SSD.

II. LITERATURE REVIEW

There have been studies on quality of service (QoS) or SLA regarding the hard disk or SSD and scheduler-related studies. However, the studies aimed to secure SLA focused on a hard disk only without considering flash. Those which considered the feature of an SSD which handles I/O without physical rotation suggested a scheduling technique targeted to guarantee I/O fairness. However, they failed to consider an SLA aspect. In other words, many conventional studies didn't cover an SSD's garbage collection in QoS or SLA.

The PARDA and VM-PSQ proposed a new scheduling technique needed to distribute I/O resources in virtualized environment or distribution system[3,4]. The PARDA improved I/O bandwidth distribution performances and fairness by measuring I/O latency in a distributed storage environment and adjusting the length of an I/O queue. Compared to the conventional scheduler, the VM-PSQ improved I/O bandwidth distribution performances, using both I/O time slice and scheduling token. However, it didn't reflect SSD features properly because a storage device was limited to conventional hard disks. The FIOS and FlashFQ which considered the features of an SSD proposed a new scheduler for fair I/O resource distribution, considering the characteristics of a flash-based storage device[5,6]. The FIOS improved the efficiency and I/O performance of fair I/O distribution by implementing a scheduler, considering a delay time on Read and Write in understanding of the fact that Read is faster than Write in an SSD. The FlashFQ improved an I/O time slice distribution method when an I/O is performed by several threads in consideration of the features of an SSD. In addition, this kind of technique has improved I/O fairness by shortening response time, compared to the conventional scheduler. However, the features of garbage collection in SLA and SSD weren't considered.

Just like conventional studies, this study focused on SLA, not on parallelism and improvement of I/O performances. Both conventional hard disk and SSD adopted a technique which regulates a time slice dynamically to improve I/O distribution performances.

III. PROPOSED WORK

A dynamic regulation technique has been adopted. The CFQ-TSC was implemented in a TSC-inserted format to control a time slice in the conventional CFQ I/O scheduler. As shown in Figure 1, 2, the TSC thread is operated in the CFQ. If a user ads weight to virtual machine for bandwidth distribution, the CFQ creates and starts the TSC thread. The TSC is independently operated. If single hard disk and single SSD are shared by several virtual machines, the CFQ creates a total of two threads: TCS thread for hard disk, thread for SSD. Because it is designed to control a time slice by creating thread for each storage device, in other words, a time

slice can be individually controlled even though the virtual machine gives different weight by the storage device.

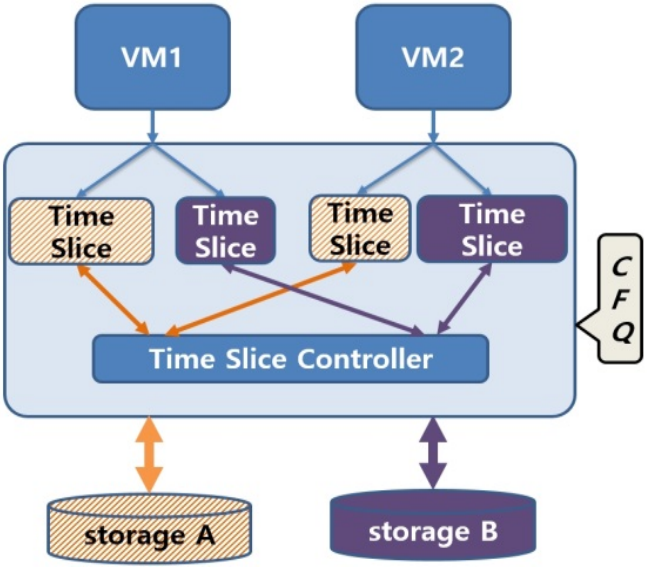

Figure 1: Time Slice Controller

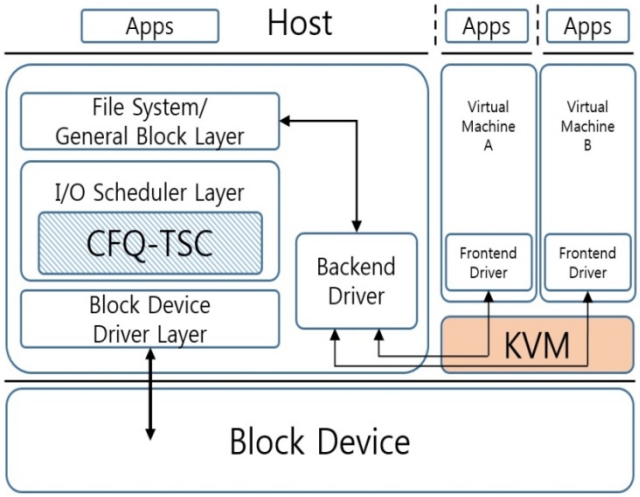

Figure 2: Operating Environment of CFQ-TSC

The CFQ-TSC controls a time slice based on the I/O bandwidth on current devices. When several virtual machines simultaneously execute I/O in a single disk, therefore, bandwidth on the storage device of each virtual machine should be collected. In this study, it is designed for the TSC to collect bandwidth by using the input/output statistics (iostat) tool which can measure I/O bandwidth by storage device and partition. If the CFQ gives weight on the I/O bandwidth to virtual machine or its storage device, the TSC thread is operated. Then, TSC thread collects bandwidth every second by the virtual machine through the iostat to check if the bandwidth is properly distributed. Then, it controls the I/O time slice of the rest virtual machines except for the ones to which the least weight is given.

IV. CONCLUSION

The performance assessment on the CFQ-TSC was conducted under two different conditions considering the features of garbage collection: a situation in which an SSD is aged because of frequent write operations, a clean state in which almost no data are left in the SSD. The characteristics of the tested workloads are stated in Table 1.

Table 1: Experiment Environment

Workload	write/read Ratio	average request size(KB)
Fileserver	2	72
Varmail	1	24
MSN	66.7	22.5
Exchange	1.5	12.5
Financial	0.24	2.38

In the conventional I/O scheduler 'CFQ,' bandwidth distribution performances differed in both aged SSD and clean SSD in most workloads. If write is performed on the aged SSD, a garbage collection operation occurs. Therefore, a bad effect on bandwidth distribution performances has been detected. In terms of bandwidth distribution performances, a clean SSD was greater than the aged SSD. However, ideal bandwidth distribution performance wasn't found in all workloads. In the CFQ-TSC scheduler proposed in this study, bandwidth is measured, and a time slice is adjusted in realtime. Therefore, bandwidth distribution was close to an ideal level in most cases, as shown table 2 and figure 3~7. This study aimed to improve bandwidth distribution performances when a single storage medium is shared by several virtual machines in a virtualized environment. In particular, it found that bandwidth distribution performances differed when garbage collection occurred (or didn't occur) in an SSD. To solve this problem, it proposed a CFQ-TSC I/O scheduler which was obtained by adding TSC to the conventional CFQ I/O scheduler.

In this study, a CFQ-TSC I/O scheduler has been implemented by adjusting the conventional Linux I/O scheduler 'CFQ' for the improvement of bandwidth distribution performances. First, the CFQ-TSC examines if the bandwidth of the storage device's partitions shared by each virtual machine is divided as a user wanted. If bandwidth is not distributed as much as a user wanted, the I/O time slice of the virtual machine is extended. If bandwidth is distributed too well, the I/O time slice is tightened, using the dynamic time slice control technique.

Table 2: Error Rate of Bandwidth Distribution

	CFQ		CFQ-TSC	
Workload	**Aged SSD**	**Clean SSD**	**Aged SSD**	**Clean SSD**
Fileserver	26.6%	14.7%	7.9%	5.2%
varmail	21.9%	15.3%	1.5%	0.8%
MSN	14.2%	7.6%	8.7%	9.5%
Exchange	4.3%	2.7%	4.1%	1.1%
Financial	58.2%	51.8%	31.3%	19.2%

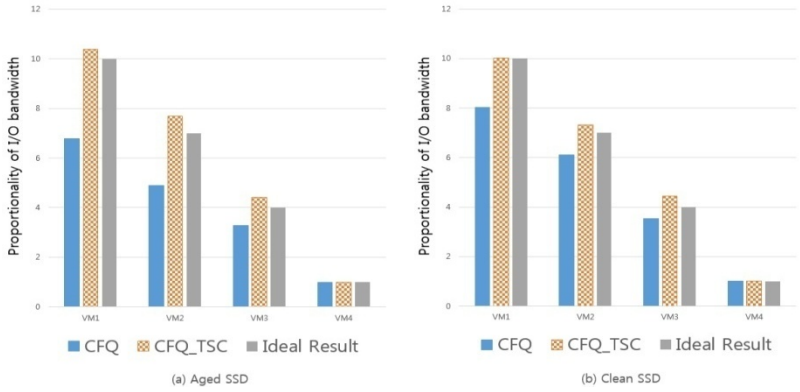

Figure 3: Fileserver Workload

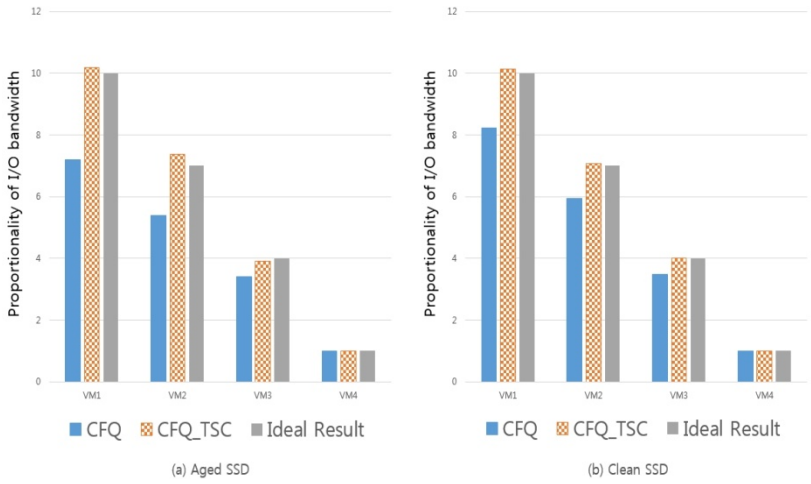

Figure 4: Varmail Workload

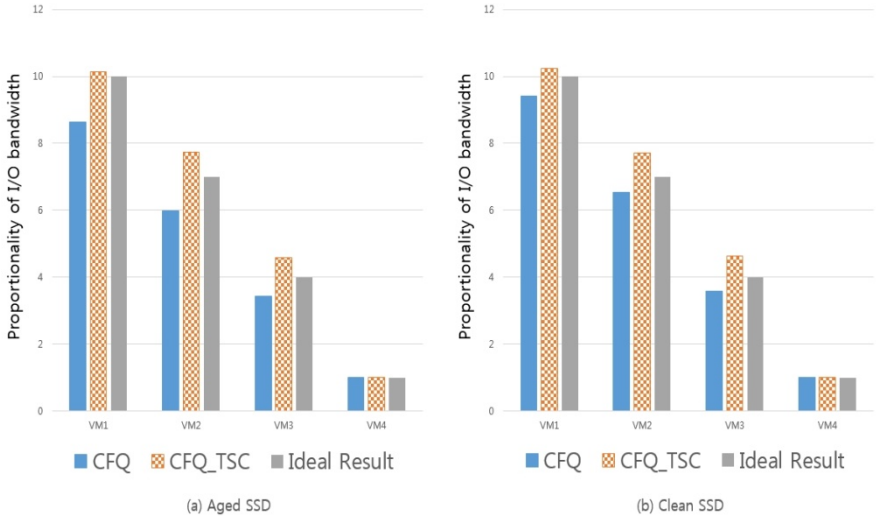

Figure 5: MSN Workload

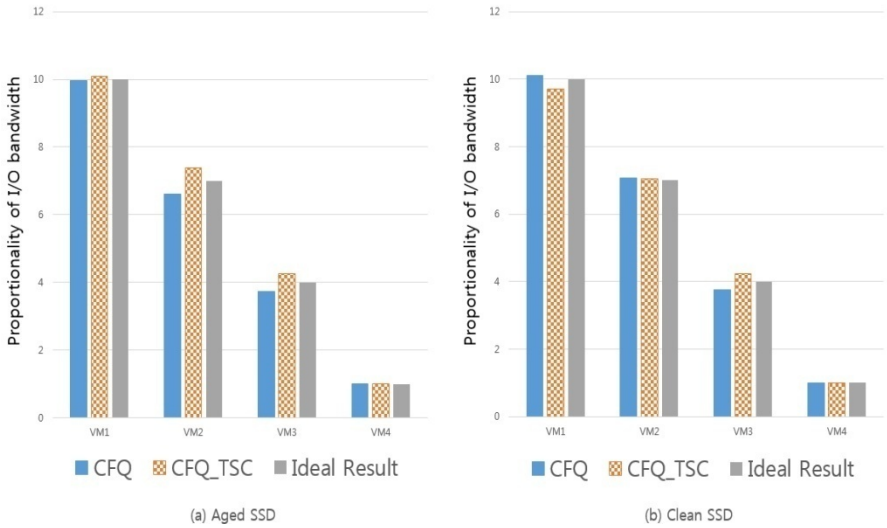

Figure 6: Exchange Workload

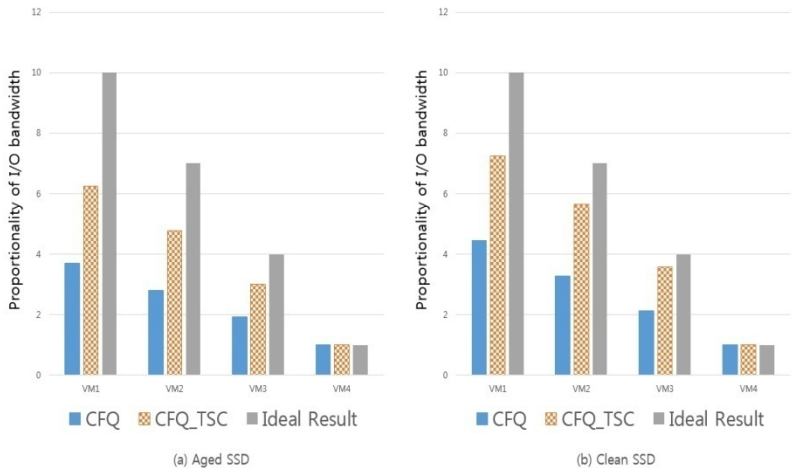

Figure 7: Financial Workload

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

FloGeo: A Floatable Three-Dimensional Geofence with Mobility for the Internet of Things

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Abstract---

Objectives: Most of the conventional geofences don't provide the 3D(three-dimensional)location information as well as mobility. So this paper presents a floatable 3Dgeofence with mobility different from the existing systems.

Methods/Statistical analysis: We propose the FloGeo as a floatable 3D geofence model with mobility for the IoT. The proposed FloGeo system is one of geofence models automatically capable of being moved along the movement route of users using location tracking mechanism regardless of whether they are in indoors or outdoors.

Findings: The proposed FloGeo system provides proactively inform when the user reaches one place marked as a PoI. In addition, it can support the intercommunication between the geofences. To do this, we design the FloGeo system model through introducing the concept of a floatable 3D geofence and describe location analysis mechanism to discover the movement route. For location analysis mechanism of the FloGeo system, the client-side with mobility consists of a Real-time Current Location module and a Geofence Information module, and the geofence server-side also consists of a Geofence Task module and a Location Analysis module based on the 3D dimensional geofence platform.

Improvements/Applications: In future, the proposed FloGeo will be a valuable application cooperating with the mobile facility for vehicle-to-vehicle communications in the connected-vehicle environment.

Keywords--- Floatable Geofence, Mobile Geofence, Three-Dimensional Geogence, Location Analysis Mechanism, Internet of Things.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Nowadays, geofencing usages and its applications are a very wide range such as retail marketing, home quarantine, human resource management, fleet management, law enforcement, compliance management, asset management, mobile device management, and the isolation of certain event areas[1-12]. However, most of the existing geofences do not provide the 3D(three-dimensional)location information no matter whether these are used indoors or outdoors[2-6].

In addition, these are the 2D(two-dimensional) stationary geofences which do not provide geofencing services with mobility[7]. That is, conventional geofencing services provide the service for being into or out in the stationary geofence by setting a specific PoI(Points of Interest) such as a store or sports complex.

Therefore, in this paper, we propose the FloGeo as a floatable 3D geofence model with mobility for the IoT. The proposed FloGeo system is one of geofence models automatically capable of being moved along the movement route of users using location tracking mechanism regardless of whether they are in indoors or outdoors. To do this, we design the FloGeo through introducing the concept of a floatable 3D geofence and describe location analysis mechanism to discover the movement route. For location analysis mechanism of the FloGeo system, the client-side with mobility consists of a Real-time Current Location module and a Geofence Information module, and the geofence server-side also consists of a Geofence Task module and a Location Analysis module based on the 3D dimensional geofence platform. Therefore, the proposed FloGeo system can proactively inform when the user reaches one place markedas a POI.

In addition, it can support the intercommunication between the geofences. In this case, there may arise quite a lot of business opportunities based on context-awareness technology[8,10,13].Furthermore,the proposed FloGeo system can not only provide the stationary and fixed geofencing services but also the flexible, dynamic and movable geofencing service to communicate the inter-geofences.

The paper begins with a review of related works, then goes on to describe design of the proposed system, before providing experimental results from an early user study, followed by a discussion and conclusion.

II. RELATED WORKS

The typical geofence is a generic concept for describing the geographic aspects of PoIsand enables users to proactively induce context based on actions[2,3,11,12]. From the user's perspective as well as the LBS(Location-Based Service) developer's perspective, geofencing services offer an easy way to discover and search information in the right place in time.

Geofencing usages and its applications are very large. The existing geofence models are human resource management, fleet management, retail marketing, law enforcement, home quarantine, compliance management, asset management, mobile device management, and the isolation of certain event areas[2-12]. Apart from this, Google's Playstore and Apple's App store offer lots of apps that implement the geofencing services[14,15]. For example, when an user approaches the vicinity of the store to provide a geofence, the service apps such as the Syrub app or the OKCashBag app for retail marketing provide the discount coupons or the goods advertisement to him[14,15].

In addition, most of conventional geofencing applications incorporate a two-dimensional map(e.g., Naver maps, Yahoo maps, Daum maps, Google maps, and Bing maps) allowing administrators to define boundaries on top of a satellite view of any specific geographical area[7-11]. However, these applications also do not support the three-dimensional spatial information regardless of whether they are used indoors or outdoors.

As one example, some maps such as Google maps and Naver maps currently provide indoor maps of the specialized building or the underground building as shown in Figure 1[14].Theleft-side map in Figure 1 is Harbour City building in Hong Kong and the right-side map is a map that showed the third floor interior of the building. Today's map services have been building an infrastructure that supports even indoors as well as outdoors.

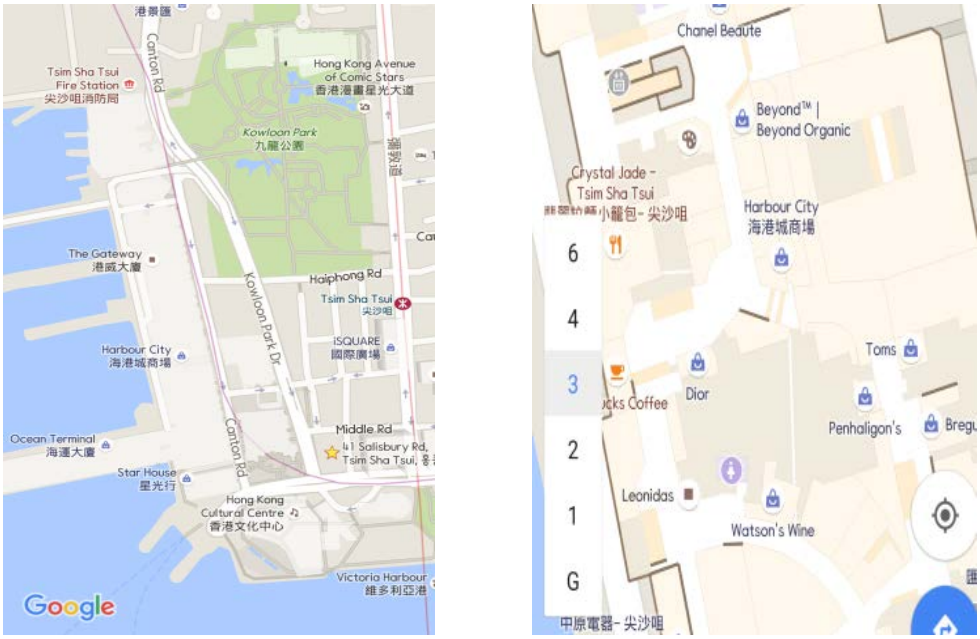


Figure 1: Google Outdoors and Indoors Maps for a Specific Location on Smartphone

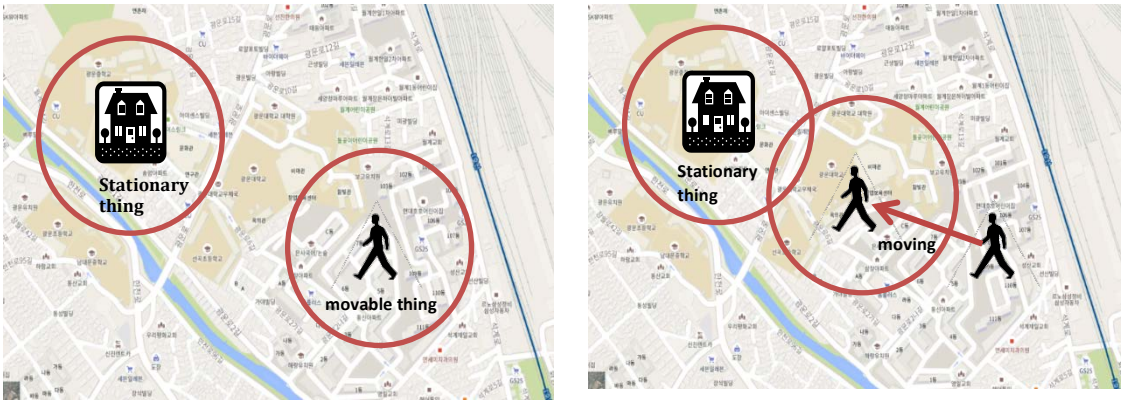
Therefore, the geofence should be support the three-dimensional spatial information as well as two-dimensional information regardless of whether users are used indoors or outdoors. In addition, we assume that the geofence can be adapted to the connected-vehicle environment. To do this, it needs to the floatable facility with mobility for vehicle-to-vehicle(V2V) communications[15].

III. DESIGN OF THE FLOGEO

The proposed FloGeo system is afloatable3D geofence model with mobility for the IoT based on the 3D geofence platform developed by our previous research which has temporal attributes and can be recognized whether an user is in indoors or outdoorslocation[1-9].In this chapter, we design the FloGeo as a proposed 3D geofence model and describe location analysis mechanism for it.

A. A Floatable 3D Geofencemodel

The floatable3D geofence proposed in this paper defines that if the things or people with mobility move after these/they set up any geofence at one of PoIs, the set geofences will automatically move along the movement route. For example, Figure 2 shows the concept of the floatable geofencing service.



(a) (b)

Figure 2: A Concept of the Floatable Geofencing Service

Conventional geofencing services provided the service for being into or out in the stationary zone by setting a specific PoI such as a store or building[10,11].In other words, as shown in Figure 2(a), if the existing geofence is set around a stationary thing(e.g. a store), it provides the trigger for entering and leaving the zone. On the other hand, when a geofence is set to the vicinity of the things capable of movement, it provides only the trigger for entering and leaving of the movable thing within the set geofence. Figure 2(b) shows a case of the floatable geofence model with mobility. Here, when the FloGeo is first set on a movable thing, it should be moved along with the thing that moves.

B. Location Analysis Mechanism for the FloGeo

The floatable 3D geofence must automatically move along the movement route. Therefore we should be supported location tracking for the floatable 3D geofence. Figure 3 shows processing flows for location analysis mechanism. Processing details of each module are as follows:

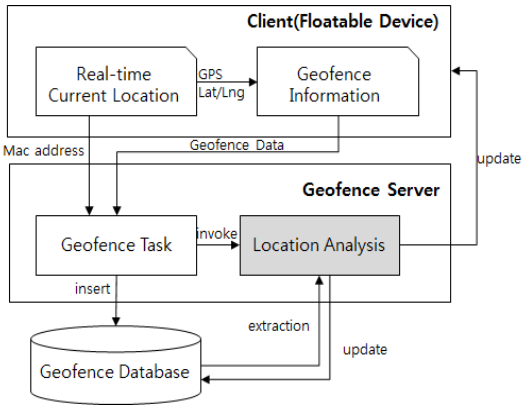


Figure 3: Location Analysis Mechanism

- Client (Floatable Device)
  - Real-time Current Location: Delivering the latitude/longitude coordinates of GPS to the Geofence Information. Also, passing the Mac address of the AP(Access Point) to the Geofence Task when the Client is connected to WiFi network.
  - Geofence Information: Configuring with the latitude/longitude coordinates of the user's location, geofence size (radius), timestamp, Client's device information, etc.
- Geofence Server
  - Geofence Task: Module that performs various operations for 3D geofence after received the Geofence Information from the client. In this paper, it updates the Geofence Database while constantly monitoring the AP and latitude/longitude coordinates information of the Client, and passes to the Location Analysis module.
  - Location Analysis: Module that analyzes the location for the floatable geofence. It performs two roles as follows. First, when the Client is in indoors, it maps the AP connection information with Mac addresses where have already been built into the Geofence Database. Mac addresses of the database is already composed of building layers with information about the AP within the building. According to this mapping, it identifies the Client where floor is in the building, constantly checks the WiFi connection status and informs after identifying the situation of moving the Client. As the role of the second, it updates the most recent information of the latitude/longitude coordinates to the Client and the Geofence Server when the Client is moving in outdoors.

IV. EXPERIMENTAL RESULTS

We show the experimental results using smartphone based on the Android platform in order to apply the FloGeo system as the proposed floatable 3D geofence model with mobility.

Figure 4~11 show that operate the proposed floatable geofence with mobility after running the FloGeoapp on the 5th floor of the building. As shown in Figure 4 and 5, we can confirm that the location information of the user is in an indoor and he is on the fifth floor of the building. Here, the radius of the geofence area was set to 30 meters, timestamps to automatically elapsed was given to one hour.

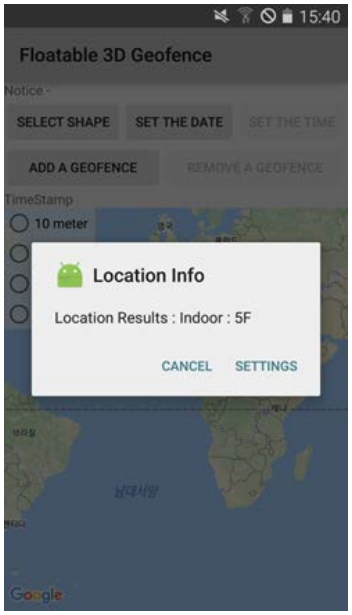


Figure 4: A Screen Running the FloGeo on the 5th Floor

Figure 5: A Screen Setting the Geofence

Figure 6 shows a screen of which the user moved from the 5th floor to the first floor in the building. In this case, the FloGeo also shows that moving along. That is, when the user arrived from the fifth floor to the first floor by a lift, it shows connected to the WiFi network on the first floor and indicates that he is the first floor via the database mapping after the Mac address of the AP that is connected send to the server.

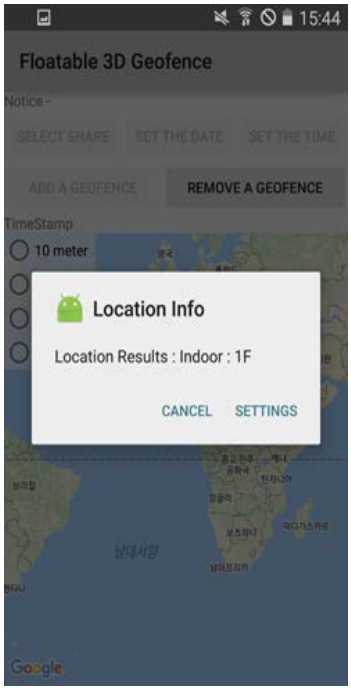


Figure 6: A Screen after Moving to the First Floor

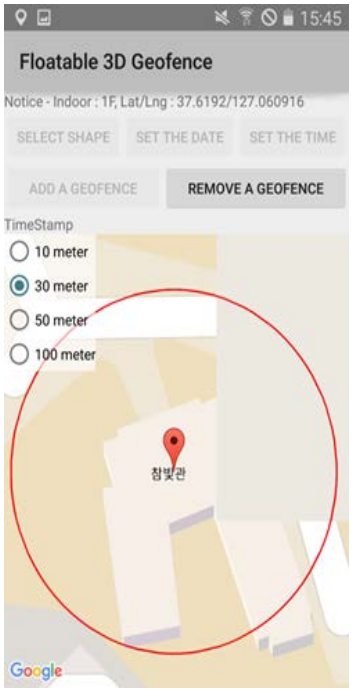
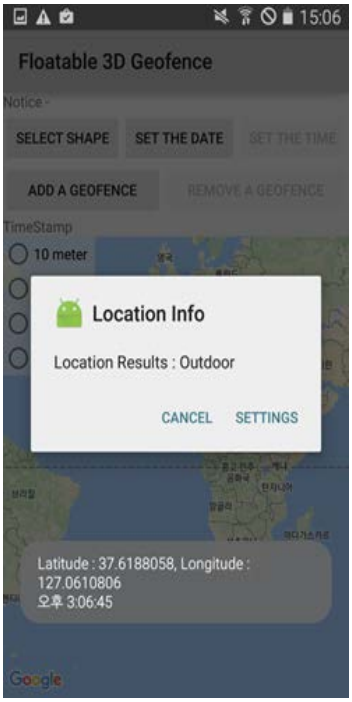


Figure 7: A Map Screen on the First Floor

Figure 7 shows the map that has already been set the information of the FloGeoin Figure 4, and can be seen that expressed the first floor within indoor at the Notice label on the screen.



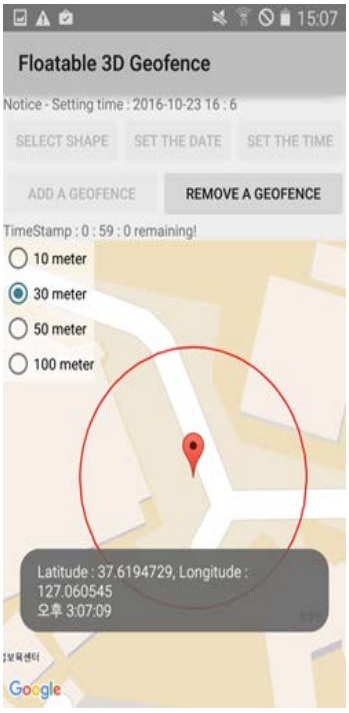


Figure 8: A Screen after Moving to Outdoors Figure 9: A Screen No.1 after Positioning

Figure 8 is a screen of a recognized outdoor in when moving from indoor to outdoor. As shown in Figure 8, we can see to express the last update position information as the latitude/longitude coordinates and updated time to the popup message through the recognition of the outdoor and GPS location tracking at the same time. Comparing Figures 7 and 9, latitude/longitude coordinates in Figure 7 is (37.6182/127.060916). In contrast, latitude/longitude coordinates in Figure 9 is (37.6194729/127.060545).

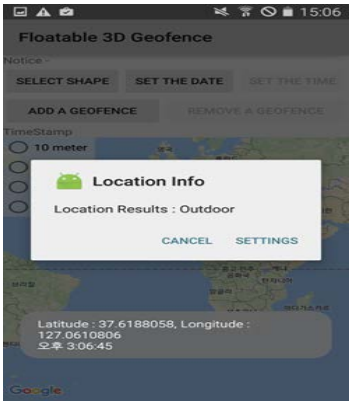


Figure 10: A Screen No.2 after positioning Figure 11: A Screen No.3 after Positioning

Figure 9~11 shows the location information and time according to the moving position. Although the FloGeo does not move with movement depending on the location, the geofence information are updated from the Client and Server with the changed information during a predetermined time interval such as 10 or 20 seconds by the Location Analysis module.

V. CONCLUSION

The typical geofence is a generic concept for describing the geographic aspects of PoIs and enables users to proactively induce context based on actions. Although geofencing usages and its applications are very large such as human resource management, fleet management, retail marketing, law enforcement, home

quarantine, compliance management, asset management, mobile device management, and the isolation of certain event areas, these donot provide the 3Dlocationinformation as well as the geofencing services with mobility.

Therefore, in this paper, we proposed the FloGeo as a floatable 3D geofence with mobility for the IoT. The proposed FloGeo system is one of geofence systems automatically capable of being moved along the movement route of users using location analysis mechanism regardless of whether they are in indoors or outdoors. Therefore, the proposed FloGeo system can proactively inform when the user reaches one place marked as aPoI, and support the intercommunication between the geofences. In addition, the proposed system can provide the flexible, dynamic and movable geofencing services to communicate the inter-geofences as well as the stationary or fixed geofencing services.

In the future, we hope that the proposed FloGeo will be a valuable application cooperating with the mobile facility for vehicle-to-vehicle(V2V) communications in the connected-vehicle environment.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology(NRF-2014R1A1A2058667).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Match Count Method (MCM) for Feature Selection with Cancer Datasets in a Neuro-Fuzzy System

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Abstract---

Background/Objectives: Finding the appropriate features for the specific target such as a colon cancer has been a challenging issue in bioinformatics.

Methods/Statistical analysis: We propose a Match-Count Method (MCM) for selecting appropriate features that can be candidate biomarkers from the colon cancer microarray dataset and minimizing the number of biomarkers from the extracted candidate features with the neural network with weighted fuzzy membership function(NEWFM).We compared our proposed method with Gini Index, Chi Square and Maximum Relevance-Minimum Redundancy (MRMR) in terms of the accuracy with the selected features.

Findings: We use the colon dataset from the public Kent Ridge Bio-medical Data Repository for our comparative experiments. The accuracy of proposed method (MCM) was compared with three classifiers. The first classifier is a Bayesian classifier that is a representative method as a statistical measure. The second classifier is J48 classifier that is Weka's implementation of C4.5 algorithm that is the induction of decision trees. The last classifier is a neural network classifier that is our previous proposed classifier. The proposed method showed the highest accuracy compared to Gini Index, Chi Square and MRMR. Finally, we selected the minimum number of features (attribute1560, 767, 377, 1924) with the highest accuracy (95.16%) with this given colon dataset. In terms of accuracy, our proposed method showed the highest accuracy.The comparative experimental results showed that the proposed method selected the minimum number of appropriate features that can be the biomarkers in the colon cancer datasets. And those results also improved higher accuracy of selecting appropriate features.

Improvements/Applications: The comparative experimental results showed that the proposed method selected the minimum number of appropriate features that can be the biomarkers in the colon cancer dataset and improved higher accuracy of selecting appropriate features.

Keywords--- Feature Selection, Neuro Network Fuzzy Algorithm, Microarray Data, Biomarker.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

In bioinformatics fields, analysis of gene expression data is to identify the selected genes that are relevant or not to clinical diagnosis and retrieved the required information [1] [5] [13]. Selecting the minimum number of appropriate genes in terms of accuracy has been a challenge issues.

Feature selection methods are to determine the most relevant features to classify the given datasets and to improve the accuracy of the classification results. They have been also used for pattern recognition and machine learning [9]. Feature selection methods such as mutual information [6],the *t*-test [12], Gini Index [18], Chi Square [19], Maximum Relevance- Minimum Redundancy (MRMR) [7],and the Bhattacharyya distance [3] [4]have been widely used in finding relevant genes. In this paper, we compared our proposed method, called Match-Count Method (MCM), with 3 feature selection methods that are Gini Index, Chi Square, and MRMR.

Classifiers in machine learning such as*k*-nearest neighbor (*k*-NN) [8], support vector machine (SVM) [10] [11], Naïve Bayes [21], and C4.5 [22]have been used to verify the accuracyand the efficiency after selecting the features from the given dataset.

In this context, we propose a match count method (MCM) for selecting the minimum number of appropriate features with a specific neuro-fuzzy classifier algorithm, which is called a neuro network with weighted fuzzy membership function (NEWFM)[13] [14] [15] and the NEWFM is used for classifier.

The proposed method is to classify tumor class and normal class from thecolon cancer dataset**.**We first used the Bhattacharyya distance method as a statistical method for selecting candidate features as biomarkers. It measures the similarity of two classes under the normal distribution. By using it, we extracted 100 candidate genes in each from the colon dataset that has 2000 genes in total. As the next process, we selected the appropriate genes with the proposed method in NEWFM from the first process result.

The comparative experimental results showed that the minimum of appropriate features as biomarkers improved the highest accuracy by using the proposed method in NEWFM classifier.Finally, 4 features of colon cancer genes were selected from the first process result that extracted 100 colon cancer genes.

In the remainder of this paper, we describe the proposed method for selecting the appropriate features as biomarkers in section 2. The accuracy of selecting appropriate features is shown on comparative experimental results in section 3. We also conclude our proposed method for selecting the appropriate features and the minimum number of genes in section 4.

II. PROPOSED A MATCH COUNT METHOD (MCM)

I We propose a match count method (MCM) for selecting the appropriate genes in NEWFM Classifier. Overview of the proposed method process in the NEWFM classifier as following this:

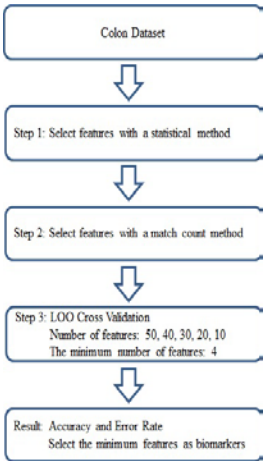

Figure 1: Overview of the Proposed Method Processed in the NEWFM Classifier

There are three steps for selecting features with our proposed method in the NEWFM classifier asfollows:

The first step, we use a statistical method, called Bhattacharyya distance [3] [4], for selecting 100 features from the colon dataset that has 2000 features originally. The Bhattacharyya distance measures the similarity

between features by calculating the correspondence of discrete probability distributions. We used the following equation for selecting 100 features.

$$D_B(x,y) = \frac{1}{4}\ln\left\{\frac{1}{4}\left(\frac{\sigma_x^2}{\sigma_y^2}+\frac{\sigma_y^2}{\sigma_x^2}+2\right)\right\}+\frac{1}{4}\left\{\frac{(\mu_x-\mu_y)^2}{\sigma_x^2+\sigma_y^2}\right\}$$

where $D_B(x,y)$ is the Bhattacharyya distance between x and y classes or distributions. σ_x is the variance of the x-th distribution and μ_x is the mean of the x-th distribution. The higher value of Bhattacharyya means that the more distinguish from each other genes. Thus we selected 100 genes from the highest value to 100th value in the given dataset.

As the second step, our proposed method selects more effective and less number of genes as biomarkers from the first step results. In this step, the proposed method counted each of the features matching with the features of classes that are tumor class and normal class until all of the features are compared with those two classes' features. And then it removed the feature that had the minimum number of the match counts until the number of features is 50 features.

The proposed method is processed in the NEWFM classifier [13][14][15]. The main difference between previous feature selection method in NEWFM [14] and our proposed method is that the previous method selects features by the non-overlap area distribution measurement [13] but our proposed method selects features by counting the number of matching features with the given result class. Our proposed method consists of three parts as follows:

```
Algorithm 1. Decision Part
Max = 0
Max_class_index=0
for i=0 to n // n is the number of classes
Begin
        Sum_i = 0
For j =0 to m //m is the number of features
    Begin
        Sum_i = Sum_i + H_ij ( feature_j ) // H_ij is a membership function for i_th class and j_th input
    End
    IF (Max < Sum_i)
    Begin
    Max = Sum_i
Max_clss_index = i
    End
End
Return Max_class_index
```

Algorithm1 shows how to make max value for the features that were used for calculating the matching number with the classes in the given dataset.

```
Algorithm 2.Calculate_Match-Count
For  i = 0 to n // n is size of data set
Begin
Sum_i = 0
Infer = call Decision(TestData_i )
For j = 0 to m // m is the count of features
Begin
    Max = 0
For k = 0 to o // o is the count of classes (= 2)
Begin
if ( Max <H_jk( feature_j ) )
Begin
        Max = H_jk(feature_j )
index_of_max = k
End
End
if (Infer == index_of_max )
Begin
matchCount_j = matchCount_j+ 1
End
End
End
```

Algorithm2 shows how to calculate the number of class that matches with the classes in the given dataset.

Algorithm3. Remove the worst feature
Call Calculate_Match_Count
Candidate_feature_index= min_index(matchCount$_i$) // i is 0 ~ feature count
Remove feature$_{Candidate_feature_index}$

Algorithm3 shows how to remove the worst feature that has the minimum number of match-count in the given dataset.

The third step, when the number of features is 50, we used the NEWFM [14] as a classifier in the LOO (Leave-One-Out) cross validation way. We executed the second step and the LOO Cross Validation until the number of features is 10. Finally, we selected the minimum number of the effective features as biomarkers by repeating the steps above.

III. EXPERIMENTAL RESULTS

The colon dataset from the public Kent Ridge Bio-medical Data Repository [2] is used for our comparative experiments. The colon cancer data set is composed of 62 samples of colon epithelial cells that are 40 tumor samples and 22 normal samples. Gene expression levels in these 62 samples were measured using high density microarrays. The initial 2000 genes were selected based on the confidence in the measured expression levels [2].

The accuracy is the probability of obtaining correct genes in all genes from the given datasets. It is defined as:

$$\text{Accuracy} = \frac{All\ true\ classified\ features(TP+TN)}{All\ classified\ features(TP+TN+FP+FN)}$$

Where all classified genes are the number of genes include true positive (TP) and true negative (TN) genes and false positive (FP) and false negative (FN) genes that were classified from the given datasets and all true classified genes include TP and TN genes in our experimental results. The error rate is the probability of obtaining incorrect genes in all genes from the given datasets. It can be defined as:

$$\text{Error rate} = \frac{All\ false\ classified\ features(FP+FN)}{All\ classified\ features(TP+TN+FP+FN)}$$

From table 1 to table 5 showed the comparative experimental results for the number of selected features that are 50, 40, 30, and 10 features each. The accuracy of proposed method (MCM) was compared with [20] based on three classifiers. The first classifier is a Bayesian classifier that is a representative method as a statistical measure [20]. The second classifier is J48 classifier that is Weka's implementation of C4.5 algorithm that is the induction of decision trees by Quinlan [20]. The last classifier is a neural network classifier that is our previous proposed classifier. In terms of accuracy, our proposed method showed the highest accuracy.

The accuracies for selecting the appropriate genes are shown as follow these:

Table 1: LOO Cross Validation Using 50 Features

Classifier	Feature Selection Methods	Accuracy	Error rate
Bayesian Network	Gini Index	85.48	14.52
	Chi Square	85.48	14.52
	MRMR	85.48	14.52
J48	Gini Index	83.87	16.13
	Chi Square	83.87	16.13
	MRMR	82.26	17.74
Neural Network	Match Count (MCM)	87.10	12.90

Table 2: LOO Cross Validation Using 40 Features

Classifier	Feature Selection Methods	Accuracy	Error rate
Bayesian Network	Gini Index	85.48	14.52
	Chi Square	85.48	14.52
	MRMR	83.87	16.13
J48	Gini Index	83.87	16.13
	Chi Square	83.87	16.13
	MRMR	82.26	17.74
Neural Network	Match Count (MCM)	88.71	11.29

Table 3: LOO Cross Validation Using 30 Features

Classifier	Feature Selection Methods	Accuracy	Error rate
Bayesian Network	Gini Index	85.48	14.52
	Chi Square	85.48	14.52
	MRMR	83.87	16.13
J48	Gini Index	83.87	16.13
	Chi Square	83.87	16.13
	MRMR	82.26	17.74
Neural Network	Match Count (MCM)	90.32	9.68

Table 4: LOO Cross Validation Using 20 Features

Classifier	Feature Selection Methods	Accuracy	Error rate
Bayesian Network	Gini Index	88.71	11.29
	Chi Square	88.71	11.29
	MRMR	83.87	16.13
J48	Gini Index	83.87	16.13
	Chi Square	83.87	16.13
	MRMR	85.48	14.52
Neural Network	Match Count (MCM)	91.94	9.68

Table 5: LOO Cross Validation Using 10 Features

Classifier	Feature Selection Methods	Accuracy	Error rate
Bayesian Network	Gini Index	87.10	12.90
	Chi Square	87.10	12.90
	MRMR	85.48	14.52
J48	Gini Index	85.48	14.52
	Chi Square	85.48	14.52
	MRMR	85.48	14.52
Neural Network	Match Count (MCM)	93.55	6.45

Table 6: Selected Genes from Colon Cancer Dataset

Feature Selection Methods	Index of the selected 10 features (genes)
Gini Index [22]	1671, 249, 493, 765, 1423, 513, 1771, 245, 267, 1772
Chi Square [22]	1671, 249, 493, 765, 1423, 513, 1771, 245, 267, 1772
MRMR [22]	1671, 249, 493, 765, 1772, 625, 1042, 1423, 513, 1771
Proposed Method (MCM)	1560, 767, 1073, 1597, 1878, 211, 1495, 377, 139, 1924

In this study, tumor biopsies and normal biopsies in colon datasets were classified with the proposed selecting feature method that is called a match count method (MCM) in terms of accuracy and the minimum number of genes. As shown above tables, our proposed method showed the highest accuracy compared to Gini Index, Chi Square and MRMR. Finally, we selected the minimum number of features (attribute1560, 767, 377, 1924) with the highest accuracy (95.16%) with this given colon dataset.

IV. CONCLUSION

In this paper, the proposed match count method for selecting the minimum number of appropriate genes as biomarkers from the given colon cancer datasets shows improving the accuracy with experimental results in section 3. The proposed method consists of three steps as follows: the first step is to extract the candidate genes as biomarkers by using the Bhattacharyya distance measure, the second step is to select the minimum number of appropriate genes with NEWFM which included our proposed method (MCM) from the extracted genes as biomarkers and the third step is to verify the classification results. As shown in section 3, the proposed method in NEWFM Classifier [13] showed higher accuracy compared to other feature selection methods [20] with the minimum genes. Finally, as our future work, to robust our proposed framework of

selecting the effective and the minimum number of biomarkers, we will experiment with another bigger size of various cancer type datasets.

ACKNOWLEDGEMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2015R1A1A09057409).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Diagnosis of Genes in Human Skeletal Muscle Channelopathies by Using ANN and Bootstrapping Method

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Abstract---

Background/Objectives: To diagnose the clinical phenotypes of Human Skeletal Muscular Channelopathies for selecting the proper genetic tests, we present an ANN and use the bootstrapping method.

Methods/Statistical analysis: The proposed ANN was designed with 45 features as the input layer neurons, 8 neurons as the hidden layer, and 4 neurons as the output layer. Bootstrapping method used for training and testing data it's estimating properties of an its variance by measuring from an approximating distribution. We use a Feed-forward Network for training and testing the data samples.

Findings: The experimental results show that ANN and Bootstrapping method is efficiently categorize all the genetic-types of Gens in Human Skeletal Muscle Channelopathies(CNCNA1S, CLCL1, KCNJ2 and SCN4A). In total accuracy is CACNA1S(98.06%), CLCN1(91.84%), KCNJ2(83.33%), SCN4A(79.26%) and average accuracy was 88.52%. Also proposed system show that ANN and Bootstrapping method is effective for analyzing the insufficient genetic data like a Human Skeletal Muscle Channelopathies.

Improvements/Applications: We can expect the priority of gene or domain that should be tested is determined more accurately, promptly and readily using propose system.

Keywords--- Gens, HSMC, ANN, Bootstrapping, Pattern Recognition.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The human skeletal muscular channelopathies (HSMCs) are a heterogeneous group of skeletal muscle disorders caused by mutations of gene encoding in the skeletal muscle calcium (CACNA1S), chloride (CLCN1), potassium (KCNJ2), or sodium channel (SCN4A). The clinical features of HSMCs, caused by the dysfunction of the muscular ion channels, are largely characterized by non-dystrophic myotonia (NDM) and periodic paralysis[1]. NDM, a disturbance in muscle relaxation after voluntary contraction or percussion, is a main phenotype of myotoniacongenita (MC), paramyotoniacongenita (PMC) and sodium channel myotonia (SCM). They are caused by mutations in either CLCN1 or SCN4A. MC is further characterized by the warm-up phenomenon, this is a reduction of muscle stiffness through repetitive muscle contractions, and PMC by paradoxical myotonia (paramyotonia), which is an exacerbation of muscle stiffness caused by cold or exertion. These periodic paralyses are characterized by episodes of muscle weakness often triggered by an alteration in serum potassium concentration. They include hyperkalemic periodic paralysis (HyperPP), hypokalemic periodic paralysis (hypoPP) and Andersen-Tawil syndrome (ATS), and are caused by mutations in SCN4A, CACNA1S, or KCNJ2, respectively[2,3]. Up until the recent past, the diagnosis of HSMC has entirely relied upon these clinical features. Since genetic testing became available, hundreds of mutations responsible for the various types of HSMC have been reported, this has lead to insights into the fundamental pathophysiology of HSMC as well as the muscular ion channel function[3]. However, it is often difficult to predict the genes that correspond to the various types of HSMCs, because there are considerable genotype-phenotype mismatches as well as phenotype or genotype heterogeneities. For example, hypokalemia-associated paralysis can be caused by mutations in either CACNA1S, KCNJ2 or SCN4A and the mutations in SCN4A can cause PMC, SCM or HyperPP[4,5]. These genotype-phenotype mismatches are major concerns, especially for the SCN4A channelopathy; the warm-up phenomenon that is a common feature of the CLCN1 channelopathy is not uncommon in the SCN4A channelopathy[6-8], and cold-sensitive myotonia that had been thought to be a specific feature of PMC caused by mutations in SCN4A[3,9] is also common in the CLCN1 channelopathy[10,11]. These mismatches lead to confusion in diagnosing HSMCs both clinically and genetically, which causes considerable social burden and reflects our incomplete understanding of ion channel functions, indicating a need to redefine clinical phenotypes of HSMCs to find meticulous phenotype-genotype correlations.

II. RELATED WORKS

Artificial neural networks (ANNs) are statistical pattern recognition systems that can perform multi-factorialanalysis[12]. The design of ANNs was originally inspired by networks of biological neurons. Communication in the brain works by numerous interconnections of axons and dendrites with synaptic junctions. A single neuron receives input from many other neurons by dendritic processes. Depending on the total weighted input, it is either activated or it remains inactive. Similarly, ANNs are composed of multiple nodes that are interconnected by weighted lines as shown in Fig.1.

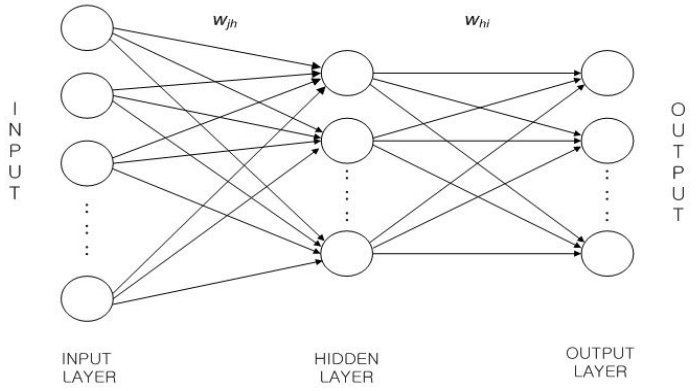

Figure 1: Example of ArtificialNeural Networks

Each node receives its input from the other nodes or from the environment. The node also delivers its output to other nodes. Finally, each node transfers its own global input into output. If an ANN is trained successfully, then it can perform complex tasks such as predictingan output value or classifying an object.

ANNs have been widely used in various fields of medicine, such as in clinical diagnosis, image analysis in radiology and occasionally in histopathology and cytology[13,14].In statistics, bootstrapping is a method for assigning measures of accuracy to sample estimates[15]. This technique allows the estimation of a sampling distribution of almost any statistic using only very simple methods. Generally, it falls in the broader class of re sampling methods. Bootstrapping is the practice of estimating the properties of an estimator (such as its variance) by measuring those properties when sampling from an approximating distribution. One standard choice for this approximating distribution is an empirical distribution of the observed data. In the case where a set of observations can be assumed to be from an independent and identically distributed population, this can be implemented by constructing a number of re samples of the observed dataset (that are of equal size to the observed dataset), each of which is obtained by random sampling with a replacement from the original dataset. It may also be used for constructing hypothesis tests. It is often used as an alternative to inference based on parametric assumptions when those assumptions are in doubt, or where parametric inference is impossible or requires very complicated formulas for the calculation of standard errors[16].

In this paper, we conduct an artificial neural network (ANN) and use the bootstrapping method to diagnose the clinical phenotypes of Human Skeletal Muscular Channelopathies (HSMCs) that allows us to select the proper genetic tests.

III. PROPOSED METHODS

A. Data Collection

We systematically reviewed the studies in English on all genetically confirmed HSMCs. Our search strategy is outlined in the following: (a) We performed a PubMed search using ‘‘myotonia”, “periodic paralysis”, “SCN4A”, “CACNA1S”, “CLCN1”, or “KCNJ2” as keywords for articles up to November 2010; (b) we explored the mutation and publication data of the Human Gene Mutation Database at http://www.hgmd.cf.ac.uk/ac/. We also explored Wikipedia at http://en.wikipedia.org/wiki/ and the Online Mendelian Inheritance in Man at http://www.ncbi.nlm.nih.gov/omim/ ; (c) we performed a careful analysis of references in the published case reports or papers related to HSMCs. Cases were selected for the analysis based on the following:

1) if the proband of a family has homogenous phenotypes then.
2) family member(s) whose phenotypes are distinct from those of the proband were selected.
3) if several different family groups described as having the same clinical and genetic features by an author then these were regarded as a case.
4) thyrotoxichypoPP.
5) the overlap cases described elsewhere previously.
6) rare HSMC cases with KCNE3 mutations (only 6 cases so far) mutations were ignored.

Variables for data-input include epidemiologic data, inheritance patterns of diseases, original clinical impressions, chief complaints and their relevant clinical and laboratory features (age of onset, disease severity, symptom duration, involved body part, precipitating or relieving factors, response to treatment, warm-up phenomenon, paramyotonia or percussion myotonia, electromyographic, electrocardiographic and muscle biopsy findings, etc) and genotype data. For extended topographical and functional characterization of HSMC-relevant mutations, details about the domain or segment of the muscular ion channels where the mutations were found were included[20]. The change of polarity and charge in amino acids by the mutations was also considered.

B. ANN(Aritificial Neural Networks)

There are a total of 627 data samples, including 4 types of genes: CACNA1S, CLCN1, KCNJ2 and SCN4A. In which, 103 data samples are from the patients with CACNA1S, 294 data samples are from the patients with CLCN1, 43 data samples are from the patients with KCNJ2 and 188 data samples are from the patients with SCN4Aas shown in Table 1.

Table 1: Experimental DataSet

CACNA1S	CLCN1	KCNJ2	SCN4A	All
103	294	42	188	627

Each data sample has 45 features. We designed a back propagation ANN. All the data collected was used as the input data. Table 2 shows the detailed network parameters. The proposed ANN was designed with 45 features as the input layer neurons, 8 neurons as the hidden layer, and 4 neurons as the output layer.

Table 2: Neural Network Structure

- Training function: Levenberg-Marquardt backpropagation
- Performance : Mean Squared Error(MSE)
- Max number of iterations: 200 epochs
- Performance goal (maximum error): 0.001
- Init weight and bias: Nguyen-Widrow layer initialization func.
- Hidden layer: tansig
- Output layer: purelin
- Layers :3 layers (Input - Hidden - Output)
- Input layer: 45 Node
- Hidden layer: 8
-Output layer: 4

Bootstrapping method used for training and testing data it's estimating properties of an its variance by measuring from an approximating distribution. We use a Feed-forward Network (FFN)[17]for training and testing the data samples. A running FFN is shown in Fig. 2.

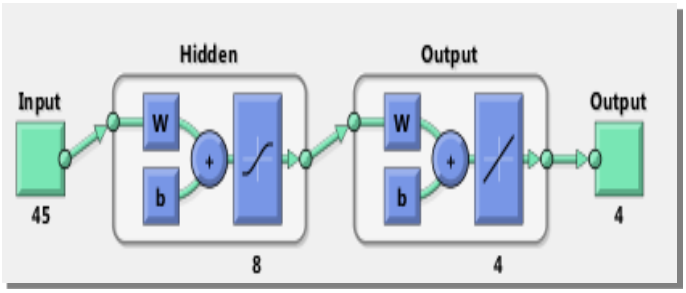

Figure 2: The Proposed ANN

FFNs consist of a series of layers. The first layer has a connection to the network input. Each subsequent layer has a connection to the previous layer. The final layer produces the network's output. FFNs can be used for any kind of input to output mapping. A FFN with one hidden layer and enough neurons in the hidden layer fits any finite input-output mapping problem. Our FFN is provided by the Neural Network Toolbox (NNT) [18] of Matlab version 7.12(R2011a).Due to the number of features for each data sample, we use 45 nodes for the input layer of our FFN. Each input node corresponds to one feature of the input sample. There are 4 types of gene, so we use 4 nodes for the output layer. Each output node corresponds to one type of gene. There are 8 nodes in the hidden layers. In our FFN, the maximum number of iterations is 200 and the performance goal for the Mean Squared Error(MSE) is 0.001. The MSE is the average squared error between the network outputs, a, and the target outputs, t. It is defined as shown equation (1).

$$F = MSE = \frac{1}{N}\sum_{i=1}^{N}(e)^2 = \frac{1}{N}\sum_{i=1}^{N}(t-a)^2 (1)$$

Fig. 3 shows the MSE histogram at 36 epochs. The performance plot shows the value of the performance function versus iteration number. It plots training, validation and test performance.

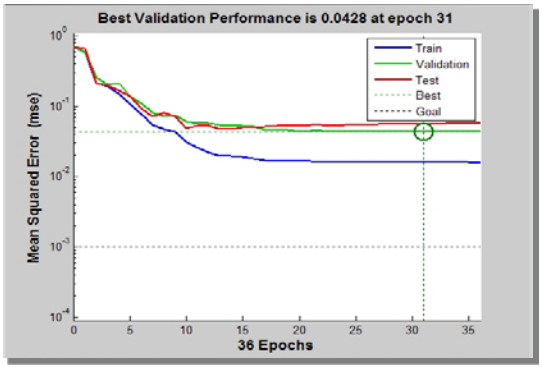

Figure 3: Neural Network Mean Squared Error Histogram

Fig. 4 shows the neural network training state at epoch 28. The training state plot shows the progress of other training variables, such as the gradient magnitude, the number of validation checks, etc. Our program normally reaches the performance criterion before reaching the maximum number of iterations. Weight and bias values are updated according to Levenberg-Marquardt optimization [19].

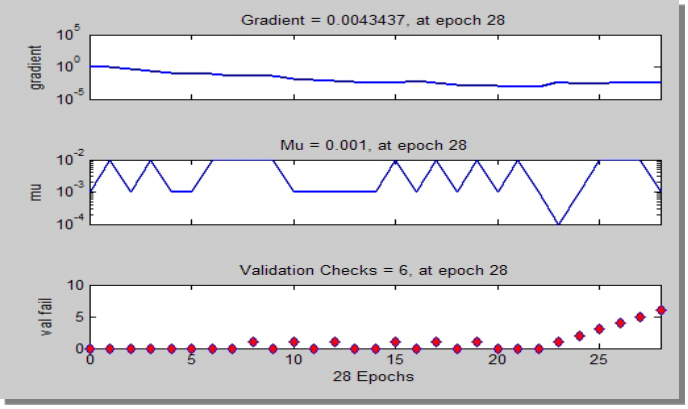

Figure 4: Neural Network Training State at epoch 28

The Levenberg-Marquardt optimization is often the fastest back-propagation algorithm for Neural Network Trainers (NNT), using this training function makes our FFN converge faster. As there are not enough samples for both training and testing data sets, we use the bootstrapping method[16] to estimate the experimental results. Bootstrapping is the practice of estimating properties of an estimator by measuring those properties when sampling from an approximating distribution. In our experiments, we choose one sample for testing and 626 other samples for training. We repeat this procedure in 627 times, and each time we choose a new testing sample that has never been tested. The final result is obtained after 627 instances of training and testing.

IV. CONCLUSION

The experimental results show that ANN and Bootstrapping method is efficiently categorize all the genetic-types of Gens in Human Skeletal Muscle Channelopathies(CNCNA1S, CLCL1, KCNJ2 and SCN4A). In total accuracy is CACNA1S(98.06%), CLCN1(91.84%), KCNJ2(83.33%), SCN4A(79.26%) and average accuracy was 88.52%.

Table 3: Experimental Results

	CACNA1S	CLCN1	KCNJ2	SCN4A	All
Total	103	294	42	188	627
Correct	101	270	35	149	555
Incorrect	2	24	7	39	72
Accuracy(%)	98.06	91.84	83.33	79.26	88.52

The results show that one of multi factorial analysis and statistical pattern recognition method ANN and Bootstrapping method is effective for diagnosis of the insufficient genetic data like a Human Skeletal Muscle Channelopathies. We can expect the priority of gene or domain that should be tested is determined more accurately, promptly and readily using propose system.

ACKNOWLEDGEMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF-2015R1C1A1A02036495)

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Learning Framework of a Deep Belief Network with Multimodal Data Set Using Gaussian Mixture Model

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Abstract---

Background/Objectives: This paper focuses on Deep Belief Network among several deep learning mechanisms. When DBN has multimodal typed data and requires a binary decision, an effective learning framework is suggested.

Methods/Statistical analysis: The data set is analyzed and modeled using Gaussian Mixture Model. Then, the initial hidden layer is estimated using the given data. Then, the joint distribution is estimated using the estimated layer's information. Based on the distribution, the parameters of Gaussian Mixture Model are updated. Then, the hidden layer is fine-tuned using re-estimated models and Gibbs sampling.

Findings: The proposed DBN architecture consists of one visible layer, multiple hidden layer and one output layer. A multilayer perceptron is used as the output layer for discrimination. When the input data set has multimodal typed data, the proposed learning mechanism update weights and biases in each layer considering the characteristics of the data set. These characteristics are captured using Gaussian Mixture Models. The proposed model is compared with existing learning models: a multilayer perceptron and a Support Vector Machine. The effectiveness of the proposed learning framework is verified with the numerical examples and tests.

Improvements/Applications: The proposed framework can be used as an effective learning mechanism of DBN with multimodal data. The suggested DBN can be used as an element of various Ensemble machines.

Keywords--- Deep Learning, Deep Belief Network, Multimodal Data Set, Gaussian Mixture Model, Contrastive Divergence Method.

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I. INTRODUCTION

Deep learning has been considered as a breakthrough for resolving several issues in existing learning and intelligence machines. In particular, the main advantage using deep learning is the extraction of discrimination features. Most of the leaning mechanisms such as *multilayer perceptron* (MLP) or *Support Vector Machine* (SVM) depend on their discrimination features heavily for better performances. The feature extraction stage is the prerequisite process for a successful learning mechanism. However, it is difficult to extract these features. The main reason is the fact that they are hidden in the data mostly or transforming processes are required. In several manufacturing applications, these features might be called as know-how. The know-how are used for solving many manufacturing issues such as lowering defects or increasing production efficiencies. While some of know-how might be obtained by long experienced and skilled employers, other know-how are extracted rarely.

The insufficiently extracted features may give result to the bad performance of learning machines. In general, the parameters of MLP are the number of hidden layers, the nodes per each layer and the used activation functions. While it is important to set up these parameters, the extracted features have influenced the performances of the machine more than these hyper-parameters.

Deep learning has been considered for resolving the issues. The term – "deep" indicates the usage of several hidden layers. The usages of many hidden layers and nodes per each layer may contribute to the successful feature extractions. The trained hidden layers' characteristics are considered as discrimination features, in general. For this reason, deep learning can be interpreted for a learning mechanism combining feature extraction stages and learning processes.

Deep belief network (DBN)[1], Convolution Neural Network (CNN)[2] and Deep Reinforcement Learning / Deep Q-learning[3] are among popular deep learning techniques, these days. They have several applications. For instance, CNN is used for image based feature extractions and learning in general. Deep Q-learning is applied for combining Q-learning and the related feature extractions. What this paper focuses on is DBN among them. In general, DBN is used for a preprocessing machine for MLP or SVM. Hinton[1] combined a DBN and a MLP for training MNIST[4] data and for discriminating the related data. As a traditional deep learning approach, DBN has been used in many applications. DBN is driven from *Restricted Boltzmann Machine* (RBM). Each node in the hidden layer and the visible layer has a binary value: 0 or 1. However, many applications use continuous variables or discrete variable with integers.

This paper suggests a mapping and learning algorithm of DBN with a multimodal data set. The DBN consists of multiple hidden layers, a visible layer and a MLP layers. The visible layer has several multimodal data and nodes in multiple hidden layers have binary number-based value. Figure 1 shows the architecture of the provided DBN.

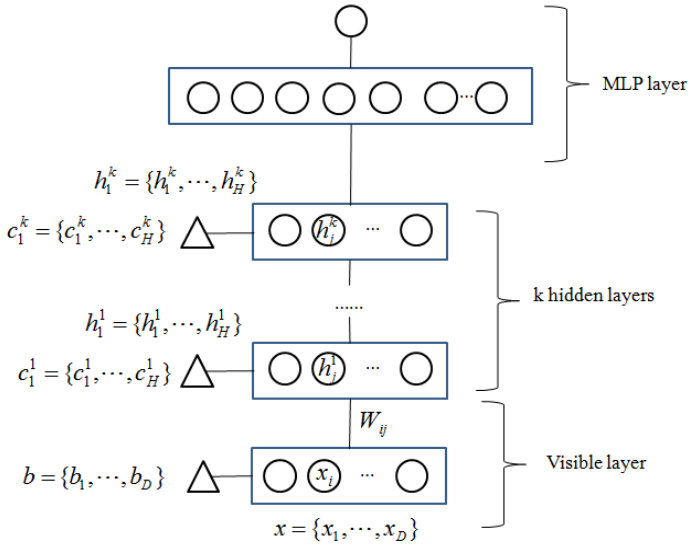

Figure 1: Architecture of the Provided DBN

This paper provides the contrastive divergence based learning framework with the suggested architecture. The following section provides background knowledge and the related literature reviews. Section 3 suggests the learning mechanism using Gaussian Mixture Model (GMM) considering the provided DBN architecture. Section 4 and 5 provides a multimodal dataset and the numerical experiments for showing the effectiveness of the proposed method.

II. BACKGROUND AND LITERATURE REVIEW

As mentioned in the previous section, this paper suggests a special type of DBN with a multimodal data based visible layer and binary number-based multiple hidden layers. This type of DBN can be used for determining a decision with a binary value. The related application is provided in Section 4.

As shown in Figure 1, the lowest layers of the provided network are interpreted as a RBM architecture. Figure 2 shows a general RBM architecture.

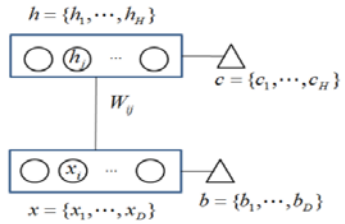

Figure 2: RBM Architecture[5]

As shown in Figure 2, a classical RBM has hyper-parameters such as a bias set in visible layer (c), a bias set in hidden layer (c) and the connection weight(w_{ij}) from i[th](x_i) visible node to j[th](h_j) hidden node. Equation (1) shows the Boltzmann energy of the machine.

$$E(x,h) = -h^T W x - b^T x - c^T h \qquad (1)$$

When it is supposed that each node in the hidden and the visible layer has a binary value (0 or 1), the state probability ($p(x,h)$) is represent with (2).

$$p(x,h) = \frac{1}{1+e^{E(x,h)}} \qquad (2)$$

$$p(x,h) \propto e^{-E(x,h)} \qquad (3)$$

As (3) is driven from (2), the state probability is represented with (4).

$$p(x,h) = \frac{1}{z} e^{-E(x,h)} \qquad (4)$$

where z = the normalization constant

Then, the weight (W) and the other bias parameters (b and c) are updated with respect to the maximization of (4). As the state probability is proportional to $\ln p(x,h)$, the weight updating is dependent of $h^T x$.

$$\frac{\partial \ln p(x,h)}{\partial w} = h^T x \qquad (5)$$

However, the $h^T x$ is an estimated and experimental index. It means that $h^T x$ has to be measured using multiple experiments and Gibbs sampling. As this work is a time-consuming work, Hinton[1,6] suggests an effective learning algorithm – contrastive divergence method. According the method, (5) is rewritten to (6).

$$\frac{\partial \ln p(x_i)}{\partial w_{ij}} = < x_i h_j >^0 - < x_i h_j >^1 \qquad (6)$$

Where $< x_i h_j >^0$ is an inner product with the data x_i and h_j

and, $< x_i h_j >^1$ is an inner product with the estimated x_i and h_j

As shown in (6), $< x_i h_j >^1$ is calculated using the estimated x_i and h_j .These estimation is driven with the direction of maximizing $p(x_i)$. Finally, the weight is updated with (7).

$$w_{ij}' = w_{ij} + \eta \cdot \frac{\partial \ln p(x_i)}{\partial w_{ij}} \qquad (7)$$

Where η = learning rate

Similarly, the bias sets (b and c) are updated using (8) and (9), respectively.

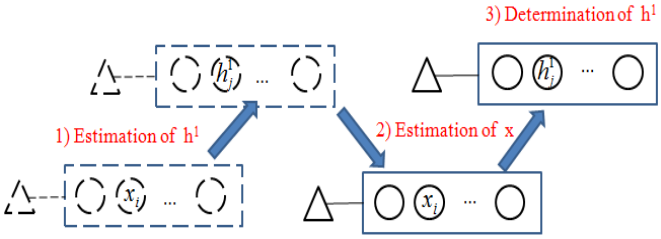

Figure 3: Determination of Learning of DBN with the Consecutive Contrastive Divergence Method

$$b' = b + \eta \cdot \frac{\partial \ln p(x_i)}{\partial b} \qquad (8)$$

$$c' = c + \eta \cdot \frac{\partial \ln p(x_i)}{\partial c} \qquad (9)$$

Figure (3) shows the procedure of determining h^1 using the contrastive divergence method. This procedure is applied to a DBN with multiple hidden layers. Figure 4 shows the consecutive contrastive divergence procedures.

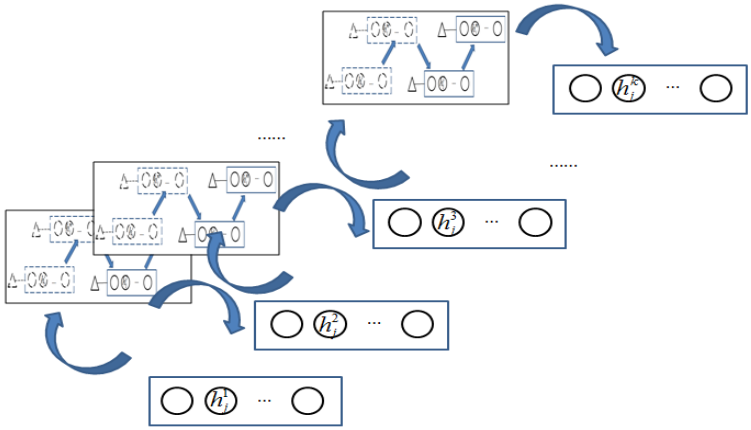

Figure 4: Learning of DBN with the Consecutive Contrastive Divergence Method

As the provided method helps to learn a DBN easily, many applications[7,8]use these DBN models. However, the explained updating rule is based on the binary value-based DBN. When nodes in a visible layer or hidden layers have non-binary values, (4) and (5) have to be modified. Then, the procedures shown in Figure (3) and (4) are to be changed. As mentioned in the previous section, more general applications use data with non-binary variables and multimodal data. The following section explains how the consecutive contrastive divergence method works using the GMM based Gibbs sampling and contrastive divergence method.

III. LEARNING FRAMEWORK USING GAUSSIAN MIXTURE MODEL

This paper focuses on the special type of DBN, shown in Figure 1. The nodes in visible layer have various typed values and multimodal data. Then, this layer is linked to multiple hidden layers. These layers have binary value based data. Finally, the final hidden node is linked to a MLP layer for determining binary decisions. The usage of binary value typed multiple hidden nodes may contribute to the verifications of input variables' explicit relationship with output variables.

While the method explained in Section 2 is an easy and efficient learning mechanismfor a DBN, many data sets include non-binary value typed and multimodal data set. It means that the explained contrastive divergence method is not applied for these data sets. In order to resolve the issue, this paper uses Gaussian Mixture Model.

Figure 5 shows the conceptual procedure for the suggested learning framework. As shown in Figure 5, each data set (x_i) is analyzed and modeled using GMM. Equation (10) represents the estimated GMM using the data set.

$$p(\theta \mid x_i) = \sum_{l=1}^{K} \tilde{\phi}_l N(\tilde{\mu}_l, \tilde{\sigma}_l) \qquad (10)$$

The parameters K , each $\tilde{\phi}_l$, $\tilde{\mu}_l$ and $\tilde{\sigma}_l$ can be estimated using various meta heuristics. Choo and Lee[9] uses EM algorithm for estimating GMM parameters in newly updated Bayesian Network. Then, initial $p(h_j = 1, x_i = \theta)$ is calculated using (2) and (4). This procedure is similar with the traditional contrastive divergence method. During the process, the modeled GMM is not used. Then, $p(x_i' = \theta)$ is calculated using (11).

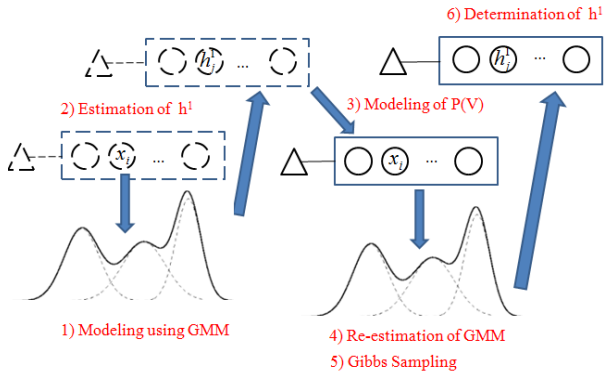

Figure 5: Learning Framework Using Gaussian Mixture Model

$$p(x_i' = \theta) = \sum_{j} p(h_j, x_i = \theta) \qquad (11)$$

Then, new parameters of GMM are estimated using the value $p(x_i' = \theta)$ and (12). Several meta heuristics can be applied for the efficient estimation.

$$(K', \tilde{\phi}_1' \ldots \tilde{\phi}_K', \tilde{\mu}_1' \ldots \tilde{\mu}_K', \tilde{\sigma}_1' \ldots \tilde{\sigma}_K') = \arg\min \left[\sum_{l=1}^{K} \tilde{\phi}_l N(\tilde{\mu}_l, \tilde{\sigma}_l) - p(x_i' = \theta) \right] \qquad (12)$$

Finally, a new input set (x'') is generated using Gibbs sampling method. Then, the h^1 layer is re-estimated. As the first hidden layer is determined and the data type follows the binary number type, the remained learning of the other hidden layers is the same with the traditional method.

The suggested method has several characteristics. First of all, the initial estimation of h^1 is driven from the data set. Then, the real-value is estimated using the estimated GMM. It means that more reliable data can be obtained reflecting the data set's characteristics. Then, more fine-tuning is achieved using Gibbs sampling. The finally estimated h^1 considered as more reliable hidden layer reflecting the characteristics of the input data set. In order to show the suggested method, the numerical test and analyses are provided in the following sections

IV. DATA SET FOR NUMERICAL ANALYSIS

This section provides the numerical test using the particular data set and the suggested learning framework. The used training and test data is *Prima Indians Diabetes Data Set*[10] from *UCI Machine Learning Repository*. The data set is the database about Pima Indians Diabetes which was owned by *National Institute of Diabetes and Digestive and Kidney Diseases*. Table 1shows the detailed data attributes.

Table 1: Initial Set of Features Used for the Experimentation

No	Attribute Name	Types / Units	Dependent Variable / Independent Variable
1	Number of times	Integer	Independent Variable
2	Plasma glucose concentration a 2hours in an oral glucose tolerance test	Integer	Independent Variable
3	Diastolic blood pressure	mmHg	Independent Variable
4	Triceps skin fold thickness	mm	Independent Variable
5	2-hour serum insulin	mu U/ml	Independent Variable
6	Body mass index	Weight in kg /(height in m)^2	Independent Variable
7	Diabetes pedigree function	Fraction number (<1)	Independent Variable
8	Age	Integer	Independent Variable
9	Class variable	Binary digit	Dependent Variable

As shown in Table1, the class variable "1" indicates a "test positive" for diabetes. Using the analysis of each attribute's data set, GMM is modeled. Figure 6 shows the histogram of Attribute 4 (Triceps skin fold thickness).

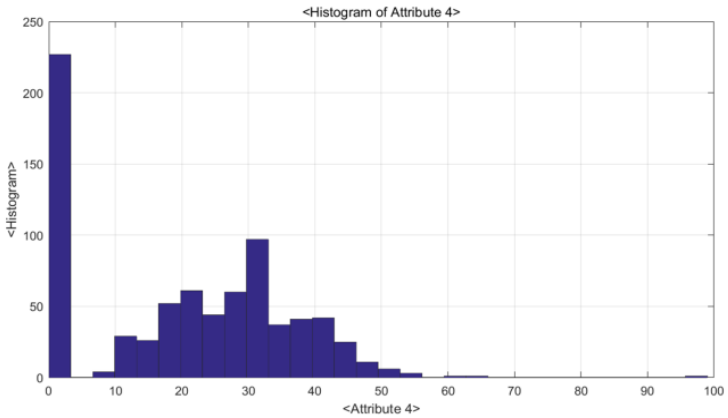

Figure 6: Histogram of Triceps Skin Fold Thickness

As shown in Figure 6, the histogram shows that one Gaussian distribution is unsuitable for the data set. In order to find more suitable GMMs, various K and their related parameters are tested. This study uses EM algorithms for finding the most suitable parameters. The following section shows the result using DBN with the suggested learning framework. Then, the result is compared with other existing learning methods such as MLP and SVM.

V. NUMERICAL ANALYSIS AND COMPARISONS

In order to apply the proposed DBN and the learning method, the data sets are analyzed. Table 2 shows the used cluster number of GMMs.

Table 2: Cluster Numbers of Input Data Set

No	Attribute Name	Cluster Numbers
1	Number of times	10
2	Plasma glucose concentration a 2hours in an oral glucose tolerance test	2
3	Diastolic blood pressure	2
4	Triceps skin fold thickness	2
5	2-hour serum insulin	2
6	Body mass index	2
7	Diabetes pedigree function	1
8	Age	1

As provided in Table 2, each data set has different GMM clusters and this fact indicates that the contrastive divergence without GMM based modeling may give result to bad estimations. After the modeling of GMMs, the contrastive divergence considering these GMMs is applied. Table 3 shows the used parameters of the tested DBN.

Table 3: The Trained DBN Parameters

No	Parameters	Values
1	Nodes In the visible layer	8
2	Number of hidden layers	2
3	Nodes of 1st hidden layer	10
4	Nodes of 2nd hidden layer	6
5	MLP parameters	• Number of hidden nodes : 1 • Activation function : hyperbolic tangent activation function (TanSig)[11] • Optimization method : Levenberg Marquardt (LM) based Back propagation method[12]

Then, the result is compared with a MLP machine and SVM machine. Table 4 shows the used parameters of each learning machine.

Table 4: The Used Parameters of MLP and SVM Models

Learning Machine	MLP	SVM
Parameters	-Number of hidden nodes : 1 - Nodes in the hidden layer : 4 - Activation function :TanSig - Optimization method : LM	- Type : C-SVM - Kernel : Radial Basis Function (RBF) - Kernel coefficient : 0

The DBN is implemented using Matlab©. SVM and MLP are tested using a data mining tool ECMiner©. Figure 7 shows the models of MLP and SVM.

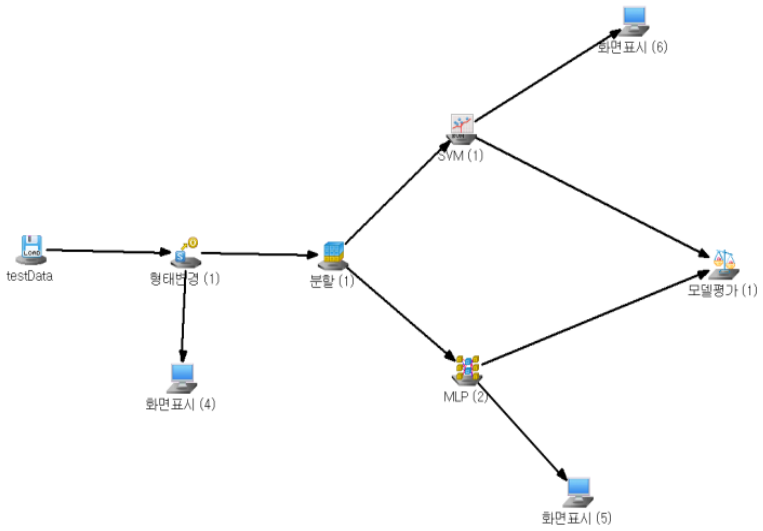

Figure 7: Data Mining Model with Multilayer Perceptron and Support Vector Machine Using ECMiner©

In order to check the validation, the 70% of the *Prima Indians Diabetes Data Set* is used for the training set and the other data is used for validation set. Table 5 shows the classification errors in the training set and the validation set among the tested methods.

Table 5: Classification Errors in the Training and the Validation Sets

Classification Error	DBN with the proposed learning framework	MLP	SVM
Training Set	18.64%	22.64%	18.08%
Validation Set	14.53%	16.88%	33.77%

As shown in Table 5, the DBN with the proposed learning framework has the lowest classification error in the validation set and has the comparatively low classification error in the training set. These results are given from the fact that the proposed method reflects the data set's characteristics using GMM and the DBN model has a role of an Ensemble Machine.

VI. Conclusions and Further Studies

While many existing learning algorithms has several issues from feature extraction stages to learning parameters' updating, deep learning mechanisms are considered as learning machines for overcoming these issues. This paper focuses on Deep Belief Network among them. The DBN is used for extracting belief elements from the given data set. The reasoned belief elements can be used for discrimination features. The contrastive divergence leaning mechanism is a representing learning mechanism using RBM layer, where their node has a binary variable. As many applications have non-binary valued and multimodal data set, this paper proposed a new and efficient learning framework using Gaussian Mixture Model based contrastive divergence method.

The proposed method analyzes the data set and models them using GMM. Then, the visible layers' node is estimated using Gibbs sampling and re-estimated GMM which is obtained using the initially estimated hidden layer. Then, the hidden layer is determined using the newly updated GMMs. The generated hidden layer has more reliable node values reflecting the data set's characteristics. The provided method is applied for many applications requiring a binary decision with non-binary data set.

This paper proposed a GMM based learning mechanism of a DBN which has various multimodal input types. The provided machine can be an Ensemble machine[13] with various combinations with existing methods. It is expected that much better result is obtained using the combination model between the proposed DBN framework and existing learning models.

Acknowledgement

This paper was supported by Research Fund, Kumoh National Institute of Technology.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on the Optimization of Architecture Assets in DMI

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Abstract---

Background/Objectives: The important and representative asset in the product line is the software component. However, there were not many researches done on the component structure and spec yet compared to much interest in the product line.

Methods/Statistical analysis: Considering the reusability and assembly in the stage of asset planning, we made it certain that the products for the product line synthesizable from reusable assets by refining the architectural assets. Architecture assets were designed inheriting the RAS structure of OMG, and asset information was analyzed as a means of optimizing this.

Findings: To address this issue, this paper will use the DMI framework for the reuse of the existing development experience in an aim to cut the cost of duplicate development due to the changes in the development conditions. Also, each extracted asset was optimized using chi-squared statistic and 23% of unnecessary terms were removed through threshold value in order to raise the accuracy of asset reuse.

Improvements/Applications: For the assets of DMI, each asset was classified and saved through more than one context to allow affinity search through synonyms. This raised the architectural reuse assets from under 90% to over 90%, which is considered to be reusable in the similar domains.

Keywords--- Asset, PLE, DMI, Architecture, Component, Optimization.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

There are many difficulties when requirements occur or maintenance and reproduction are needed to enhance software productivity due to technological changes. To resolve this issue, product line has been widely recognized as a research method for reuse[1]. The important and representative asset in the product line is the software component. However, there are not enough researches on the asset structure and specification in the product line compared to much interest in the product line[2]. This paper will use DMI for the reuse of the existing development experience in an aim to cut the cost of duplicate development due to the changes in the development environment[3]. DMI provides abstract planning information of the platform, which is independent from development environment, as architecture assets in the stage of planning to reuse the planning information. Also, designing application domain is possible based on well-designed architecture assets. Therefore, this paper puts its basis on DMI structure, which can standardize and express the platform and application domain information, and provides the basis for synthesizing and producing the designing information from a designing stage with high abstract level. In DMI structure, platform-based reusable designing is possible, and it is the PLE structure in an extractive way, which can solve the problem of standardizing and reusing the existing designing information to design the platform-based software. Therefore, in this study, common designing in a wide and broad sense is conducted in the domain of architecture asset planning based on DMI structure. And planning in a narrow sense, which suits each application domain, is possible in the asset planning. Also, considering the reusability and assembly in the component designing, we made the products, which are planned for the product line, synthesizable from reusable assets by refining the architecture assets without fail. Architecture assets were designed inheriting the RAS structure of OMG, and as a means of optimizing this, it analyzed and stored the asset information[4]. Also, each extracted asset was optimized using chi-squared statistic and 23% of unnecessary terms were removed through threshold value in order to increase the search efficiency. And for the assets of DMI, each asset was classified and saved through more than one context to allow affinity search through synonyms. Therefore, DMI-based PLE architecture enabled the users to save and search through spreading synonyms in the process of storing and using asset information, which optimized the reuse of architecture assets.

II. BACKGROUND AND RELATED WORK

A. DMI Framework

The structure of DMI system has three layers; design layer, mapping layer, and infra layer[3]. Design layer is the one that expresses stored information and the design information based on UML. Infra layer is the one that stores the architecture information and component information by componentizing through XML. And mapping layer is the middle layer which exchanges the stored design information and design layers. It is a layer that converts the expression of UML and the XML information, playing a role of searching and managing the component and creating codes.

The mapping layer provides a service that stores modules which model the design structure which is expressed with UML, and also Meta models which compose the design structure of infra layer. And it is composed of the code-creating modules that generate XML code by mapping the saved Meta models at code-creating template[5]. Planners authenticate either by the component planner or the architecture planner. Asset planners register the service component and are given authority to make revision and deletion only for the registered service component.

The registered service component supports the facet search which has facet items classified by use objective and evaluation as well as the existing component name search[6]. To create the architectural design structure that can be reused independently from specific tools and platforms, the structure should be modeled into UML and the composition information should be saved into the product line asset when the design information is registered after being authenticated by the architecture designer. And the UML-based editor is supported to model this design structure visually[7]. To reuse the architecture structure later, the composition information saved in the database should be mapped into the code-creating template, which is composed of SMI spec, and then created with XML code and saved.

B. PLE

To increase the software productivity, component-based parts are being produced and assembled, but there is a difficulty when maintenance and reproduction are needed to adjust to the changes in the various architectural platforms and boost productivity. There has been an ongoing demand of effective methods of development to solve this problem, and the product line engineering method is the one that can solve this problem of reuse of the software system and automated production. PLE is composed of two stages; the domain engineering that makes product assets by analyzing the common grounds and differences, and the applied engineering that produces specific products customers want using PLA[8]. Domain engineering makes the product-line assets by analyzing the common grounds and differences of the products that are included in the specific domain, and it is composed of architecture design and component design. In the architecture design, design decision in a broad sense is made, while in the component design, design decision in a narrow sense is made. In the component design, architecture components are refined considering the reusability and assembly, which allows us to assemble the products designed for the product line from the reusable asset components without fail.

The proactive method is the one that analyzes, designs, and materializes the complete software product line to support all the ranges which are predicted to be necessary for the products later. After S/W product line assets are developed, the time and effort for developing the products suitable for the market can be minimized, but it takes long to analyze and design the S/W product line and also takes a lot of cost and procedures. As this method takes a lot of time and cost, it is not adequate for the cases that are over the acceptance range; it is adequate for the domains whose demands for the needed products are well defined and secure. The reactive method is the one that expands the existing S/W product line gradually when new products are needed or new demands occur for the existing products. It can expand the S/W product line with small cost and cope with new demands flexibly. However, it has characteristics that it is difficult to apply it when there are no common grounds between the new demands or many parts stay unfixed. It is adequate when the demands for the new products are hard to predict in the S/W product line. Also, it is adequate for the domain that needs flexible response when new demands proposed by the users have much in common or new demands are frequent. The extractive method is the one that makes one S/W product line after analyzing and extracting the common grounds and differences from the existing developed systems or products. It is a method that extracts the information from the existing data such as source code, design, and domain analysis. As it takes less time and cost than the proactive method, it is not adequate for the cases where it is hard to find common grounds and differences from the existing developed system although effective reuse of S/W is possible. It is useful for the cases where the existing systems and products can be reused; especially for the cases where there are many things in common between systems and the differences are consistent.

III. CONFIGURATION OF THE ARCHITECTURE ASSET

A. Asset Configuration

Specifications have been made to take care of the software assets based on RAS, which is the public standardized specification of OMG. This specification describes the structure, contents, and explanation of the software assets that can be reused for the consistency of reuse procedures. DMI is divided into two areas just like the structure of RAS. The architecture asset includes the basic components regarding the asset specification just like Core RAS. And the applied asset has the profile function that shows the expansion of Core RAS to introduce the additional meaning with respect to the specific form of assets.

Figure 1 shows the main sections and elements that the architecture asset comes to have just like the asset composition of RAS. Core RAS is composed of the classification section, solution section, usage section, and related asset section[9]. The classification section lists a series of statements to classify the assets. The solution section describes the artifacts of the assets. The usage section includes the rules to use and customize the asset. The related asset section describes the relationship with other assets. This paper used the method of setting up the range for hierarchical classification of the asset and classifying according to the behavioral characteristics of the assets.

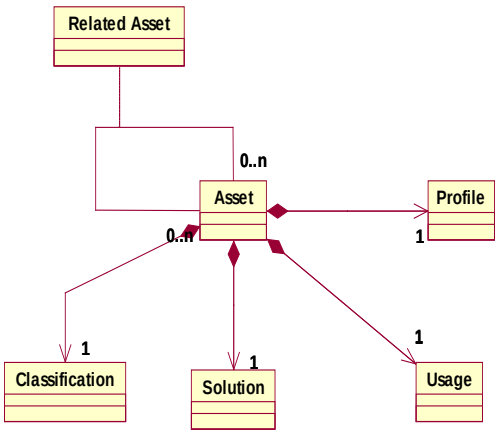

Figure 1: Configuration Model of Architecture Asset

Figure 2 modeled and expressed the classification section in detail among the asset models. The asset is composed of more than one artifact, and one artifact might include other artifacts and have relationship with other artifacts. One artifact is related to the artifact context such as development of demands, design, or runtime context. Artifacts can be specialized in the form of artifact constituents and models. The artifact constituents have a variability point that shows the revisable spot in case of reuse. The model is composed of other models or diagrams, and specifications, and it should be able to express the adaptive point that the artifact constituent includes according to each form.

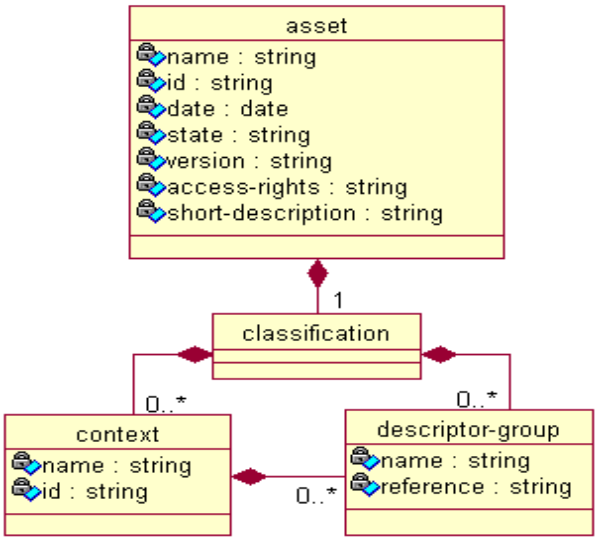

Figure 2: Classification Section Model

B. Analysis of the Architecture Asset

To analyze the architecture asset information, key word analysis of each asset is conducted, and terms that are included in each asset are analyzed along with the name of the components. Here, the key word and name of the assets, which will be saved onto DMI, are the relationship of term-asset. And a lot of terms that are created here are again classified by the concept categories, creating the relationship matrix of term-concept category as shown in Figure 3. The concept category plays a role of a medium between the term and the asset. Here, the term-concept category matrix is generated and we can get the optimal number of term through chi-square statistics calculation. Also, for the search efficiency, terms are utilized in the matched or mismatched calculation of concept categories, composing the synonym matrix between the terms.

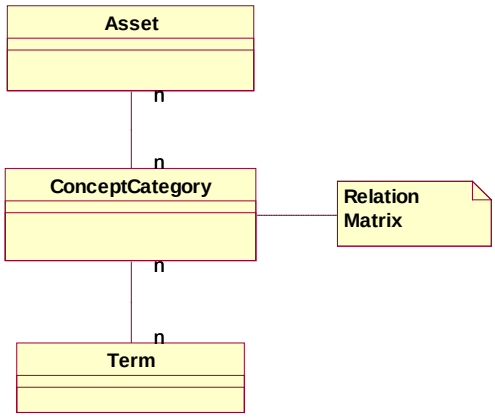

Figure 3: Term-Asset Model

IV. OPTIMIZATION THROUGH CHI-SQUARE

The architecture asset optimized the extracted asset information by using the chi-square statistics[10]. The purpose of the optimization is meaningless, for instance, when the extracted term is included in many concept categories as a lot of assets are searched using this term. Therefore, to remove these terms, chi-square statistics are used. Formula (1) calculates the weight value regarding one term with chi-square statistics. As a result, each term has its own weight value, and the threshold is set up through simulation and terms are removed. The simulation removed around 23% of the total terms.

$$x^2(t,c) = \frac{N(AD-CB)^2}{(A+B)(B+D)(A+B)(C+D)} \quad (1)$$

A: The number of frequency that t and c occurred simultaneously

B: The number of frequency that t occurred but c did not

C: The number of frequency that only c occurred

D: The number of frequency that neither c nor t occurred

N: The total number of concept categories

For DMI assets, each asset has been classified by more than one context using the fact classification concept. Contexts are composed of the extracted features from the source code, and the features consist of a pair of the verb form, which is the method name, and the noun form, which is the first factor of the method. To search the assets that are multi-facet classified by contexts, we need to find the context that the query tries to express and understand that the query can satisfy multiple contexts. In this regard, this paper set up the initial active value of the features and contexts to find the right context when the query is given as features of verbs and nouns.

The initial active value of each feature is determined by the weight value between the asset and characteristics. This is called feature weight, and it plays a role of emphasizing the features that are closest to the behavior of the asset. The expression regarding the feature weight is as shown in the Formula (2). The initial active value of each feature is set up as the average of feature weight that is calculated with respect to one feature.

$$\mathrm{FW}_{i,k} = \frac{ff_{i,k} \times log\left(\frac{N}{n_k}\right)}{\sqrt{\sum_{k=1}^{F}\left(ff_{i,k} \times log\left(\frac{N}{n_k}\right)\right)^2}} \quad (2)$$

$\mathrm{FW}_{i,k}$: Weight of the kth feature of ith asset

N : The number of the total assets

$\mathrm{FF}_{i,k}$: Feature frequency

N_k: The number of the assets that kth feature shows

F : The number of different features in DB

Feature-context value, which uses the correlation between the features and contexts, is defined to set up the initial active value of the context, the expression regarding the feature-context value is as shown in the Formula (3). This puts its basis on the meaning that the number of features that belong to each context implies the relationship between the asset and the context.

$$FCV_{i,j} = p_j(i)\frac{featur\ e_{i,j}}{featur\ e_i} \qquad (3)$$

$FCV_{i,j}$: The relation value between context *j* and feature *i*

P_j: The percentage that *i*th feature occurs in Context *j*

$feature_{i,j}$: The number of frequency that *i*th feature occurs in Context *j*

$feature_i$: The total number of frequency that *i*th feature occurs in all contexts

We can calculate the consistency degree between the features based on the feature-context relation value. First, the consensus value of feature A and feature B is calculated with respect to one context according to the formula (4). And then, calculation is made with respect to all contexts, and the values are added up according to the formula (5). This is defined as feature-feature value, and this value is used in the equivalence relation formula between each feature of queries and features of candidate assets.

$$m1_{ab} = \frac{1}{1+|a1-b1|}, \quad (a1 \neq 0,\ b1 \neq 0)$$
$$m1_{ab} = 0, \quad (a1 = 0,\ OR\ \ b1 = 0)\ or\ (a1 = b1 = 0) \qquad (4)$$

$$M_{AB} = \sum_{j=1}^{c} mj_{ab} \qquad (5)$$

V. CONCLUSION

This paper aims to enhance the reuse efficiency through optimization of assets. This can be materialized when the users provide queries in a familiar way and automatically search the asset by minimizing the manual work. Queries that are given in the form of features automatically extract the context related to the query using the feature-context relation value and feature weights, which are calculated under DMI. Here, candidates contexts related to the query are extracted to automatically extract the context. Later, the asset that satisfies the context extracted from the query set is found. The reliability between the candidate assets and the query is calculated, and finally, the asset is searched according to the priority of reliability.

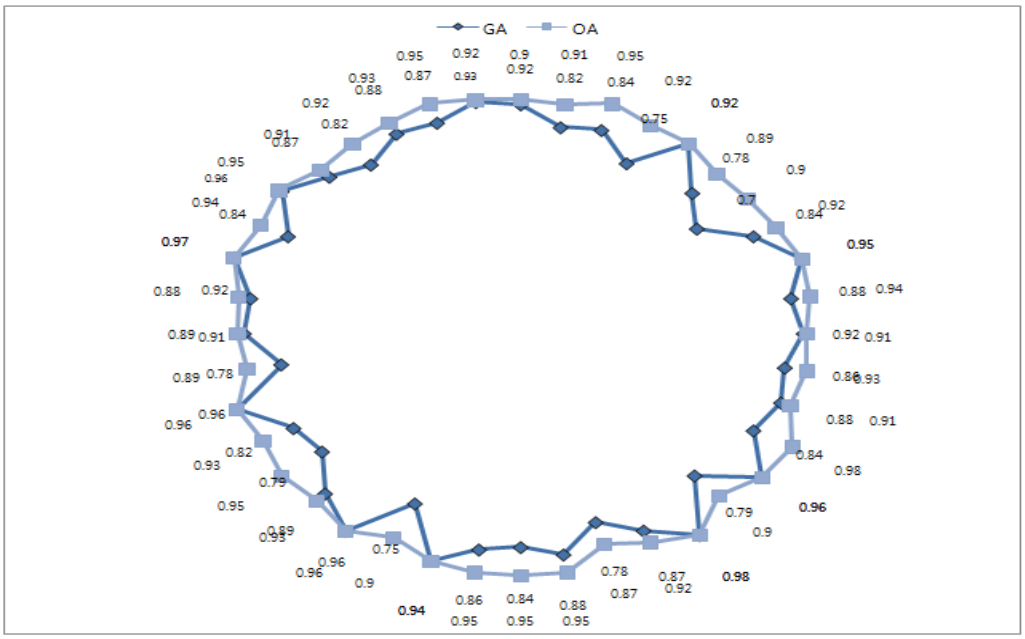

Figure 4: Accuracy Through Optimization

As a result of context search, reliability is calculated between the query set and assets regarding the candidate assets that meet all the contexts commonly appearing in one query set. The final reliability can be achieved by calculating equivalence relation, inclusion relation, and similarity. Therefore, the reuse of adequate architecture assets is enhanced as shown in Figure 4 through multi-facet-classified component search. This is because feature weight and feature-context relation value methods have been applied to use the reusable assets.

To measure the accuracy of architecture asset reuse, we measured the result of reuse accuracy of asset components regarding random queries. As shown in the result in Figure 4, we can see that accuracy increases when we design and save the architecture assets and reuse them in general and through conducting optimization. The accuracy greatly goes up when the difference in the accuracy of two methods are under 90%. This means that when we don't know the information about the architecture asset exactly that is intended to be reused, the reuse of the assets increases more greatly. Also, it means that for DMI assets, each asset is classified and saved by more than one context using the concept of facet classification and optimized so that the assets can be searched in an expanded way through synonyms.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on Development of Web Portal for Creative Economy-Focusing on the Creative Economy Town (Idea Commercialization Support Portal)

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Abstract---

This year, the Creative Economy Town which opened in September 30, 2013 celebrates its 3rd year. So far, the platform has continuously improved and developed services by allowing diverse entities such as citizens and enterprise to freely propose and develop their ideas. People's interest and use of the online platform continued to rise even after the launching of the offline idea commercialization support platform 'Creative Economy Innovation Center.' This study attempted to analyze the progress of the Creative Economy Town services for the past three years during which more than 3.54 million people visited with 120,000 members (as of September 30, 2016) and search for the service development plan to help the platform play the role of the leading creative economy portal.

Keywords--- Creative Economy Town, Creative Economy, Idea Commercialization Support, Web Site Integration, Portal Site.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

'Creative Economy' refers to the new paradigm of the Park Geun-hye Administration, which is targeted to create new industry and market by adding people's imagination and creativity to science & technology and ICT and make good jobs by strengthening current industries[1].For the establishment of a sustainable creative economy ecosystem, in particular, the online idea commercialization support platform titled 'Creative Economy Town' was launched in September 2013. Any citizens with an idea are assisted to develop their thoughts and accomplish their commercialization.

This year is the 3rd year of the Creative Economy Town. Now, it provides the service which quite differs from the one provided in the very beginning. There have been a lot of efforts to encourage more users to join the Creative Economy Town and realize the commercialization of their ideas including the improvement of key processes (e.g., idea proposal, talk with a mentor, etc.), expansion of the information and contents, introduction of user-participating new services and change in main page design. In particular, even since the offline idea commercialization platform 'Creative Economy Innovation Center' opened in 18 regions across the country, people's use of the Creative Economy Town has gradually increased. As of September 30, 2016, a total of 37,000 ideas were proposed, and 1.2 million people joined the online platform with over 3.54 million visitors in total.

Therefore, this study attempted to investigate the progress of the Creative Economy Town services for the past years, propose ideas by attracting people from diverse fields and develop a service system to play a role of the leading creative economy portal which can share and utilize the various contents of the Creative Economy.

II. HISTORY OF THE CREATIVE ECONOMY TOWN

The service menu of the Creative Economy Town at the time of its opening(2013) was comprised of 'Idea Power Station,' 'Idea Commercialization Support Information,' 'What is the Creative Economy?' and 'Creative Economy Cases.' The 'Idea Proposal' and 'Talk with Mentor,' the core services of the Creative Economy Town, are provided in a 2-level format in 'Idea Power Plant,' allowing users to be able to construct services easily. In addition, after classifying startup-related support program information which has been scattered across many websites by idea commercialization stage, idea commercialization support information services are provided to allow users to check the information more easily[2].Furthermore, it informed a concept of the 'Creative Economy' to people through the 'What is the Creative Economy?' and 'Creative Economy Cases.'

From the perspective of the main page, the (Idea Proposal -> Mentoring Program -> Commercialization Support Information -> Creation of the Success Cases) process was displayed in the middle of the home page, allowing users to have a better understanding of the services of the Creative Economy Town.' In addition, there was an attempt to establish a ground for an active response to changes in future website and system based on the standard technology which adopts the latest web technologies[3].(Figure 1)

Figure 1: Creative Economy Town (Stage I)

In 2014, the Creative Economy Town aimed to improve the service process by reflecting users' and experts' opinions (June 2014) and increase people's participation in the Creative Economy Town through the expansion of contents and establishment of communication channels (August 2014). The 1:1 mentor-mentee communication service was reorganized into a 1:N (mentor) format (mentoring with up to 10 mentors at the same time), allowing the idea proposers to get mentoring from mentors from diverse fields. Furthermore, it was designed to disclose an idea to a mentor or members if wanted when the idea proposer submits a patented or registered idea to strengthen the openness of ideas and allow many people to get a feedback on such ideas[4].

In addition to idea commercialization support information, furthermore, diverse contents (e.g., commercialization support agency information, business plan preparation method, promising commercialization technology (connection with Future Technology Plaza), etc.) were developed to allow business startup candidates who propose an idea and prepare its commercialization to get access to commercialization-related contents easily. In particular, a menu which introduces incubating (excellent) ideas among the proposed ones is designed to advertise such ideas and provide mentoring and commercialization cases through news coverage and interview to have the case itself become another mentoring. Furthermore, new menus (e.g., the Town's People, Communication Plaza, etc.) were designed to increase members' participation and allow free commercialization-related Q&As in the Town. (Figure 2)

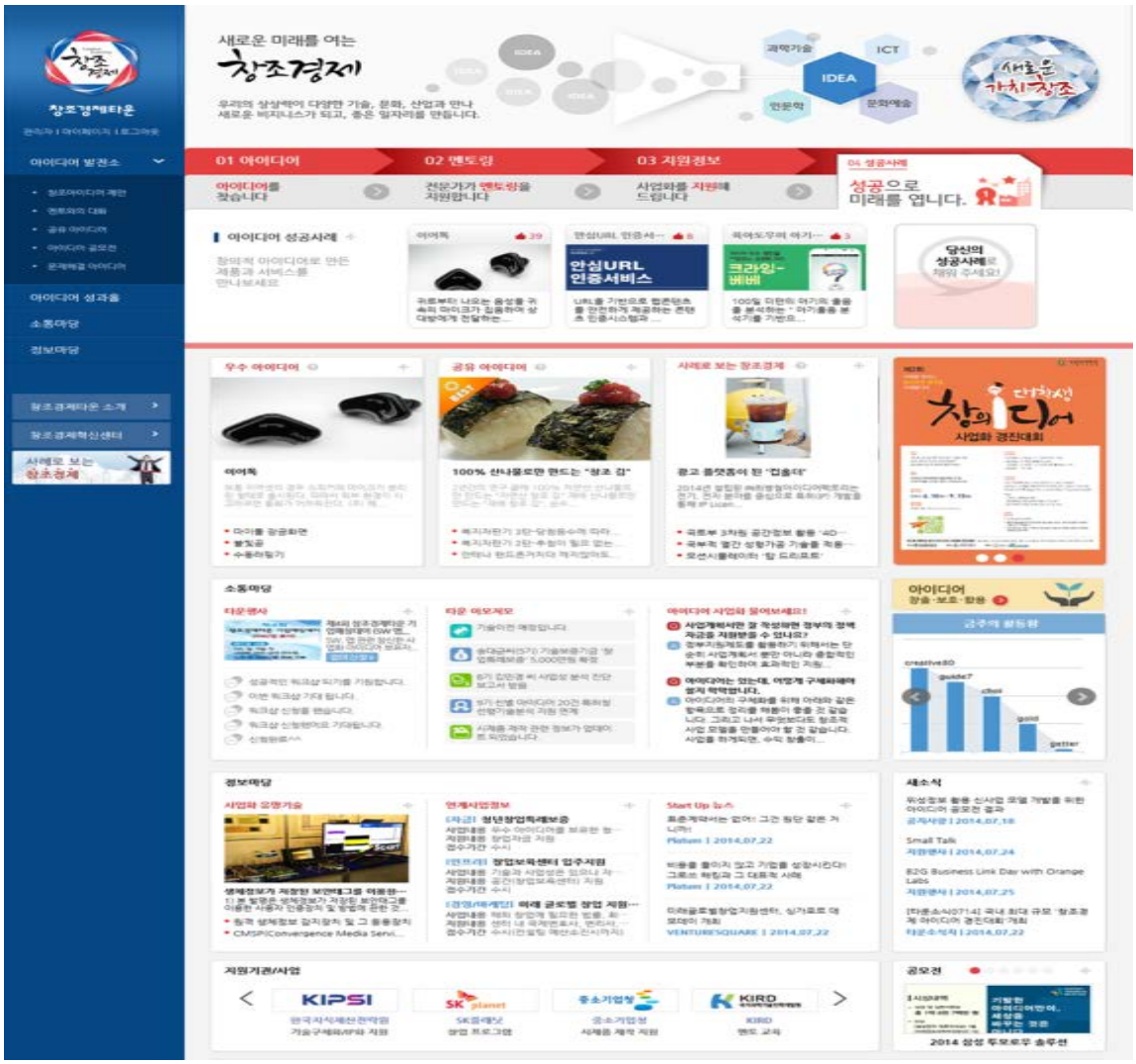

Figure 2: Creative Economy Town with Diverse Contents

In 2015, an intro page which reflected the latest trends was provided to allow users to be able to the Creative Economy Town services in a more exciting fashion. A total of seven menus were developed with a story to help first-time visitors find the services they want easily. In addition, a responsive web system was constructed to allow them to use the Creative Economy Town without any inconvenience under diverse device environments including a mobile system[4].In the main menu configuration, the vertical menu bar was converted into a horizontal one. In addition, a promotional banner opened on top of the page to announce important program information and events. Furthermore, the idea commercialization smart calendar was designed to help users check the commercialization-related events and support schedule in a quick and easy manner. (Figure 3)

Figure 3: Creative Economy Town (Stage 2) (Left: Intro Page, Right: Main Page)

In 2016, there was an attempt to establish the Creative Economy Town as the starting point of invention and business startup by allowing people from more diverse fields to create ideas by joining the online platform and share and utilizes its diverse contents. For this, first, an online gateway was constructed to support idea commercialization through integration with the website ('Creative Economy Innovation Center'). Second, the 'Idea Community' service was developed to enable assessment and investment simulation on the proposed idea and create contents through users' open activities.

The Creative Economy Innovation Center has provided support in diverse fields such as startup incubation, technical assistance and development of sales routes in connection with local authorities and private businesses. In addition, they developed and operated a leading website which integrates each local center's website and all innovation centers. Since they are operated under the same goal with the Creative Economy Town, which is 'Idea Commercialization & Business Startup Support,' there was confusion between the Creative Economy Town and Creative Economy Innovation Center among many service users.

There are three types in terms of the integration of two different websites: i) one website is shut down and acquired by the other one which in turn becomes the leading website ('acquisition'); ii) after shutting down all current websites, a new website is reconstructed, and its functions are maintained as an independent website; iii) each website is kept alive, and services are connected to each other ('connection & integration')[5].

In terms of an integration type, both advantages and disadvantages are found. If the 'acquisition' method is applied in terms of the integration of the Creative Economy Town and Creative Economy Innovation Center, one of the two websites should be chosen as the leading website. Therefore, the brand of the website to be acquired could be ignored. If a new website is reconstructed, it may become the leading website of the 'Creative Economy.' However, development costs occur. In the 'connection & integration,' same services are integrated under a single menu while each website's features are still available. In this method, while current websites are kept, contents are connected through related technologies such as API. Under this system, each website's system and database are provided. In case of the website of Samsung (www.samsung.co.kr), the notices and other information of the head office and its affiliates are provided on the integrated website. Here, users are able to visit each affiliate's website through the 'Go to the Affiliate' menu at the bottom.

In the Creative Economy Town, the 'connection & integration' method was adopted. With the Creative Economy Town in the middle, the Creative Economy Innovation Centers' contents are linked and provided. In addition, they are linked through the 'Go to the Innovation Center' menu in the Creative Economy Town, making it easy to get access to the menus of the Creative Economy Innovation Center. In addition, 'single-sign-on' was applied to the website of the Creative Economy Town-Creative Economy Innovation Center website to improve the convenience of use between the two websites.

The website in which the connection with the Creative Economy Innovation Center is improved is designed to have five menus: About Creative Economy, Creative Economy Town Lounge, Creative Economy Innovation Center Lounge, Commercialization Support and Customer Support. In addition, the contents of the Creative Economy Town and Creative Economy Innovation Center are provided through seven menus such as Town-Innovation Center News, Outcomes and Notice. (Figure 4)

Figure 4: Creative Economy Town with Upgraded Linkage with the Innovation Center

In the Creative Economy Town reopened on October 28, 2016, furthermore, the description and contents of the Creative Economy Town were organized on top of the home page, allowing users to find the services they want readily. In addition to the expansion of contents, the system was designed to provide the contents and services in a customized manner. For the first-time visitors, fun and exciting magazine-type contents were provided to help them have inspiration for new idea and business startup. For startup candidates and those who just started business, a wide range of information was provided. Furthermore, the newly developed 'Idea Community' service proposes an idea by topic and offers members an opportunity to freely exchange opinions through assessment and mentoring. This service targeted to encourage more users to participate by applying a level system according to users' activities (idea proposal, recommendation and assessment). As they were more active, their level increased. In other words, a concept of gamification was introduced to increase users' participation. (Figure 5), (Figure 6)

Figure 5: Main Page with User Convenience-Reflected Interactive Menus

Figure 6: Idea Community Service

III. DISCUSSION

Since its opening in September 2013, the Creative Economy Town has attempted to provide diverse information and contents to startup candidates and those who have launched and operated business. Instead of just submitting an idea and getting mentoring from experts from each field through the Creative Economy Town, the openness of ideas was improved to have them shared by more diverse people by developing the 'Idea Community.' Furthermore, access to the Creative Economy Innovation Center services was further strengthened through the connection and integration with the website of the Creative Economy Innovation Center. It appears that a ground for the Center to play a role of the integrated Creative Economy (idea commercialization support) portal is almost established. If we have a system which can support the materialization and visualization of ideas and nurture makers in connection with infinite imagination labs, design & prototyping agencies and maker spaces across the country, the Creative Economy Town would evolve into a creative economy portal which realizes the Creative Economy through creative ideas as a noted online idea commercialization support platform.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Reconstruction and Analysis of Gene Regulatory Network for Lung Cancer Using Relational Matrix and Neuro-Fuzzy System

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Abstract---

Objectives: Owing to the appearance of microarray technology, researchers were able to obtain huge amounts of gene expression data. This vast amount of microarray data and computational methods has allowed researchers to look at overall biological mechanisms as a network. Gene regulatory network which models interactions among genes from microarray data helps to reveal pathways associated with disease and predict the effect of the drug.

Methods/Statistical analysis: In this paper, a relational matrix which is used to reconstruct the gene regulatory network of lung cancer is proposed, and we demonstrate that by weighted neuro fuzzy algorithm, the groups of interacting genes founded by scanning relational matrix can classify the types of lung cancer very well. The relational matrix is constructed by counting the number of meaningful relationship between two genes for all samples. The weighted neuro fuzzy algorithm uses a bounded sum function that the three functions are combined into one for learning and classifying.

Findings: We discovered more than about 500 genes which have strong relationships with the one or more genes by investigating the matrix after constructing the proposed relational matrix, and reconstructed gene regulatory network with the discovered genes. We were able to find that only 42 genes in reconstructed gene regulatory network receive affect from a large number of genes. We were also able to find that they were connected with each other. When we investigated the other target genes which have a target geneas regulator, it played a role as regulator in almost all 42 target genes. From this result, we can know that there exist a group which is consisted of genes that have very high interactions in gene regulatory network, and the genes included in the group play an important role for lung cancer. We discovered the genes which have high relationship according to the type of lung cancer. These genes were used for classifying the type of lung cancer.

Improvements/Applications: When the types of lung cancer were classified through machine learning by the weighted neuro fuzzy algorithm with those genes,we got the accuracy of 99.5074% for classifying five types of genes.

Keywords--- Lung Cancer, Relational Matrix, Weighted Neuro Fuzzy Algorithm, Gene Regulatory Network, System Biology.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Cancer is a complex genetic disease involving many genes, proteins, pathways, and interactions among genes. Some cancer-causing genes have already been revealed using several existing methods; however, the entire process that leads to cancer still is not clearly understood. Before microarray technology was used, research had been focused on one protein or a small number of genes. Owing to the appearance of microarray technology, researchers were able to obtain huge amounts of gene expression data. This vast amount of microarray data has allowed researchers to look at overall biological mechanisms. Life is sustained by genetic interactions. If a problem occurs with such interactions, diseases can arise. In particular, cancer is a disease that can be caused by errors among complex genetic interactions. Gene-gene interactions are presented in the form of a network and we call this network gene regulatory network. It is very important to reconstruct gene regulatory network from microarray expression data. If certain characteristics or anomalies are discovered in such networks, they will help us to predict gene functions, understand interactions among transcription factors, or simulate drug effects[1,2,3].Ithas been demonstrated that the discovery of cancer-causing genes by network based method can provide more accurate information about variation or anomaly than the discovery of such genes without network. Lung cancer represents the leading cause of cancer-related mortality in the world.

In this paper, we reconstruct a gene regulatory network, and analyze its characteristics using a relational matrix and a weighted neuro fuzzy algorithm with lung cancer gene expression data. We propose the relational matrix to be statistical method for extracting relationships among genes. The relationship between two genes was extracted based on the expression values of two genes having the same trend(increasing or decreasing) or exhibiting a different trend. The gene-gene relationships for all genes were presented in one matrix. The relational matrix allowed us to reconstruct gene regulatory network and discover groups of genes that have strong relationship. The machine learning was performed using the weighted neuro fuzzy algorithm with genes included in “strong relationship” group for classification. The relational matrix allows for the discovery of a variety of interactions according to the relationship extraction method, and such interactions are classified through machine learning using the neuro fuzzy algorithm.

We discovered more than about 500 genes which have strong relationships with the one or more genes by investigating the matrix after constructing the proposed relational matrix and reconstructed gene regulatory network with about 500 genes. We can find that only 42 genes in reconstructed gene regulatory network receive affect from a large number of genes. The 42 genes are connected to each other. Also we discovered the genes which have high relationship according to the type of lung cancer. When the types of cancer were classified through machine learning by the weighted neuro fuzzy algorithm with those genes, accuracy was high. We got the accuracy of 99.5074% for classifying five types of genes.

The remainder of this paper is as follows. We present the related works in section 2. In section 3, we propose the relational matrix and the weighted neuro fuzzy algorithm. The experimental results and our conclusions are presented in section 4.

II. RELATED WORKS

Over the past few decades, researchers have proposed many computational methods for reconstructing gene regulatory networks. One very famous method is a Boolean network. This method uses binary digits to represent gene expression data. Consequently, this model is limited by the potential loss of information, even though it can model gene regulatory networks very simply[4]. The Bayesian network models gene regulatory networks using probability theory. The interactions among genes are represented by conditional probability. The limitation of this method is that it cannot describe the cycles that often happen in the network[5].

The use of the proposed relational matrix enables the extraction of bidirectional information between two genes. For this reason, the loss of information can be avoided and the cyclic relationship can be presented. For the fuzzy system, as the number of genes is increased, the rules and overhead calculations are increased. However, the relational matrix is independent of the number of genes.

III. MATERIAL AND METHOD

A. Relational Matrix

We used the 12,600-gene expression profile of 203 lung cancer samples for experiment. Seventeen samples are normal, 139 are adenocarcinomas, six are small cell lung cancer, 21 are squamous cell lung

carcinomas, and 20 are pulmonary carcinoid among 203 samples. First we selected 3312 genes of 12,600 genes according as references6 and 7;these 3312 genes are considered the most valuable genes for this analysis. Therefore, the size of the dataset is 3312 × 203.

The relational Matrix is 3312 × 3312. Each element of matrix is set to binary digit, 1 or 0 and the relational matrix is constructed as follows:

Step1. Preprocessing of gene expression value:

All gene expression values are transformed to 0 or 1 using the following formula[8].

$$tg_{ij} = if\ g_{ij} \geq avg(g_i)\ then\ 1, otherwise\ 0\ (i = 1,2,\dots,3312,\ j = 1,2,\dots,203) \quad (1)$$

where g_{ij} is the expression value of sample *j* in gene *i*, tg_{ij} is the transformed value of sample *j* in gene *i*, and $avg(g_i)$ is the average of all samples of gene *i*. The rational for changing gene expression values to transformed values is to remove noise.

Step2. Calculating of relationship between two genes:

The relationship between two genes is calculated by the following formula.

$$r_{i,j} = \sum_{n=1}^{202}(\sum_{m=n+1}^{203} f(tg_{i,n\to m}, tg_{j,n\to m})) \quad (i = 1,2,...,3312, j = 1,2,...,3312) \quad (2)$$

where tg_i and tg_j are the transformed values of gene *i* and gene *j*, respectively, and function $f(tg_{i,n\to m}, tg_{j,n\to m})$ returns the type of relationship between two genes and the types are presented in Table 1.

Table 1: The Kinds of relationship between Two Genes

types	$tg_{i,n\to m}$	$tg_{j,n\to m}$	relationship	$f(tg_{in}, tg_{jm})$
a.	increase	increase	exist	+1
b.	decrease	decrease	exist	+1
c.	increase	decrease	exist	-1
d.	decrease	increase	exist	-1
e.	no change	increase or decrease	not exist	0
f.	increase or decrease	no change	not exist	0

The relationships are classified by six types as in Table 1 and the following is an explanation about Table 1.

Type a. When the value of sample n is larger than the value of sample m in gene tg_i, and if the value of sample n is larger than the value of sample m for gene tg_j, it is considered that a relationship exists between gene *i* and gene *j*. The role of this relation is as an activator and the result of function is 1.

Type b. When the value of sample n is smaller than the value of sample m for gene tg_i, and if the value of sample n is smaller than the value of sample m for gene tg_j, it is considered that a relationship exists between gene *i* and gene *j*. The role of this relationship is as activator and the result of function is 1.

Type c. When the value of sample n is larger than the value of sample m for gene tg_i, and if the value of sample n is smaller than the value of sample m for gene tg_j, it is considered that a relationship exists between gene *i* and gene *j*. The role of this relationship is as a repressor and the result of function is -1.

Type d. When the value of sample n is smaller than the value of sample m for gene tg_i, and if the value of sample n is larger than the value of sample m for gene tg_j, it is considered that a relationship exists between gene *i* and gene *j*. The role of this relationship is as a repressor and the result of function is -1.

Type e. When the value of sample n is the same as the value of sample m for gene tg_i, and if the value of sample n is smaller or larger than the value of sample m for gene tg_j, it is considered that a relationship does not exists between gene *i* and gene *j*. The result of function is 0.

Type f. When the value of sample n is smaller or larger than the value of sample m for gene tg_i, and if the value of sample n is the same as the value of sample m in gene tg_j, it is considered that a relationship does not exists between gene *i* and gene *j*. The result of function is 0.

Relational matrix is constructed by $r_{i,j}$ and gene regulatory network can be reconstructed.

Step 3. Applying threshold:

After 3312 × 3312 matrix was produced by step 2, a threshold is applied to each element of the matrix. If the value obtained by dividing are lated element of matrix by the total number of comparisons of gene *i* and *j* is smaller than threshold, that element is set to 0,otherwise it is set to 1. We empirically decided on a threshold of 70%.

Step 4. Finding a strong relationship group:

If the element of matrix was set to 1, two genes associated with that element interact with each other. We were able to identify the group of genes related to one gene by scanning relational matrix.

B. The Weighted Neuro Fuzzy Algorithm

The groups of genes that are obtained from the relational matrix are learned using neuro fuzzy algorithm in order to classify the types of lung cancer. The neuro fuzzy algorithm which is utilized in this paper creates the weighted fuzzy functions and produces one bounded sum function as the result of learning[9,10,11].The weighted fuzzy functions are depicted in Figure 1. Five variables v_i(i=1,2,...,5) and three variables w_j (j=1,2,3) are determinded according to max and min values of a gene. The v and the w are adjusted on learning. This fuzzy set is created the same as the number of class. After finishing learning, bounded sum functions are generated as many as the number of class by using these fuzzy set for one gene. Red line of Figure 2 shows bounded sum function. The bounded sum is to add bound values of fuzzy functions and all bounded sum is connected. This bounded sum function is used to classify whether a sample is lung cancer or not and which kind of cancer a sample is.

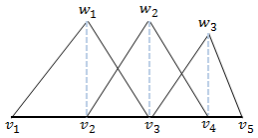

Figure 1: The Weighted Fuzzy Functions

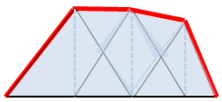

Figure 2: The Bounded Sum Area

IV. CONCLUSION

We discovered more than about 500 genes which have strong relationships with the one or more genes by investigating the constructed relational matrix and reconstructed gene regulatory network with about 500 genes. Each gene as target gene is connected with the one or more regulators. Table 2 shows the number of target genes according to the number of regulators. All target genes with one regulator to ten regulators are 468. 11 to 20 regulators are 20. The number of target genes is drastically decreased from when the number of regulators is the more than 20. From this result, we can find that the 42 genes among about 500 genes receive affect from a large number of genes. Table 3 shows what 42 genes are.

Table 2: The Number of Genes According to the Number of the Connected Genes

The number of regulators	The number of target genes
1~10	468
11~20	20
21~30	7
31~40	5
41~50	5
51~60	5
61~70	2
71~80	3
81~90	2
91~100	3
100~	10

Table 3: The Genes According to the Number of the Connected Genes

The number of regulators	Target genes
21~30	32323_at, 32512_at, 32652_g_at, 33703_f_at, 35245_at, 40165_at, 41016_at
31~40	32650_at, 34382_at, 36750_at, 39178_at, 40075_at
41~50	32648_at, 33702_f_at, 36160_s_at, 39266_at, 40272_at
51~60	32252_at, 35592_at, 35778_at, 39352_at, 40746_at
61~70	36148_at, 37210_at
71~80	272_at, 273_g_at, 33426_at
81~90	260_at, 41289_at
91~100	33377_at, 36924_r_at, 38887_r_at
100~	1390_s_at, 33157_at, 34265_at, 37478_at, 38484_at, 38886_i_at, 40808_at, 40995_at, 41430_at, 41792_at

The genes arranged in Table 3 have a characteristic. The 42 genes are connected to each other. For example, we investigated the genes which have target gene, 32652_g_at as regulator, which has 21 regulators. Table 4 shows those genes.

Table 4: The Genes which have Target Gene 32652_g_at as Regulator

gene	number	gene	number	gene	number
1390_s_at	116	260_at	89	272_at	73
273_g_at	73	310_s_at	6	31918_at	10
32323_at	27	32512_at	23	32650_at	32
32771_at	16	33157_at	114	33377_at	97
33446_at	8	34265_at	135	34382_at	36
34847_s_at	10	35245_at	22	35531_at	9
35592_at	60	35670_at	13	36148_at	69
36160_s_at	45	36750_at	35	36924_r_at	100
37182_at	15	37210_at	61	37478_at	111
38146_at	20	38146_at	10	38484_at	106
38800_at	6	38886_i_at	123	38887_r_at	97
39178_at	39	39266_at	43	40075_at	34
40272_at	44	40746_at	58	40808_at	140
40995_at	198	41016_at	22	41289_at	81
41388_at	10	41430_at	178	41792_at	102
41835_at	16				

Table 4, number columns mean how many regulators the genes which have target gene 32652_g_at as regulator have. Yellow background cells exist in Table 3. We discovered that all target genes in Table 3 play a role as regulators to almost all other genes in Table 3. It means that the genes in Table 3 interact strongly with each other.

Also we discovered the genes which have high relationship according to the type of lung cancer. Table 5 shows the number of genes which have high relationship in types of genes. Normal means it is not lung cancer. Even though we didn't find the genes which have relationship over 70% in the type adenocarcinomas, when the types of cancer were classified through machine learning by the weighted neuro fuzzy algorithm, accuracy was high. We got the accuracy of 99.5074% for classifying five types of genes.

Table 5: The Number of Genes with High Interactions According to the Types of Lung Cancer

Types of lung cancer	The number of genes with high interactions
adenocarcinomas	0
Normal	71
Small cell lung cancer	61
Squamous cell lung carcinomas	16
Pulmonary carcinoid	224

From these result, we can know that there exist a group which is consisted of genes which have very high interactions in gene regulatory network and the genes included in the group play an important role for lung cancer. Also we can classify the types of lung cancer with high accuracy through the proposed method. In the future, we will try to find more detailed interactions and analyze the gene regulatory network in detail.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology (2015R1D1A1A09057409).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Big Data Research for Effective Use of Parking Space Firms

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Abstract---

Background/Objectives: This study aims effective use of parking space in Seoul. About plan to improve parking problem in Seoul effectively through various parking lot public data of Seoul is as following.

Methods/Statistical analysis: Based on Seoul public data portal and opened data plaza, it conducted big data group analysis by using R program and big data Analysis.

Finding: Although parking surface increases along with registered vehicle number in Seoul, securement of parking space had limitation because area of Seoul is limited. As a result of this study 'S' parking lot of Germany, real-time parking demand alarm, using baseball and soccer field, parking situation notifying communication network were suggested as solutions for parking shortage of Seoul.

Improvements/Applications: It seems to be helpful to establish Seoul parking policy, it also seems that it may consider introduction of the system to other local government.

Keywords--- Big Data, Park Shortage, Park Space, Parking System, R, Big data Analysis.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

There are many changes going on according to rapid development of information communication technology. Especially, the data explosively increases due to appearance of IoT (Internet of Things), ICT (Information Communication & Technology), Internet, SNS (Social Network Service). Many researches about how to use this have been executed since the massive data collecting was begun.

As big data is proliferated, many researches about this are in progress. Park et al.(2016) analyzed storage environment for realizing cloud computing, and progressed a research about the technology about plan to construct cloud storage and use this[1]. Kim et al.(2015) progressed a research about method prevent and suppress fire by using big data and new approach method that secure safety from disaster through this[2].

Kim et al.(2015) progressed a research about the plan to suppress fire early by using CCTV big data[3]. Kim et al.(2016) predicted birth and BCG vaccine demand by using ARIMA analysis[4].

Big data has been used in these various sectors. Although the person who has more information won the information battle in the past, how to analyze and use the information well is the key to win the information battle these days.

About parking lot problem in 2016, since it analyzed various parking lot data of Seoul through big data through attempts of various analysis mainly with existing opened public data, it seems that it may find the solution.

About current parking problem of Korea, it is still not settled down well in terms of parking recognition. For overall recognition regarding parking problem, there are many kinds of people such as people who get stressed out because of parking problem usually and people who hesitate to drive car out because of parking problem, and parking problem is often the reason for argument or fighting and threats pedestrians, and there are many cases occurring in real life because of parking problems.

If people change these recognitions, parking problems would be spontaneously solved, and problem solving plan through big data to solve parking problems. Finally, since parking culture reflects national character, we need to improve these parking problems.

To manage parking lot effectively and make it operated organically, it aims to realize public parking lot network as it indicates Seoul public parking lot data on the map with ggmap by using R that is a big data analysis tool, and it will bring parking lot data of baseball and soccer field and connect to make network operated organically as it indicates on the ggmap, and it used group analysis through statistic data of Seoul parking lot securement rate.

II. RESEARCH METHOD AND PROCEDURE

A Problem Definition

People who park generally try to park in the shortest time. However, since there are shorted parking space, they just keep going around the area before they find a space. According to survey regarding the reason why people who have experience in illegal parking did illegal parking, the answers were as 'there was no where to park around' (69.2%) 'they could not find proper parking space' (68.9%)[5].

In other words, while number of cars constantly increases, shortage of absolute parking space to accept is the most fundamental problem. For this reason, proper parking space should be secured.

As a result that Trend monitor of Macromill embrain that is specialized enterprise in market research conducted recognition survey regarding parking problem with 1,000 male and female of 19~59 years old who have driving experience, it was surveyed as 62.2% of responders think that Korean parking culture is not matured.

Also, as a result of survey of cause of domestic parking problem, the answers were 'selfishness of car owner' (47.7%), because number of own car by household increased (37.4%), 6 out of 10 drivers thought that it is because of lack of parking lot (52.2% answered duplicately) that is the first ranked in domestic parking problem[6].

B. Information that is Needed for Problem

7 autonomous districts besides Seocho-gu among districts in Seoul were the sample. Among them, the district that has the most parking lots was Gangbuk-gu that has about 51, and the district that has the least was Eunpyeong-gu that has about 11.

In order to see parking lot distribution by district at a glance, it is needed to display in ggmap form. Also, figuring out information like statistic of securement rate of parking lot of each autonomous district and displaying in group form by year, finding out the reason why parking spaces are shorted and the plan to year change is needed.

C Needed Data for Deducting Information

To figure out the problem, relevant data for deducing information is needed. To figure out actual condition of current parking lot, parking lot information data of Seoul is needed, and to figure out number of registered car and parking surface, and parking securement rate, parking lot securement statistic of Seoul would be the analysis subject data. Also as it uses available space around, Seoul baseball and soccer field data may be needed for using parking lot space.

D. Analysis Technique Method for Deducing Information

First, in order to figure out parking lot information by autonomous district of Seoul, it visualized current state of parking lot on the map with ggmap by using R that is a big data analysis tool.

Also, it conducted non-hierarchic group analysis and visualization of parking lot securement rate statistic by 25 autonomous districts.

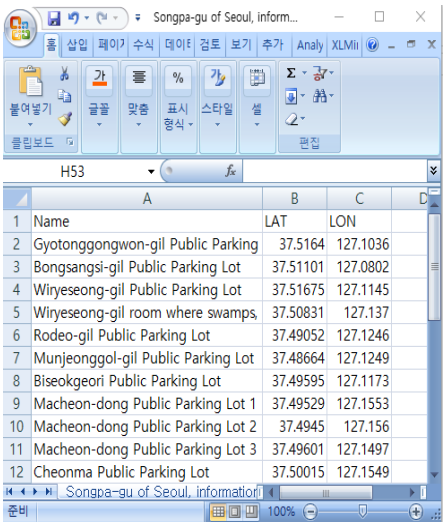
As it visualizes parking lot securement rate comparing to number of car registration and parking surfaces comparing to number of car registration in group, it conducted to verify hypothesis that parking space will be shorted as number of registered car increases every year.

For analysis, it arranges collected data to enable to analyze through preprocessing and collect data that needs for analysis from each data, and then it makes new analysis subject data. At the last, it calculates wanted information through relevant analysis tool named R[7].

III. DATA COLLECTION AND ANALYSIS

A. Data Collection and Preprocessing

Data that needs for analysis may be gotten from the public data portal (https://www.data.go.kr)[8] and Seoul open data plaza (http://data.seoul.go.kr) [9]that have various nation owned data. e could collect parking lot information data by district of Seoul from public data portal site.



	A	B	C
1	Name	LAT	LON
2	Gyotonggongwon-gil Public Parking	37.5164	127.1036
3	Bongsangsi-gil Public Parking Lot	37.51101	127.0802
4	Wiryeseong-gil Public Parking Lot	37.51675	127.1145
5	Wiryeseong-gil room where swamps,	37.50831	127.137
6	Rodeo-gil Public Parking Lot	37.49052	127.1246
7	Munjeonggol-gil Public Parking Lot	37.48664	127.1249
8	Biseokgeori Public Parking Lot	37.49595	127.1173
9	Macheon-dong Public Parking Lot 1	37.49529	127.1553
10	Macheon-dong Public Parking Lot 2	37.4945	127.156
11	Macheon-dong Public Parking Lot 3	37.49601	127.1497
12	Cheonma Public Parking Lot	37.50015	127.1549

Figure 1: Songpa-gu of Seoul, information, the Parking Lot

As it preprocessed the collected data, it switched into the form that may be analyzed as it categorizes into year, registered car number, parking surface number, and it converted used data for analysis into CSV and used for analysis. [Figure 1] and [Figure 2] are the examples of data that went through preprocessing process[10].

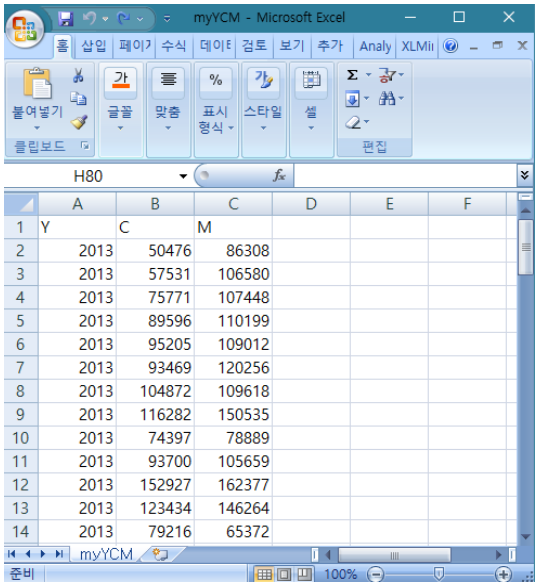


Figure 2: The City Rate Statistics, Secure Parking Lot

B. Data Analysis

It conducted group analysis of number of registered car VS number of parking surface [Figure 3] in period from 2013 to 2015 by 25 autonomous districts from Jongro-gu to Kangdong-gu in Seoul. With same method, it conducted group analysis of number of registered car VS parking lot securement rate [Figure 4] too.

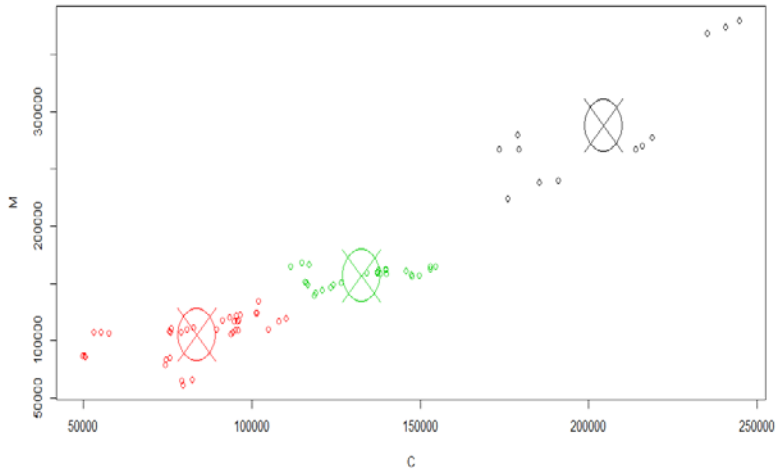


Figure 3: Annual Changes in the Number of Registered Cars and Parking Space

Also, it determined number of groups as 3, and it visualized the result of non-hierarchical group analysis. 3 groups means relevant year, and #1 group means 2013, #2 group means 2014, #3 group means 2015.

According to [Figure3], as a result that it conducted non-hierarchical group analysis and visualized, it may confirm that parking surface also increases as number of registered car increases. According to [Figure 4], it increased and decreased mainly with group, but may confirm there is no big change.

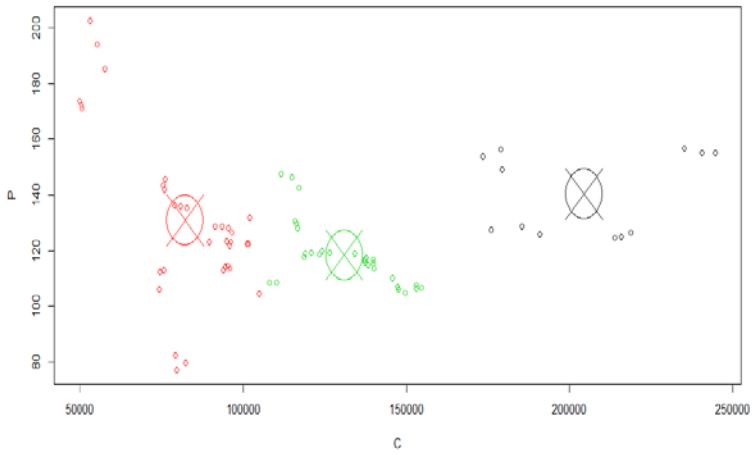


Figure 4: Annual Changes in the Registered Cars and Parking Securing Ratio

It may find out that change percentage of number of registered car and parking lot securement rate are similar according to each group center

As it integrates result of two group analysis, though number of parking surface increases as number of registered car increases, importance of parking surface comparing to number of registered car is same.

In other words, since increase rate number of registered car and parking surface is same, there is no big change in parking securement rate. Since increasing parking area is limited, the plan to use existing parking space efficiently may be needed.

IV. Solution Plan

A Domestic Application Alternative of Foreign Parking Policy

Introduction of Germany 'S' parking Lot to Domestic

Is it true that German 'S' parking lot has high spatial use?

To prove this, we assumed and drew two rectangles as parking lot in same width that are an intersected parking lot called 'S' parking lot on the left and a parallel parking lot that may been seen often in our country on the right, which is a parking slots in same width (Figure 5).

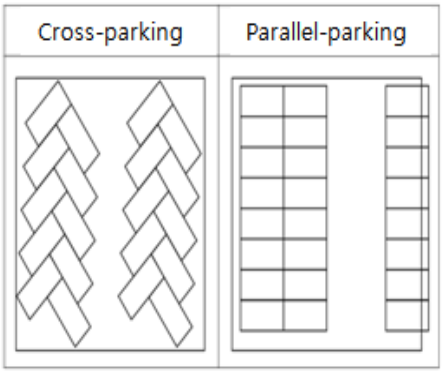


Figure 5: Difference of Cross-Parking Space and Parallel-Parking Space

When we drew two lines of parking slot, though number of slot for a line is 16 slots that has 6 columns more than intersected columns that has 10 slots for a line, but since parallel parking slot needs bigger space than intersected parking slot for parking, the parking lot that consists of intersected parking slots is more effective[11]. In addition, since it may be re-painted its shape of slot, it may get bigger effect with lower cost compared to other plans.

Real-Time Parking Space Notify

With installing a sensor on the road of SF Park, it aims to apply the fact that updates current state of parking space to drivers and flexible application of fare according to New York Park Smart time zone to domestic situation (Figure 6).

If you see the road, there are many street parking lots around shopping arcade and companies, and installing a sensor at the side rather at the end of pedestrian road than road may reduce fault hazard of sensor, so as it surveys parking demand by time zone and differs parking fare, it allows to measure fare automatically.

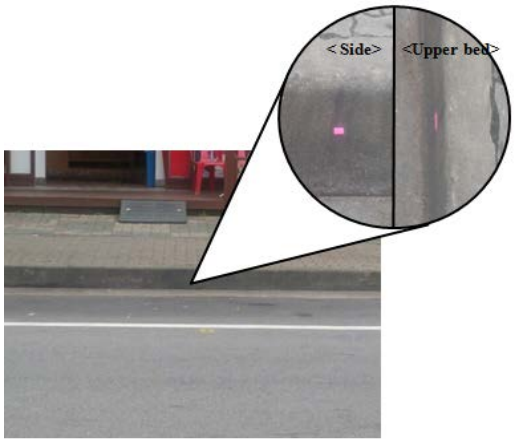


Figure 6: Sidewalk Brick Side of the Sensor

Also, as it offers this information to parking staffs to manage more effective than before. Next, we marked the appearance that it attaches a sensor at the side of the end of pedestrian pavement on the road.

With using sensor, it offers whether it has spare parking lot and parking fare information to drivers in real-time, it may reduce finding time, and as it may encourage public transportation, it may reduce traffic jam also.

B. Domestic Spare Space Use Plan

Baseball Field and Soccer Field

We collected the location of parking lot, baseball field and soccer field of Seoul. At here, the reason why we included baseball field and parking lots is because baseball field and soccer field do not have game on rainy day, and the parking lot is emptied at night time.

Thus, if baseball field and soccer field offers spare parking space for office workers who are commuting, we thought it may solve parking problem.

With regarding Seoul parking lot information as sample among autonomous districts of Gangbuk-gu, Guro-gu, Geumchun-gu, Songpa-gu, we visualized it in ggmap by using R that is a big-data analysis tool.

Besides private parking lot, parking lots of Gangbuk-gu are about 33 places, 15 places for Guro-gu, 39 places for Geumcheon, and 24 places in Song pa. In addition to, Seocho has 29 places, 29 places for Yeongdeungpo-gu, 11 places in Eunpyeong-gu.

Parking Status Notify Communication Network

Parking lot distribution rate of Seoul is about 127%, but the reason why it is such difficult to do parking is because parking lot is not enough in which the parking demand is concentrated, which means that local variation of public parking lot is large by Seoul region.

To supplement this, it forms status notify communication among public parking lots, and as notice board of German parking lot updates status of public parking lot, it may prevent bottleneck phenomenon that parking lot is concentrated. Also as baseball field and soccer field that has relatively bigger parking space, it is expected to secure enough parking space[12].

It is a communication network that shares real-time situation Parking situation notify communication network makes a network that links among parking lots around, For example, when a parking lot does not have parking space, it shares the situation with B parking lot to introduce to do parking instead. Also, you can get offered with notice board and application in real-time while it is moving (Figure 7).

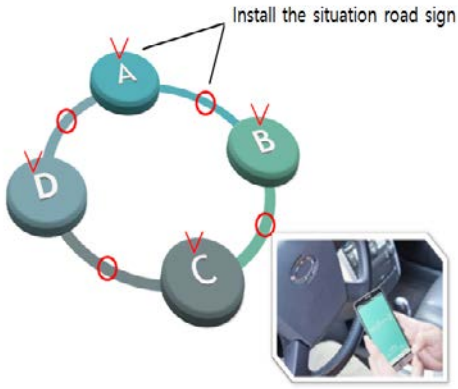


Figure 7: Parking Situations Notification, Communication Networks

Like this, as it offers information about parking slot that may use 'situation notify communication network application in real-time, it is the application that supplemented the limitation of 'parking lot of everyone' that offers limited information like location, fare, direction for private or public parking lots.

Before integrating this, it visualized ggmap as of Songpa-gu among parking lot information sample of 4 autonomous districtof Seoul that was appeared as ggmap and formed network including baseball field and soccer filed that may use surrounding space and near parking lots. Also, with installing bulletin every mid pot of the network, we vitalized parking situation notify communication network (Figure 8).

Figure 8: Activation of Parking Situations Notification, Communication Networks

As near parking lot, and baseball and soccer field form network, and interact, it may reduce worry to secure parking space for parking lot owner and time and energy that takes to move to find parking space.

V. CONCLUSION

In this parking lot problem solution plan research, the result that discussed about plan to improve parking problem in Seoul effectively through various parking lot public data of Seoul is as following.

First, in order to solve parking problem, it designed how to use parking lot and parking space efficiently, and it collected various parking lot data based on this and marked on the map with ggmap based on R and made parking situation notify communication network.

Second, usually, most people cannot park at parking lot because parking space is not enough in which demand is oriented, they could not use efficiently because they did not recognize empty parking lot even though there is parking lot.

However, it made parking situation notify communication in this study and communicate parking lot situation each other between public parking lots, there is no bottleneck phenomenon, and it may distribute efficiently. Currently to make public parking lot, considering 1 billion KRW of budge for 1 surface is required, parking situation notify communication network may reduce budget more efficiently than making a public parking lot, and it is thought as realistic alternative plan.

However, to realize parking situation notify communication suggested by this study, suggestion of many environmental variable and policy are followed. First, among public parking lot, before forming parking situation notify communication, there are public parking lots that have many parking spaces, and there are also parking lots that there are always full of cars.

When we think like that, public parking lot that there are always many guests does not have to communicate with empty public parking lot, and they also do not want to send their customers to another parking lot. And the baseball field and parking lot may be used in off day, but it is difficult to link with parking situation notify communication network because they mostly have games.

Thus, this study has limit that it could not analyze various parking lot data besides Seoul public data. In the future, as it grafts other data besides Seoul public data constantly, more and more efficient big data analysis is demanded, and as it modifies and lacked part and plan to it, so it seems that it needs to make more organic.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study of Impact on the Customers Psychological Reaction and Continuous Intended Use in Accordance with Lock-In Strategy of the Smart Mobile Devices

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Abstract---

Objectives: The overall research strategy for smart-phone/pads locking effect of the emotional response and the impact on loyalty and continued use affects the test results that the terms and conditions and loyalty programs this app reactions emotional response information services.

Methods/Statistical analysis: The smart-phone loyalty programs affect only cognitive effects appear to be small emotional reactions depending on the attitude also the impact was not uniform locking strategy without the other. In addition, as a psychological reaction of cognitive reactions and emotional responses to loyalty even in a positive impact on the continued use also showed that only affects cognitive responses.

Findings: The smart mobile devices lock-in also continued loyalty and loyalty programs in the use of these terms and loyalty and continued use in accordance with the strategy a positive influence.

Improvements/Applications: Which existing smart-phone in use several options contract assumes the implementation of various agreements in the form of by providing each customer loyalty programs can be evaluated as to the actual level that is utilized to support the long-term incentive deals.

Keywords--- Smart Mobile Devices, Internet of Things, Cognitive Responses, Emotional Reactions, Continue to use Intention, Social Networking Services.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Recently, Internet, Mobile Web, consumers have been widespread consumption of real value to the consumer, including information obtained through experience, looking for a new experience to enjoy is the desire grows even find your own personality style generic private Consumer psychology as the spread preferences of consumers and lifestyle over the internet of things(IoT), expectations, values, feelings are more important, such as the study of subjective area[1].

In this paper, we have smart-phones and pads are called smart mobile devices. Revealing the acceptance process, even as it reflects the real user rather than consumer services that focus on putting the emphasis on systems in increasing measure the performance of information systems in the field of consumer behavior studies[2,3,7].But so far advanced technology acceptance model (TAM).

In the studies, carried out in terms of the validity of the existing technology acceptance model every time a new information technology has emerged[3], to find out that presents an extended TAM new external variables related to information technology, and to verify this direction[4]. In particular, studies on the smartphone-related research are also adopting smart-phone rationalism is as mainstream the use of diverse applications now access the user's view of the situation that the lower technical services and features are still lack-in[4].

Knowledge can be formed through a short period of training or education; psychological and emotional factors, attitudes and reactions are generated starting from mindfulness to reflect the experience of history innate attributes[5]. If the mobile handheld terminal always carry with In view of the degree of reaction and used in accordance with the psychological attitude becomes important, and will be required for this study.

In this study, the purpose of the present study than locking customers in the use of smart-mobile devices (smart-phone) for an extended time strategy proposes a user's mental attitude and its implications revealed the Influence of continuous use for smart-phone, pads as mobile convergence products have.

II. RESEARCH STRATEGY BASED ON RELATED WORK

A. Acceptance of New Media Theory and Mobile Information Service Factor

A method for the acceptance of new media theory and mobile information service factor will be evaluated through the existing literature. First, we introduce a method called TAM. TAM is to develop the factors affecting the diffusion of innovation diffusion theory presented by Rogers saw the perceived usefulness and ease of use as a decisive factor in the innovation adoption[3,4]. The use of specific technologies or systems perceived usefulness is that it would improve the performance of individuals refers to the extent to believe. This Rogers[6]relative advantage that is similar to the concept of the proposed innovation, new technology that uses a person's physical and mental effort is a complexity similar to the theory of innovation diffusion factors proposed by Rogers believes the less. The person receiving the recognition it will be used more innovative technologies by adopting the new technology products useful to them, and as they perceive themselves without a great effort to use such technology more likely to accept innovations will have. TAM focuses on predicting the behavior patterns of users of the acceptance of innovation products based on human rational action theory[3].As such, information technology acceptance model provides a useful framework for the adoption and use of technological innovations (products) through perceived usefulness and ease of use to help such factors[7]. However, acceptance of new technologies is not intended to be determined by the availability and ease of recognition for technical innovation, system innovation, quality and the same technical characteristics of the technology itself, the user perception of value innovations (products), perception of the user supported service, education and training, is influenced by various factors, such as whether the use of others[9,11].

B. Lock-in Strategy

Many companies are utilizing the various strategies in order to attract more customers early after new product launches. One of the strategies typically use a lot of technology is in its locking strategy. Lock-in as follows: Looking at the specific method for locking a market perspective.First, the strategies being used are

the easiest first lock-in by contract. This is a way to prevent customers from switching to other products, such as trade agreement that sets out the duties and compensation of an exclusive relationship and its breach of a certain period of time.

This method is a very institutional, legal costs, and can act as a coercive conversion contract is terminated hold the downside is that it can increase rather than decrease, depending on the transition probabilities, but that is one of the most widely used strategy in the initial stable customer base side[8].

Secondly, the lock-in tactics is a way to increase the dependence on its customers by inducing a large initial investment. In this case, the company can raise admission and complementary services, after-sales revenue over the subsequent massive sales of such upgrades. But this tactic also switching costs over time due to aging[9,10], such as durable goods is that the shortcomings of the initial investment reduced. In particular, technological progress is rapid industrial obsolescence and subsequent depreciation can be quickly made.

In order to minimize these effects by actively promoting the cross-selling of complementary prevent the whole system should also make it difficult to switch to aging due to the engagement of multiple products. The same process is locking the customer's point of view to exert the highly effective when proceeding in the following three steps[11,12].

The First stage is that the investment is actively made to ensure the customer is the first step. In particular, the market should expand its customer base to mobilize all the various means if entered a growth phase, where the customer base should be considering forming strategic mobilization event or events that can overwhelm a variety of competitive products, including alternative[13,15].

C. Psychological Reactions and Attitudes of Customers

Attitude towards the psychological reactions of consumers, how the behavior of consumers as to whether he recognized the customer sentiment is expressed by the novelty, surprise, sympathy, etc. that humans have internally. Large number of employees in the service receiving space, the higher the consumer willing may perceive as active in the service receiving space, when the arousal level is further increased influences the emotional reaction of the consumer.

An important factor in consumer behavior resulting nuclear family emotional attitude to the changes in society about was that higher education levels and changes in income that the higher the quality of life you want to enjoy a relaxing consumption itself is changing. Also feeling the emotions of consumers as internal feelings of consumers before a purchase as an important part when the former decision to purchase a product, and that the role of purchasing behavior based on purchase decisions. Also were called to action more important in brand assets to meet customer expectations with emotion and enterprise customers were satisfied that the top priority should work takes a behavioral attitude.

Taken as a whole, when the psychological reactions of customers as a consumer perspective, consumers are psychological attitude is formed on any subject as an individual act of will and belief in the future, which means the subjective psychological state of the individual[13,14]. Has the property according to the reaction.

Therefore, the psychological reactions and factors affecting the attitude of consumers as well as cognitive and emotional factors and co-factors when these factors are affecting the mutual coupling has a substantial component of customer loyalty and long-term sustainable use of attitude formation, such as in that it affects reaction customer behavior study to be measured and also to reflect the factors to elucidate the relationship according to these properties.

D. Study on the Sustainable Use of Information Technology

Information systems in the field of research related to the continued use is expected to the study of factors affecting the degree of user satisfaction. And continued use for online banking based on the theory of continued disagreement with the use of a couple of TAM has developed a model to explain whether and late acceptance can be said to have been started in earnest after by conducting research to demonstrate empirically.

In this model, the conventional expectations and post to remove the pre-release expectations in the notion of inconsistency pointed out problems in the theory of 'expectation' was conducted focusing on the post-expectations. In addition, the perceived usefulness has been used frequently in the information systems field as a concept for the post-expectancy, by modifying the dependent variable, the concept of repurchase intention also developed a model of sustainable use. They were added to the output expectations and Internet self-efficacy in models with social cognitive theory. Through these related studies, we are expected to expand the study on the mismatch theory of existing research, and social recognition based on this theory has studied a model to explain the extent of continued use.If you want to reduce the associated increase customer loyalty and customer 5% bounce rate of 5%, according to empirical studies have therefore the sector 25 to bring a profit of 85% the same height as the end customer savings of 2% cost reduction is 10% bounce rate it has been reported to be effective.

The costs incurred to acquire new customers in the competitive realities are being intensified between companies and is five times more common than to keep an existing customer. As shown in previous studies to examine smart mobile devices early expansion causal model based on the acceptance by the TAM process and, most studies to verify it in the least, a study on the initial acceptance and constitute the main, action after acceptance study on the relatively small. Latest smart-mobile devices over the stage to accept the product repurchase, repeat purchases, so you can see it is happening continuously acceptance and diffusion behavior at step after acceptance is very important. In particular, products such as smart phone and rapid diffusion behavior after the acceptance and smooth communication with the advantage of ease of use and real-time delivery can move contributed to the spreading use of social network services (SNS) is an essential requirement[10,11,13,14].

In this paper, we employ a lot of people use it if the current smart-mobile operating system(IOS and Android etc.) of the factors on the degree of continued use of smart-phone to bring a change in the mobile digital convergence smart-mobile devices that is to spread and vary depending on the function you must be verified.

III. RESULTS AND DISCUSSIONS

A. Framework of Analysis (Research Model)

This paper is an extended technology acceptance model for the current smart-mobile operating system use of product information. Locking characteristics based on the Technology Acceptance Model and the psychological reactions and continuous use and to explore. These models went through a lot of changes and modifications, based on previous studies since first published in 1995, there are now a variety of models. In this study, by combining the extended TAM on the basis of the expected mismatch theory's user lock-in accordance with the smart-mobile device product information is reported as leading to the degree of psychological response variable and continuous use, technology, informational interview, operational gender, institutional lock-in strategy as a company to perform gender perspective in strategy was constructed to affect the degree of use of the customer's psychological reaction and continued use. As follows is show in figure 1, shows the conceptual research model of this study.

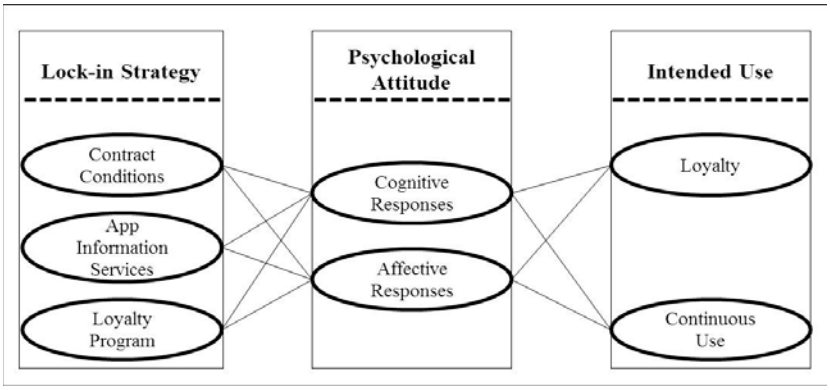

Figure 1: Framework of Analysis (Research Model)

B. Establish Hypothesis

Locking of smart-phone users is influenced by the information factors, user factors, legal and institutional factors in the social aspects of the product service. First information means that the characteristic factors are evaluated for product quality, quality information, and quality of service.

Factors other users is shown in accordance with individual characteristics of the end-user to use the new technologies and new services availability and familiarity with the individual use of the device.

Finally, the social characteristics factors are affected by others' opinions, information and action that increases when the effect of social influence and social characteristics of individual perception of the influence of social interaction.

Such services are typically locking in a racist affect the customer's mental attitude is so satisfying to appear for the personal use of application services.

Thus one is less recognizable anxiety for service than others, is the hypothesis was set because trust is formed will have a degree conforming to the theoretical basis of the following long-term continuous use.

H1: Smart-phone Locking Strategy is to have a Positive Effect on Cognitive Responses

H1-1: smart-phone purchase agreement will have a positive effect on cognitive responses.

H1-2: smart-phone app information service will have a positive effect on cognitive responses.

H1-3: smart-phone loyalty program will have a positive effect on cognitive responses.

H1-4: smart-phone agreement will have a positive effect on emotional reactions.

H1-5: smart-phone app information service will have a positive effect on emotional responses.

H1-6: smart-phone loyalty program will have a positive effect on emotional responses.

H2: Psychological Reaction will have a Positive Effect on the Loyalty and also Continuously Used

H2-1: emotional response will have a positive effect on loyalty.

H2-2: cognitive reaction will have a positive effect on road of continuous use.

H3: Mental Attitude will have a Mediating Effect on the Relationship between the Lock-in Strategy and Continued Use

H3-1: mental attitude will have a mediating effect on the terms and loyalty.

H3-2: mental attitude will have a mediating effect on the App Information Services and loyalty.

H3-3: mental attitude will have a mediating effect on loyalty programs and loyalty.

H3-4: mental attitude will have a mediating effect on the terms and conditions and continuous use.

H3-5: mental attitude will have a mediating effect on the continued use information services and apps.

H3-6: mental attitude will have a mediating effect on loyalty programs with continued use.

C. Subject to Investigation and Method (Tools)

For the analysis of the data collected, estimate, assess, and present models to show hypothesized relationship among variables for this study were used two statistical package of SPSS 21.0(Statistical Package for the Social Sciences version 21.0) and Amos 21.0 program for PC.Data analysis was performed with a first frequency analysis to determine the reliability of the sample characteristics were analyzed using factor analysis and Cronbach's ‘α’ coefficients for validity and reliability for measuring tools. In addition to the correlation analysis is performed to determine the relationship between the variables included in the analysis. And using Amos21.0 program to analyze the previously presented research model was applied to structural equation modeling analysis .Investigation period of the survey is from September17th(Saturday), 2016 to October16th(Sunday), 2016 were up over the course of 30 days. Response of the data was done through self-how to fill the respondents directly. It is found that in Seoul, smart mobile devices(smart-phone, pad) users surveyed are from the 20s to the 50s after each arrangement of each age group for a total of 300 features collected through questionnaire were distributed as seen in table 1.

Table 1: Configuration and Research Sample of the Population

Investigation Object	Sex (Male: 150, Female: 150)
Investigation Period	From September 17th(Saturday), 2016 to October 16th(Sunday), 2016: 30 days
Sampling Method	Convenience sampling methods
Empirical Method	Questionnaire : 300 copies

IV. CONCLUSION

The results obtained through this study is generally characteristic of the subjects is shown in the table 2male gender analysis 150 people (50.0%), 150 people showed up to the girls (50.0%), 166 people 20 years of age (55.3%), 30 58 (19.3%), 40 52 patients (17.3%), was more than 50 in 24 patients (8.0%). In addition, the final high school education or less 65 people (21.7%), more than 180 people graduated from colleges (60.0%), 45 employees or less graduation (15.0%) appeared to graduate at least 10 people (3.3%).The following table 2 shows the general characteristics of each entity.

Table 2: General Characteristics of each Entity

Entity Classification		Frequency	Percent (%)
Sex	Male	150	50.0
	Female	150	50.0
Age	20s	166	55.3
	30s	58	19.3
	40s	52	17.3
	Over 50s	24	8.0
Highest Level	Less High School	65	21.7
	Less College Education	180	60.0
	Less University Education	45	15.0
	Less Graduate School E ducation	10	3.3

In the overall study, locking strategy of smart mobile devices(smart-phone, pad) and loyalty and emotional response to the ongoing impact on even terms and conditions of use, test results and loyalty programs can influence cognitive and emotional responses and reactions impact on the application information services loyalty program appears to affect only the cognitive, emotional reactions influence attitudes also appear differently depending on the lock-in strategy, but it was found that it is not uniform.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Quality of Service Framework for Supporting Next Generation Mobile Services

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Abstract---

Background/Objectives: Wireless and cellular networking technologies as well as the corresponding mobile devices have evolved significantly over the past few years. Hence their use in future internet services such as mobile cloud computing, high performance mobile computing, 3D imaging and hologram service, the Internet of Things and other real-time services has emerged as a key area of research.

Methods/Statistical analysis: Such applications involve the processing and dissemination of a large amount of data among the mobile users. Therefore, to support such applications, a high throughput, low latency, reliable network with low packet loss rates is needed. As mobile data traffic has been increasing rapidly, serving such applications with stringent QoS requirements is a challenging task.

Findings: Therefore there is a need for strict QoS guarantees to efficiently support such applications over existing wireless networks. Such applications not only require ultra high data transfer speeds and low latency, but also seamless connectivity across multiple devices as well as high reliability and fault tolerance. There is also a need for flexible, QoS-based pricing as this can directly influence user behavior and so be used to manage resources more efficiently.

Improvements/Applications: In this paper we discuss various requirements and challenges for ensuring QoS for supporting advanced mobile applications and services over existing wireless networks. We also propose a QoS framework for supporting these services over existing and future wireless networks and briefly discuss how it can be implemented using dynamic pricing, admission control, congestion control and optimal resource allocation.

Keywords--- QoS, Mobile Cloud Computing, High Performance Computing, Pricing, Cellular Networks.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Wireless networks have evolved to support resource intensive applications such as interactive multimedia and video streaming as well as traditional services such as email, web and voice, over the same network infrastructure. The number of mobile devices and the overall mobile data traffic has been increasing exponentially over the past few years and it is expected to increase even more rapidly in the future[1]. The total mobile data traffic is expected to increase up to 30.6 exabytes per month by 2020. The main contributing factors include advancement in network technologies capable of providing high data rates and QoS guarantees, affordability of smart mobile devices including cell phones, tablets, etc., and the introduction of advanced data intensive applications. The cellular networks have been evolving providing higher performance and capabilities when compared to first and second generation networks. The Third Generation of wireless networks (3G) had been optimized to enable better connectivity and mobile broadband services. The Fourth Generation Networks (4G), including LTE and LTE-A is further capable of providing more capacity and higher data speeds for enhanced mobile broadband experience. The future Fifth Generation wireless systems (5G) will futher revolutionize mobile communications. It is not only focused on enhancing the mobile broadband experience (higher capacity and data rates), but also on providing low latency, high reliability and massive machine to machine (M2M) communications[2].

Hence the use of advanced wireless mobile networks and mobile devices in future internet frameworks such as mobile cloud computing, high performance mobile computing, 3D imaging and hologram service, Internet of Things (IoT), and other real-time services has emerged as a key area of research interest. Such applications are characterized by high processing power, data intensive computations, high data storage and access rates, high data transfer speeds, reliability and accuracy.

Hence, for supporting advanced applications that require stringent QoS requirements over existing wireless mobile networks there is a need for a QoS-based framework, and dynamic pricing plans based on it, to maximize resource utilization while providing high user satisfaction. In this paper we discuss various requirements and challenges for ensuring QoS for supporting advanced mobile applications and services. In addition, we discuss how proper charging and resource allocation can be used to balance between resource consumption and the QoS provided. The paper is organized as follows: Section 2 describes some advanced mobile applications and their QoS requirements; Section 3 provides a brief overview of the QoS framework and discuss how QoS requirements of different services can be satisfied, followed by the conclusion and acknowledgement in Section 4 and 5 respectively.

II. ADVANCED MOBILE SERVICES

Due to the evolution of wireless technologies, many revolutionary applications and services will be developed for mobile devices in the next few years. These applications will combine the benefits of smart mobile devices with high computation power and memory, and advanced networks such as 5G. Some of the potential applications and their QoS requirements are discussed below:

Mobile Cloud Computing (MCC)

Cloud computing enables on-demand access to a number of computing and storage resources provisioned as a service to the end users. Cloud eco-systems have become a popular choice for scientific research collaborations where cloud services can be deployed by different service providers, at distributed locations, using different middleware software stacks thereby creating a heterogeneous eco-system. MCC integrates cloud computing and mobile computing, and hence it is important to overcome various challenges related to the environment (e.g., scalability, availability, heterogeneity) and performance (e.g., throughput and delay constraints, etc.). Hence network performance and QoS assurance plays a vital role in MCC. A lot of work has been done to enhance the performance and efficiency of dedicated cloud networks and collaborative research networks [3] in order to meet the demands of large scale resource intensive cloud applications. However, due to a rapid increase in the adoption and use of mobile devices, provisioning stringent QoS for supporting MCC over existing wireless mobile networks is still a challenging issue.

High Performance Computing on Mobile

High performance computing over mobile devices involves the integration of advanced wireless networks, smart mobile devices with high computational power, and advanced applications and services. Mobile devices

offer high computational capabilities, including processing power, memory, energy efficiency, at relatively low cost. Hence they have become a popular choice for accessing HPC facilities even when users are mobile. Many firms, including Intel and NVIDIA [4], have been focusing on the optimization of mobile platforms for supporting advanced mobile services. In addition, some applications have also been developed to access HPC facilities via mobile devices[5]. From the mobile communication aspect, a high level of QoS support (high throughput and reliability with low latency) is needed to support data intensive workloads of HPC applications including parallel processing. Significant work has been done to optimize the performance of HPC cluster networks and data-centres but supporting such applications over mobile devices is still a challenging issue. Exisiting 3G and 4G networks and the future 5G networks are capable of provisioning high data rates and increased capacity and hence have the capability of supporting such HPC services. However, there is a need for an adaptive QoS framework[6] to overcome the challenges imposed by the intrinsic properties of mobile networks including interference, channel fading, mobility, etc.

3D Imaging and Hologram Service

Existing 3G and 4G networks are already capable of supporting high definition (HD) video calls and voice calls over LTE (VoLTE). In the next few years services such as 4K-UHD and 8K-UHD, offering 4 times and 8 times the resolution of full HD respectively, as well as 3D imaging and holograms will be available over mobile devices. With the ultra-high capacity, reliability and ultra-low latency that the future 5G networks are expected to provide, supporting such mobile applications will become possible. However, such applications have stringent QoS requirements. For instance, 3D holograms require huge bandwidths [7], and even its low bandwidth alternatives such as super multi-view stereoscopic images and computer generated holograms, will impose strict QoS constraints on the underlying network. According to the projection by IBM [8], cell phones and other mobile devices will be capable of providing 3D holograms, and 3D video telephony in real-time in next five years. For example, a real-time 3D hologram of a person or object, projected from the surface of the mobile devices. This will consume a large amount of bandwidth and a 3D moving image will further increase the amount of data required.

Internet of Things (IoT):

The Internet of Things can be defined as a network of physical objects with embedded communication capabilities and other features such as sensors, etc., enabling them to sense information and to interact with other objects and the environment. These objects range from simple devices such as cell phones, headphones, household machines (washing machine, microwave, coffee maker, etc.), wearable devices etc., to more complex ones such as monitoring sensors implanted in human bodies, automobile sensors, etc. Currently, IoT is being applied in many applications such as smart homes, smart cities, smart grids, traffic management, connected health, etc. In the future, when massive connectivity will be possible through the 5G infrastructure, IoT can be applied to other areas such as video surveillance, remote monitoring and control, etc. Such applications require massive connectivity and, although throughputs tend to be relatively small, the signalling required to support potentially billions of devices will be challenging. So in this case the signalling network infrastructure will be of concern.

Remote Surgical Procedures

Another potential application is the use of teleoperation in the field of medicine[9]. By using this technology, the surgeons can perform specialised medical surgeries and procedures remotely. This allows the experts to apply their expert knowledge remotely, without the need for on-site presence at the time of surgeries. The experts can see the images of the patient and remotely control the robot through their computer. Although such applications are still in their nascent state, their widespread use is expected with the advancement of technology and the communication networks. In addition, sensory information and arifical intelligence can further help to enhance the quality and precision of the remote operations. In order to carry on the remote operations accurately, there is a need of a high quality communication connectivity between the remote control station and the machines being operated. The current solutions either make the use of wired connections of wi-fi to implrmrnt the last hop of the communication link. Although these provide low latency and higher reliability, the cost of installation and maintainance is high. Hence, the cellular networks offer a number of benefits in terms of wider coverage and low cost of installation and management. However, such

applications require low latenct and jitter with minimum bit rate guarantee. These applications involve HD video transmission and haptic interactions and hence such links require low latency and low jitter , while some packet loss can still be tolerated.

Other Applications

Some of the other applications include autonomous driving (vehicle to vehicle communication), industrial applications such as remotely controlling industrial operations using teleoperation, large scale immersive virtual reality services, big-data based intelligent services, etc.

III. QoS Framework

In this section, we describe, in brief, the QoS-based scheduling framework and discuss how QoS constraints for different applications can be satisfied. Note that we only focus on the bearer channels (i.e. the connections for the actual data) and not on the signalling aspects. However, as we noted above, some applications such as those for IoT, will require improvements in the Signalling aspects of the wireless network. As discussed in the previous section, advanced mobile applications have stringent QoS requirements. Hence there is need of an adaptive QoS control framework to ensure that the stringent QoS requirements of such applications are satisfied.

If we consider the shared resource allocation problem, as defined in[10], the utility function can be defined in terms of one or more QoS parameters such as throughput, latency, etc. The utility function can be defined in terms of throughput as follow:

$$maximize \quad F(\vec{r}) \equiv \sum_{i=1}^{k} (UT_i(r_i) \tag{1}$$

$$subject\ to \quad \sum_{i=1}^{k} r_i < C \tag{2}$$

$$and \quad r_i \geq rmin_i \tag{3}$$

$$over \quad r_i \geq 0,\ 1 \leq i \leq k. \tag{4}$$

where,

k = the number of active users competing for the channel,

$UT_i(r_i)$ = Utility function of user i experiencing an average throughput r_i ,

C = the total channel capacity,

$rmin_i$ = the minimum throughput for user i ,

Since the cellular networks are dynamic in nature in terms of varying channel conditions, user mobility, intereference, channel fading, etc., the optimal solution can be found using the dual ascent method. If we consider the utility function as a linear function of the average throughput r, then it can be defined as

$$U(r) = \alpha r \tag{5}$$

for some constant α.

In this case, the scheduler will pick the user with the maximum achievable bit rate. This results in an increased average sector throughput, however there is no consideration given to QoS and fairness. Now let us consider the traditional proportional fair algorithm (Describe what this is in more detail), In this case the Utility function can be defined in terms of throughput r as

$$U(r) = \log(r) \tag{6}$$

Here some degree of fairness is ensured as the users in bad radio conditions are also served when their throughput drops significantly. However, this comes at the cost of reduced sector throughput. Hence, the utility function should be defined to guarantee the QoS as per the application requirements. One way of doing this is by including some Barrier function with the utility function[11]. Barrier functions can help to penalize the movement into areas where the QoS constraint is violated.

For instance, the QoS demands of high performance mobile computing will impose throughput, delay, jitter and Packet Loss Rate (PLR) constraints on the underlying wireless networks. Hence there is a need to provide QoS guarantees for each such parameter. In the case of throughput and delay, the utility functions can be defined using the concept of a barrier function to enforce various constraints and the PLR can be maintained by using the Hybrid Automatic Repeat Request (H-ARQ) retransmission mechanism. H-ARQ is a combination of the automatic repeat request error control mechanism and the high-rate forward error correction coding. If a transferred block is received correctly, an ACK is sent. If no ACK is received or a NACK is received, then the transmitted block will be sent again. Two commonly used methods of H-ARQ for high speed data networks include chase combining and incremental redundancy.

For throughput, a lower bound on the achieved throughout (r_{min}) is required, and hence, a suitable Barrier function can be chosen such that the priority function value increases rapidly as the throughput approaches the minimum throughout threshold. Similarly Barrier functions can be defined in terms of delay such that the priority function increases rapidly as the delay approaches the maximum delay threshold[11]. Similarly, suitable barrier functions can be defined for different QoS constraints to guarantee QoS depending on the application requirements, as shown in Figure1. Advanced mobile services and applications can be classified based on the QoS constraints that are critical for each of them.

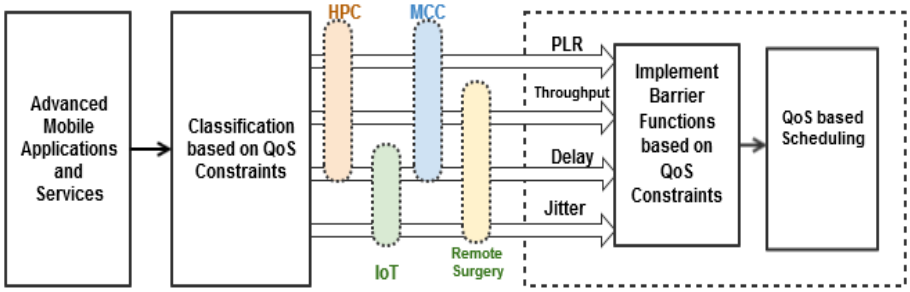

Figure 1: QoS Based Scheduling Framework

QoS-Aware Pricing

In the previous section we described the QoS framework and discussed how the constraints on different performance attributes can be satisfied for supporting advanced mobile applications and services over existing mobile networks. As pricing is an important part of the QoS control framework, we now discuss how proper pricing can be used to maintain a balance between user quality requirements, service efficiency and operator revenue.

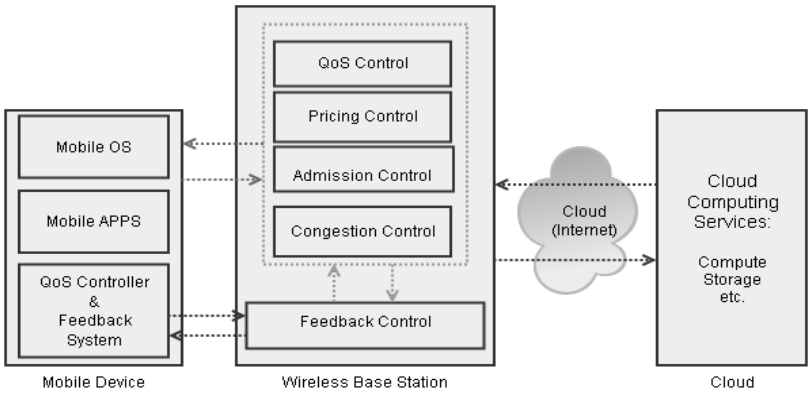

Figure 2: QoS Framework for High Performance Mobile Computing

We propose the use of tiered data plans, integrated with appropriate congestion management and admission control. We propose various data plans: A gold plan devised for advanced application users, and

silver (QoS based) and bronze (best-effort) plans for normal users. The per bit price charged will be higher for the QoS plan as compared to the best effort plan, and the total price paid will depend on the QoS level as well as the monthly data cap.

In the case of the gold plan subscribers, high QoS (high throughput, low delay and jitter, and low PLR, depending on the application requirements) can be guaranteed, along with a high data allowance. In this case, there will be strict QoS guarantees and hence a higher cost per bit. When the monthly data cap is exhausted, the user can still achieve high QoS but will be charged an even higher cost per bit.

Apart from the differential pricing as described above, management of QoS in the case of congestion must also be addressed. Different congestion detection mechanisms can be used to monitor the load on the network. For instance, as proposed in[12], the average value of the priority over all users, (i.e., the average utility function gradient) can be calculated to estimate the current network load. If this exceeds some threshold then various actions can be taken (e.g., block new connection requests or reduce QoS constraints etc.). In addition, to avoid excessive charges when a user is not using a high performance computing application, they can switch to a lower QoS level on demand.

Next we provide an example of how the QoS based scheduling and pricing frameworks can be integrated to satisfy the QoS requirements of the advanced application users while optimizing the operator's revenue. The QoS control framework for Mobile Cloud Computing application and its various components are shown in Figure 2.

The QoS controller and feedback system provide the QoS information to the wireless base station at periodic intervals of time. The feedback controller at the base station collects the information received from various mobile nodes, analyzes the QoS information, and passes it on to the QoS control functions for dynamically adjusting the resources in order to meet the QoS requirements of the connections.

IV. CONCLUSION

Due to the evolution of wireless data networks, there has been an increasing demand for better Quality of Service and performance. Hence there is a need for network operators to adopt dynamic QoS and pricing strategies in order to support high performance mobile computing workloads. Such applications not only require ultra high data transfer speeds and low latency, but also seamless connectivity across multiple devices, reliability and fault tolerance. In this paper, we discussed various requirements and challenges and proposed a framework for addressing these requirements. The proposed method helps the network operator to manage the network resources more efficiently while maintaining a balance between user quality requirements and operator revenue. In addition, by providing features such as dynamic quality variation, the approach allows the end user to use the network services in a more flexible manner.

ACKNOWLEDGEMENT

This work has been supported by the research projects: Computational Engineering Advanced Research (K-17-L01-C02-S04) of Korea Institute of Science and Technology Information (KISTI), Daejeon, Korea.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Image Object Segmentation Using Various Weights in Each Pixel

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Abstract---

Background/Objectives: In object segmentation, extract object more clearly is important issue in various image processing using object. In this paper, we proposed object segmentation using a clustering technique with multiple color space weights for improve object segmentation.

Methods/Statistical analysis: First, the process of estimate approximate color position each pixels was carried out using LAB color values to extract a cluster sample group to be used in the clustering process from the image. Then, color clustering based on local means was used with the three primary colors, LAB. Then saliency map was created based on the LAB color space for targeting main object and adaptive multi-layer threshold was performed.

Findings: The conventional clustering-based K-means and Mean Shift Segmentation generated unnecessary segmentations or objects. They were divided and perceived as the same objects. However, the proposed method minimized unnecessary segmentations because only the areas with salient differences were segmented, which produced improved object segmentation results because only objects that needed to be distinguished were selectively segmented. For numerical comparison of the experiment results, the segmentation boundary values of the Ground Truth image and the F-measure as well as the Precision-Recall values of boundaries of the existing methods and the proposed method were calculated and compared.

Improvements/Applications: This improved segmentation method will be utilized in object tracking, object recognition.

Keywords--- Object Segmentation, Clustering, K-Means, Mean Shift Segmentation, Saliency Map.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Ongoing research aims at more accurate and faster processing results with the gradually expanding application of image processing techniques. The information required in each application area differs, but the method of accurately separating and extracting only the essential data needed to approach the forms recognized by people with the corresponding purpose is an indispensable element. This process is defined as image object segmentation, and the diagnosis of disease, motion detection and identification tasks can be performed through an analysis of medical images or images acquired from CCTVs and traffic network analysis. Image object segmentation is a key issue in image analysis and computer vision areas. However, it is a complex and difficult process to accurately extract objects regardless of the image composition. Various approaches are required instead of a simple process to distinguish objects because images have various colors and textures. There are several methods that have been developed studies have been conducted to improve object segmentation. Representative methods include object segmentation based on graph cuts (ex. grabcut and normalized cut) and region segmentation-based methods (ex. clustering based algorithm and mean shift) [1, 2, 3, 4, 5]. However, existing methods are highly dependent on color values because they use color value differences. Furthermore, due to vague differentiation criteria for similar colors, objects that need to be divided are grouped together and perceived as same objects or objects that need to be perceived as identical are divided. Therefore, getting more improved segment methods to divide objects are researched based on the visual selective attention of people[6]. Therefore, in this study, to improve the simple color-based object segmentation method, a estimate approximate colorposition of each pixel comprising an image was extracted. Pixels were grouped by analyzing their similarity and locations and color-based weights were generated. A saliency map was created and each region was divided by multi-layer thresholds to divide objects based on the differences in visual effects. Then the forms of some lost objects were restored by hole-filling and the results were used as weights considering brightness and visual attention. Thus, an object segmentation method using multiple weights was proposed.

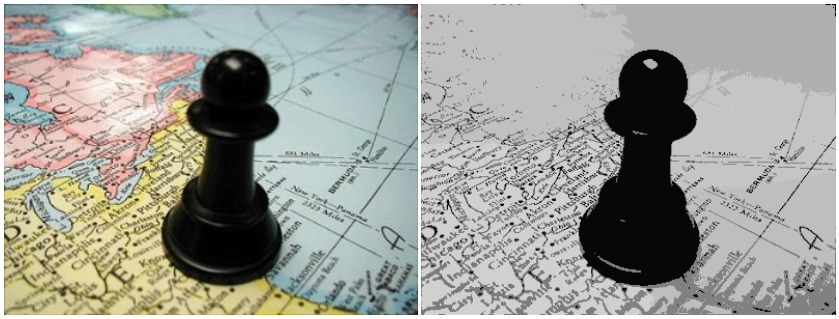
II. RELATED WORK

A. Existing Region Segmentation Algorithms

K-Means Clustering

The K-means algorithm groups given data by K members allocates K center points to the data region, and repeatedly performs the process of assigning each data to a center point group by judging how similar it is to the center point until the center point group of each data is unchanged[7, 8].

This method has disadvantages, since K values must be input, the results are sharply divided depending on the input K value, and the data groups cannot be divided accurately unless the data distribution is spherical. For images, unnecessary segmentations inside a background or an object may occur depending on the number of K, or the background and objects may be perceived as the same group. An example of K-means clustering with the original image and segmented image is shown in Figure 1.



(a) (b)

Figure 1: K-means Clustering. (a) Original Image; (b) Result Image

Mean Shift Segmentation

The Mean Shift Segmentation algorithm groups generated data after calculating the similar color density for a certain range of area and repeatedly performs color density calculation for a certain range of area from the mean position of the grouped data. Thus, the mean position of each group converges to the point of

maximum data density[9]. This method has the advantage of flexible results unlike the aforementioned K-means, which requires input values and should have the number of segment result by input values. However, this method also has disadvantages of long processing time and data grouping based on similar color and brightness data as in the object segmentation. Furthermore, a specific range of area may not be grouped and the grouping results may be unnecessarily large depending on the image data composition. An example of Mean Shift Segmentation with the original image and the result image is shown in Figure 2.

(a) (b)

Figure 2: Mean Shift Segmentation.(a) Original image, (b) Result image.

B. Saliency Map

Saliency map generates information to be applied to the computer image processing area based on selective attention, which is a psychological phenomenon of people who only focuses on specific area of interest in certain information while ignoring other information. As a result of selective attention, only specific objects may be expressed or unnecessary or uninteresting objects are excluded. Several studies are conducted to apply this characteristic to various image processing areas including object segmentation. Saliency map was first presented by Ullman and Koch[10], and various studies to create a saliency map in various methods were conducted, such as nonlinear saliency area estimation method, conspicuity map with the application of multiple weights, local contrast, graph normalization, log-spectrum analysis[11,12, 13, 14]. Most methods until now had problems such as low-resolution output and unnecessary area perception, but considerable advancement has been made through continuous research. However, it is difficult to develop effective and efficient algorithms to similar of human perception.

III. PROPOSED WORK

The algorithm proposed in this study creates a saliency map that infers weights and human visual characteristics as a result of color-based clustering. To solve the problems that can result from the existing segmentation algorithms, a preceding task for improving the clustering process was introduced, and modification was made to make the clustering results flexible for image processing. Furthermore, a separate saliency map was created and applied as weights for object-centered segmentation, in order to obtain improved final output. The flowchart of the proposed method is shown in Figure 3.

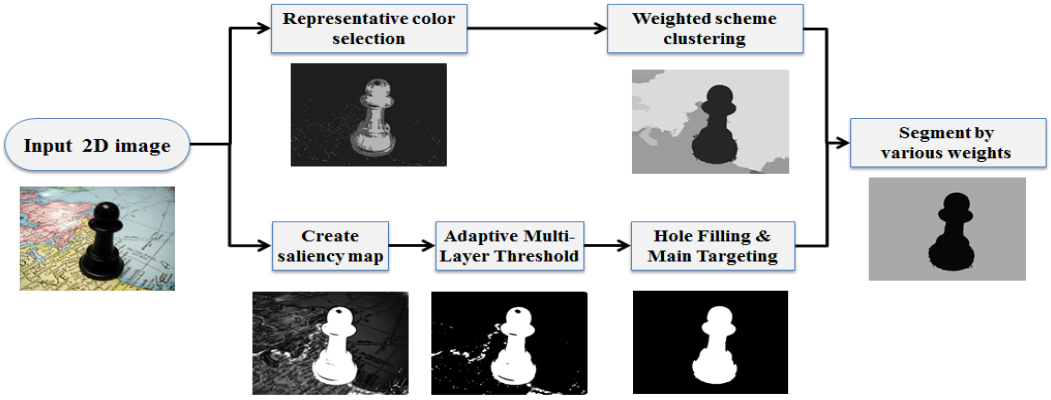


Figure 3: Flowchart of the Proposed Method

A. Color Clustering Based on Local Means Similarity

Estimate Approximate Color Position

Estimate approximate color position was performed to acquire image processing-centered result before clustering. This was performed as a preceding process to roughly specify groups to be used in the clustering process with the LAB values of images, considering that the colors of certain objects are similar. To create a estimate approximate color position result, the existing RGB color information was converted into LAB color space, which contains brightness information and has a shape similar to that of ganglion cells that are responsible for the color perception of human eye[15].

The following equation was used to convert RGB-to-LAB color space:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.412453 & 0.357580 & 0.180423 \\ 0.212671 & 0.715160 & 0.072169 \\ 0.019334 & 0.119193 & 0.950227 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$

$$\mathrm{L} = 116(\frac{\mathrm{Y}}{Y_n})^{\frac{1}{3}} - 16$$

$$\mathrm{A} = 500(\left(\frac{\mathrm{X}}{\mathrm{X_n}}\right)^{\frac{1}{3}} - \left(\frac{\mathrm{Y}}{\mathrm{Y_n}}\right)^{\frac{1}{3}}) \quad (2)$$

$$\mathrm{B} = 200(\left(\frac{\mathrm{Y}}{\mathrm{Y_n}}\right)^{\frac{1}{3}} - \left(\frac{\mathrm{Z}}{\mathrm{Z_n}}\right)^{\frac{1}{3}})$$

The pixel values were determined with the following equations.$P_{eac}\,(x, y)$is to analyze the values of the L, A, B channels at the location of each pixel simply evaluate the specific gravity of the brightness and color information, and by analyzing the ratio value and performs the pixel classification. Estimate approximate color position with the original image and the result image is shown in Figure 4.

$$\mathrm{P_{eac}}\,(\mathrm{x, y}) = \max\left(\mathrm{I_L}\,(\mathrm{x, y}), \mathrm{I_A}\,(\mathrm{x, y}), \mathrm{I_B}\,(\mathrm{x, y})\right) \quad (3)$$

$$\mathrm{I_{cp}}\,(\mathrm{x, y}) = \mathrm{if}\begin{cases} 1, \mathrm{P_{sel}}\,(\mathrm{x, y}) = \mathrm{I_L}\,(\mathrm{x, y}) \\ 2, \mathrm{P_{sel}}\,(\mathrm{x, y}) = \mathrm{I_A}\,(\mathrm{x, y}) \\ 3, \mathrm{P_{sel}}\,(\mathrm{x, y}) = \mathrm{I_B}\,(\mathrm{x, y}) \\ 0, \text{ otherwise} \end{cases} \quad (4)$$

(a) (b)

Figure 4: Estimate Approximate Color Position.(a) Original Image; (b) Result Image.

Local Mean Similarity-Based Clustering

The clustering process by LAB color values was performed after estimate approximate color position. The pre-determined pixels around the cluster group above were grouped based on the positions and similarity of surrounding pixels, so as to group the small data of isolated point data generated from the estimate approximate color position process. Boundaries were given for large color differences so that the differences in color properties could be differentiated despite similar colors.

The following equations were used for local mean similarity analysis. Pixel clustering result is shown in Figure 5.

$$\mathrm{P(x, y)} = \mathrm{I_{cp}}\,(\mathrm{x, y}) * \mathrm{abs}(\mathrm{L_{Avg}} - \mathrm{L(x, y)} + \mathrm{A_{Avg}} - \mathrm{A(x, y)} + \mathrm{B_{Avg}} - \mathrm{B(x, y)}) \quad (5)$$

$$I_{label}(x,y) = \begin{cases} k, & \text{if} \sum_{w=x-width/2}^{x+width/2} \sum_{h=y-height/2}^{y+height/2} \frac{P(w,h)}{width*height} > P(x,y) \\ k+1, & \text{otherwise} \end{cases} \quad (6)$$

(a) (b)

Figure 5: Pixel Clustering result. (a) Original Image (b) Result Image.

B. Additional Weights Based on Visual Attention

Creation of Saliency Map

A saliency map based on human visual attention was created to improve the color-based clustering result. Saliency map considers brightness information in addition to color, and is used to infer an area of object type with a specific pattern. To create a saliency map after the LAB color space conversion, the mean of the pixel values that each of the L, A, and B channel was inferred and compared with the pixel of each normalized channel. Then the estimated value for each channel to be used to create the saliency map was calculated and the application ratio weight was added so that specific projected areas can be selected based on human visual attention. The following equation was used to create saliency map:

$$S(x,y) = \left(L_{a\mu}(x,y) - L_{\mu}(x,y)\right)^2 * W_L + \left(a_{a\mu}(x,y) - a_{\mu}(x,y)\right)^2 * W_A + (b_{a\mu}(x,y) - b_{\mu}(x,y))^2 * W_B \quad (7)$$

Here, L_μ, a_μ, and b_μ denote the mean values of each channel, and $W_L, W_A, and\ W_B$ denote the application ratio weight to apply the estimated value in each channel. In this process, robust projected areas in the image were selected by creating a salience map that considers both brightness and color. The result of saliency map with the original image and the result image is shown in Figure 6.

(a) (b)

Figure 6: Saliency Map Result (a) Original Image; (b) Result Image

However, it is still difficult for use in object segmentation. Additional work is required to select objects and extract shapes from the image.

Adaptive Multi-Layered Threshold

The created saliency map goes through a thresholding process to leave only object-centered areas. The thresholding process generally has different results depending on the given threshold value. Furthermore, automatic setting of multiple threshold values must be considered, given the multiple objects in an image. Therefore, multi-layered thresholds were applied to obtain reliable like accuracy of the manual inputs and specified values in this thresholding process.

The total size and histogram distribution were analyzed to create a saliency map through adaptive multi-layered thresholds. The minimum size of a shape that can be distinguished as an object in the image was

defined and set as the reference for finding a mode in the histogram. For this found mode, a point with a large gradient of the histogram value to the direction of smaller value than this minimum value was used as the segmentation point. Then, the pixel values of the entire image were counted and the average of the pixel values of the image was determined. The median value between this average of pixel values and the segmentation point was defined as the threshold point for thresholding. Because each object in image has different saliency value between each object and each object need cover minimum area in a few difference value. Histogram of saliency map result image is shown in Figure 7 to explain this method.

The following equation (8) was used to calculate adaptive multi-layered threshold, where T_m was the Mth threshold value obtained from the mthmode value M_m, and V_{avg} was the average of all pixels in the image.

$$T_m = \begin{cases} (M_m + V_{avg})/2, & \text{If}(M_m > V_{avg}) \\ M_m - (M_m + V_{avg})/2, & \text{Otherwise} \end{cases} \quad (8)$$

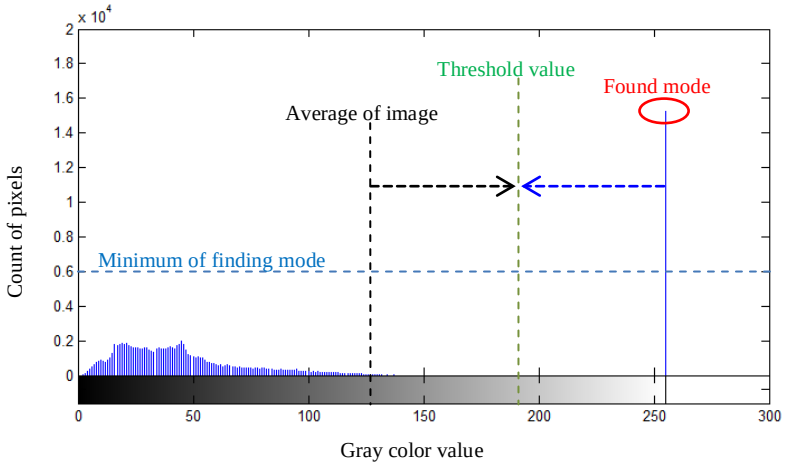


Figure 7: Histogram of Saliency Map Result Image

The threshold value created in this process was defined as the maximum pixel value in place of the maximum pixel value (ex. 255) of the image when the next threshold value is applied in case of multiple modes, and multi-layered thresholding. As a result of thresholding, salient areas of similar levels are extracted and the other areas are removed. The result image after applying adaptive multi-layered threshold to saliency map compared to the original image is shown in Figure 8.

(a) (b)

Figure 8: Adaptive Multi-Layered Threshold.(a) Original Image; (b) Result Image.

However, despite such thresholding process, accurate object forms may not be provided in the saliency map, or may be lost in the thresholding process, or only unnecessary noise-type data may remain. Therefore, hole filling and main targeting process is performed to obtain accurate object forms and remove noise data.

Hole Filling and Main Target Filtering

Hole filling is performed to obtain accurate object forms in case data loss occurred inside the objects or data acquisition was impossible. The typical hole filling process involves filling the inside area based on the outline. In this study, however, external objects on the boundary erode the internal objects and the areas are

perceived twice if the hole filling process is applied to multiple objects. Therefore, the hole filling direction is defined based on the position of outline for each object and the outline and object center that exist inside. Finally, noise data is filtered considering the minimum size of the objects, and variations of color and brightness inside the objects to create the final weight map based on visual attention. The result of hole filling with the thresholded image and the result image is shown in Figure 9.

(a) (b)

Figure 9: Hole Filling and Filtering (a) Original Image (b) Result Image.

The following equations were used to apply the weights generated above to the final object segmentation. Object segmentation results for each area with visual differences can be obtained by weighting multi-layer areas created in the multi-layered thresholding process on each area defined in the clustering process. MLC in Equation (9) is the total number of multiple segmentations acquired from the above multi-layered thresholding process.

$$I_{nC}(x,y) = \begin{cases} 1, \text{ if } I_{Label}(x,y) * S_{nC}(x,y) > 0 \\ 0, \text{ otherwise} \end{cases} \quad (9)$$

$$\text{Where, } nC = 1, 2, 3, \ldots, MLC$$

$$I_{Seg}(x,y) = \sum_{nC=1}^{MLC} I_{nC}(x,y) * \left(\frac{255}{MLC - nC}\right) \quad (10)$$

(a) (b)

Figure 10: Final Segmentation (a) Original Image; (b) Result image.

The final object segmentation result shows in Figure 10 that only the visually salient object was accurately extracted from a complex image.

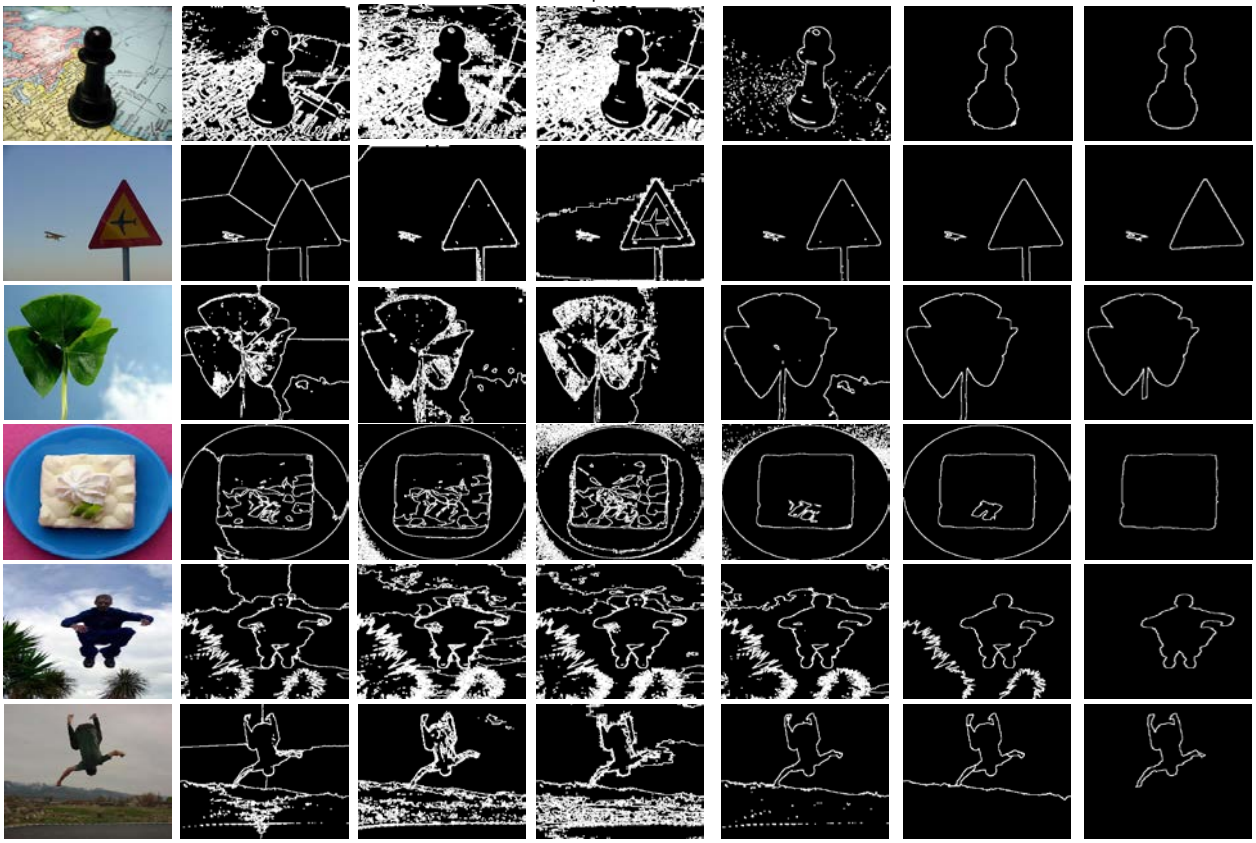
IV. EXPERIMENT AND DISCUSSION

For this experiment, the 1000 images from a previous study[16] were used to determine K-means, Adaptive K-means, Fuzzy C-means, and Mean Shift using the existing clustering algorithms and the proposed algorithm. We determined the value for F-measure. We also performed precision-recall for each image and extracted the average value from all dataset to quantitatively compare them. To compare each method to the groundtruth image, we extracted edges from segments of result images and analyzed the score by matching pixels from each method with ground truth for comparing each area in image were segmented more clearly. The following equations were used, where I_{comp} was the result of segment, I_{GT} was ground truth, and $N(f(x))$ was the number of pixels.

$$\text{Precision} = \frac{N(I_{comp} \cap I_{GT})}{N(I_{comp})} \quad (11)$$

$$\text{Recall} = \frac{N(I_{comp} \cap I_{GT})}{N(I_{GT})} \quad (12)$$

$$F - \text{Measure} = (1 + \beta^2) \cdot \frac{\text{Precision} \cdot \text{Recall}}{\beta^2 \cdot \text{Precision} + \text{Recall}} \quad (13)$$



(a) (b) (c) (d) (e) (f) (g)

Figure 11: Comparing Segment Result (a) Original Image (b) K-Means (c) Adaptive K-Means (d) Fuzzy C-Means(e) Mean Shift (f) Proposed Method (g) Ground Truth.

Table 1: Quantitative Comparison

Image	Compare Method														
	F-measure					*Precision*					*Recall*				
	K-means	Adaptive K-means	Fuzzy C means	Mean shift	Proposed	K-means	Adaptive K-means	Fuzzy C means	Mean shift	Proposed	K-means	Adaptive K-means	Fuzzy C means	Mean shift	Proposed
Img1	0.039	0.030	0.025	0.184	0.731	0.036	0.027	0.023	0.172	0.725	0.887	0.980	0.906	0.818	0.804
Img2	0.358	0.411	0.209	0.741	0.747	0.340	0.391	0.196	0.730	0.740	0.864	0.935	0.967	0.887	0.843
Img3	0.179	0.149	0.088	0.458	0.746	0.167	0.139	0.082	0.444	0.743	0.869	0.812	0.765	0.708	0.782
Img4	0.139	0.092	0.054	0.131	0.319	0.130	0.085	0.050	0.121	0.302	0.850	0.810	0.924	0.839	0.881
Img5	0.138	0.077	0.094	0.125	0.285	0.128	0.071	0.087	0.116	0.269	0.951	0.993	0.971	0.916	0.923
Img6	0.183	0.103	0.077	0.403	0.579	0.171	0.096	0.071	0.384	0.561	0.939	0.982	0.980	0.861	0.911
Avg of all	0.157	0.116	0.092	0.350	0.591	0.146	0.108	0.085	0.333	0.575	0.876	0.919	0.936	0.847	0.869

As a result of the experiment, the conventional clustering-based K-means and Mean Shift Segmentation generated necessary segmentations or objects. They were divided and perceived as the same objects. However, the proposed method minimized unnecessary segmentations because only the areas with salient differences were segmented, which produced improved object segmentation results because only objects that needed to be distinguished were selectively segmented. This result shows in figure 11. For numerical comparison of the experiment results, the segmentation boundary values of the ground truth image and the

F-measure as well as the Precision-Recall values of boundaries of the existing methods and the proposed method were calculated and compared. As a result in table 1, the proposed algorithm showed much higher F-measure and Precision values compared to the existing clustering-based algorithms. In addition, the Recall value was better than those of other algorithms.

V. CONCLUSION

In this study, a pixel grouping method with the application of weights in pixel clustering process was proposed for object segmentation. The object form was fully preserved and unnecessary segmentation of the inside objects and the background was prevented because saliency map information was used in the object segmentation process. The object forms were maintained even in multiple objects and highly accurate results could be obtained. Furthermore, the image segmentation algorithm of the conventional pixel clustering method requires the manual setting of parameter values for use in segmentation and the results show severe variations depending on the set values. However, the proposed algorithm automatically produced improved results compared to the existing algorithms because it used the color analysis of images.

ACKNOWLEDGEMENT

This study is sponsored by the 2017 research fund of Kwangwoon University.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on the Modeling and Rendering about 3D Submarine Topography Using in SAS System Information

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Abstract---

Background/Objectives: Although there are many programs that realize topographic information obtained by tow fish in 2D, not many programs are out there to realize the information in 3D.

Methods/Statistical analysis: Limited size 3D RAW image files are imported into a program tool called Unity3. Although the existing 2D images are used, utilizing 3 dimensional objects rather than 2D images enables clearer object identification.

Findings: Display with 3D objects enabled clearer object identification than 2D expression. There are not many studies on expressing topographic information using 3D objects; however, further studies will improve accuracy in identification of underwater objects.

Improvements/Applications: Bigger raw data significantly slows down the speed of reading files. If the speed issue is resolved and user-friendly GUI is realized, it will contribute to application of underwater topographic information using sonar like the navy.

Keywords--- 3D Terrain, Submarine Topography, 3D Tool, Sonar, Modeling, Rendering.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

For long term application of tow fish used in various fields, real time collection of information on constantly moving current speed and direction, surrounding elements, detection, moving objects, etc. is needed. Also in case of rescue or measuring underwater structures, identification of underwater topographic information is needed and such underwater topographic information should be realized in 2D or 3D, similar to the actual topography, to provide information.

For this, SAS is used to obtain information on topography or perceived objects, then the information is stored in database. The places identified in the past and the number of use are displayed and GUI development is needed to compare with information on similar objects. There are many programs that realize underwater topographic information in 2D to display; however not many 3D programs are available, compared to 2D programs.

Therefore, this study performs modeling information obtained from SAS using 3D tool and library; and realizes functions to enlarge, reduce and rotate/move in top/bottom/left/right direction by generating 3D objects and rendering to explain design and development of user-friendly GUI.

II. PROPOSED WORK

SAS is a technology to identify remote underwater objects and investigate underwater topography. One of sonars is Side Scan Sonar, which is an underwater ultrasonic wave system that investigates both sides.[1] As a ship tows tow fish with towing signal cable, transducer of both sides of tow fish transmits ultrasonic waves underwater and receives the ultrasonic waves reflected from underwater objects to restore the underwater status into video using signal/video-processing device.

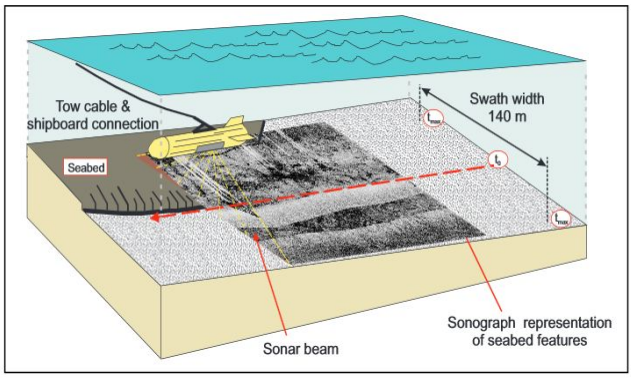

Figure 1: Process of Investigation of Underwater Objects and Topography with Tow Fish Installed in Side Scan Sonar

As shown in figure 1, as tow fish moves, it investigates underwater objects and topography and sends values of x, y coordinates via towing signal cable. Many GUIs transmit coordinate values which are visualized and displayed in 2D images.

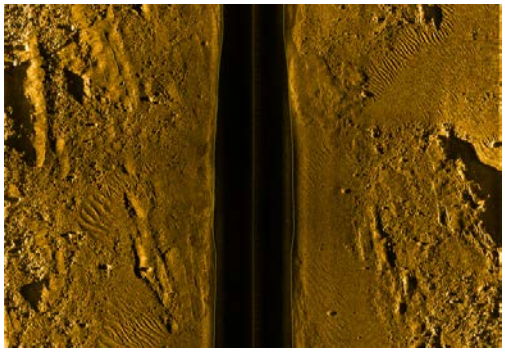

Figure 2: Video that Visualizes and Display Underwater Topography Investigated by Side Scan Sonar in 2D Images

As shown in figure 2, since 2D images display objects cross-sectional, it is difficult to identify object information. To improve 2D image resolution, Mean Filter that sets center pixel values of each kernal to 3x3[2]; Lee Filter that uses weighted value calculation for the min. average square error; and SRAD Diffusion Filter that stores Edge information and inhabits spot noise effectively are used. However the images are shown cross-sectional only therefore it is difficult to identify objects in 3D.

To resolve these issues, this study suggests visualization and display of 3D topographic information with x, y and z coordinates to resolve difficulties in 2D images which were identified cross-sectional only. Also, to identify objects more easily, topographic information is modeled in 3D and various rendering methods to enlarge/reduce and move objects in front, back, left and right are applied to provide more 3 dimensional object information.

First, to obtain topographic information on objects, GIS(Geographic information System) is used to obtain topographic information. GIS is an information system that converts geographic information into computed data for efficient application[3]. GIS displays all information in numeric data. Since all geographic information is saved in numeric data, users can select information to output in formats they want. Many works can be done using GIS; not only for underwater topography, but also for building structures, GIS can be used to obtain information and 3D objects can be generated. In other words, GIS is very useful for many purposes not only for topographic information but also for buildings.[4]

III. The Design of 3D Data Display

Figure 3: Process of 3D Data Modeling and Rendering

Figure 3 shown above shows process of realizing functions to enlarge/reduce and move front, back, left and right by converting 2D images into 3D RAW files, creating 3D model objects using various 3D modeling programs such as 3Ds Max and rendering.

To convert into 3D RAW files, information on height of topography such as height map should be included in the image. When importing 3D files containing height-related information in 3D engine, it automatically draws height information within the files to create 3D model objects.

IV. Simulation and Result

3D modeling process for actual underwater topography is by sending underwater topographic information obtained from tow fish via towing signal cable, a series of processes and creating 3D image data files. This study hypothesizes that all processes are complete and 3D image data files are created for simulation.

Tool and libraries for 3D modeling include Unity3D, Blender, 3Ds Max, Mono Game, Visualization Tool Kit, etc. and Unity 3D was used for simulation in this study.

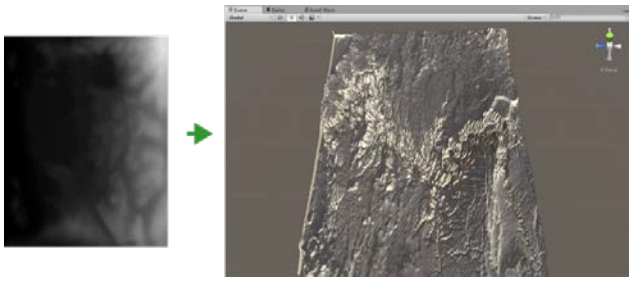

Figure 4: The Result of Height Map Image Import to Unity 3D Tool

Figure 4, Height map image containing topography height information is converted to RAW file and the result of import to 3D tool called Unity3D. The image in the left has a dark part and a bright part: the dark part indicates lower side of topography. Brighter part indicates higher topography. As brightness of the image is clearer, more height information is included; therefore when importing and modeling, clearer 3D objects are created.

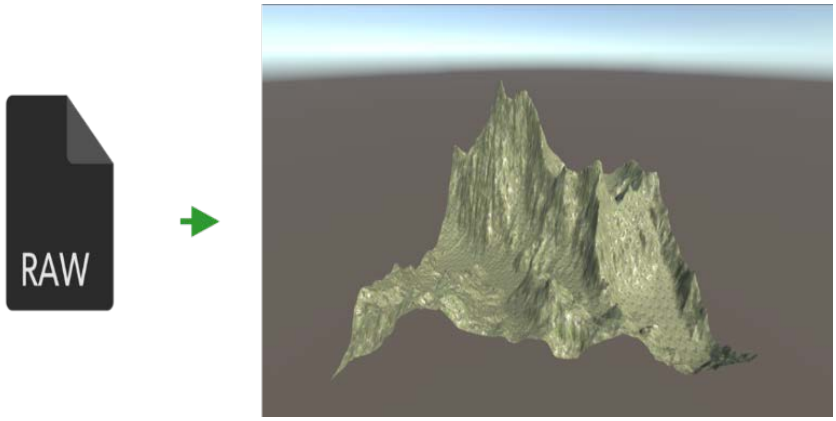

Figure 5: The Result of RAW File Import to Unity 3D Tool

Figure 5 shows file not converted from Height map image to RAW file and imported to Unity3D. Figure 5 shows height and topography more clearly than figure 4. Such result is significantly affected by brightness definition on height map information. Brightness definition is information on topography height. Such information can affect accuracy in creating 3D topographic objects depending on how much detailed information is included.

V. CONCLUSION

This study used GIS to obtain height status as well as topographic information through height map image and explored process of creating 3D terrain objects using 3D tool. As explained earlier, it was confirmed that brightness information on height map used to express topography height affects quality of 3D objects. And the larger the volume of image file, the longer the working time for modeling. The clearer image quality, that is, resolution, or the clearer brightness, the larger the volume; therefore it takes longer from import to modeling, yet the quality is completely different from that in creating 3D objects of small images.

Only Unity3D was used in this study but various tools including VTK and Mono Game and libraries will be used for further 3D Modeling and Rendering. By running other programs, data processing speed will be compared with that of Unity and time from import to modeling will be reduced as much as possible for user's convenience. GUI with various convenient features will be developed for users.

ACKNOWLEDGMENT

We would like to acknowledge the contribution of all the people who have in reviewing this paper. This research is supported by the project of “Development of towed interferometric Synthetic Aperture Sonar.”

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Depression Diagnosis Using Feature Selection of Neuro-Fuzzy System-based Match Count Method

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Abstract---

Background/Objectives: Depression has become severe social problems. Because of depression, people may find it difficult to engage in their social life. Early diagnosis of depression plays an important role in improving the quality of life. This study aims to suggest an algorithm for diagnosing depression disorder using heart rate variability (HRV) and the Neural Network with Weighted Fuzzy Membership functions (NEWFM).

Methods/Statistical analysis: This study aims to present an algorism for depression diagnosis using a neuro-fuzzy system, called the Neural Network with Weighted Fuzzy Membership functions, NEWFM. Hear rate variability is a method to measure the activity of the autonomic nervous system (ANS). In order to diagnose depressive disorders, this study employed Electrocardiography (ECG) data after transforming it into HRV data. And, six features were extracted from the following four optimal areas; time domain, frequency domain, wavelet, and Poincaré transform, which well suit the features of the HRV data. After extraction, this study selected four features among them by using Match Count Method (MCM) of the non-overlap area of the NEWFM to assess the importance of each feature.

Findings: In order to diagnose depression, this paper used as sample 22 normal healthy cases and 10 depressive cases. These data were analyzed by ECG and transformed into HRV data through the QRS detection algorithm. The NEWFM, a neuro-fuzzy system, was used to diagnose the conditions of both cases. The NEWFM created a fuzzy set for each feature and made these fuzzy sets learn. And it calculated the non-overlap area by adding weight. The non-overlap area decides which case is healthy or depressed by using two methods: average of weights (AOW) and Match Count Method (MCM). AOW is to categorize classes by figuring out the average value of each feature while MCM is to make decision by the number of classes of each feature. When AOW was applied, the experiment's accuracy was 95.6%. However, as for MCM, the accuracy was 97.619%. MCM had a higher accuracy in distinguishing healthy and depressed cases compared to AOW. In addition, the study of Hosseinlfard where nonlinear method was applied, extracted and analyzed EEG data with 15 features by using a K-Nearest Neighbor (KNN) classifier and logistic regression analysis, leading to an accuracy of 88.6%. Li's study which analyzed EEG data with 18 features by using Artificial Neural Networks (ANN) had an accuracy of 60%. However, MCM had a higher accuracy in the study using the NEWFM based on the neuro-fuzzy system compared to the previous studies.

Improvements/Applications: This study built an algorithm for depression diagnosis using the neural network. The plan for next studies is to create an algorithm by using more advanced neuro-fuzzy system. It will be more accurate. Also, the study aims to apply the neuro-fuzzy system to IoT and easily diagnose the disorders so that people have better quality of their life.

Keywords--- Neuro Fuzzy System, Match Count Method (MCM), Feature Selection, Depression, HRV (Heart Rate Variability).

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Depression is a disease causing loss of interest or joyfulness in every activity and changes in appetite, weight, or sleeping and other psychological activities. And it is being researched that such depressive disorders have a close relationship with many other diseases, including heart disease and high blood pressure and sometimes cause death.[1] The autonomic nervous system (ANS) is the nervous system maintaining homeostasis against internal and external changes within human's body. Those who show the symptoms of depression after suffering continuous stress experience disturbance in their ANS, which will drop the alternative function of their body[2].HRV shows that human's heart rate varies depending on circumstances, which means that if your HRV decreases, your heart rate becomes less dynamic and its change becomes less complex. In other words, people who have better control react to changes in their body temperature or blood pressure sensitively while the heart rate will drop for those who do not[3]. HRV is highly correlated to depression diagnosis and used as an important indicator[4]. The depression diagnosis algorithm using the neural network employed HRV data in order to diagnose depression. There are two methods to measure HRV data: time domain method and frequency domain method. The time domain method is to identify the impact of ANS on heart rate. ECG signals, illustrated in Figure 1, have consecutive peaks in various patterns consisting of P-Q-R-S waves, which are SDNN showing the standard deviation of normal to normal RR intervals and RMSSD showing root mean square of successive NN interval differences[5].(Figure1)

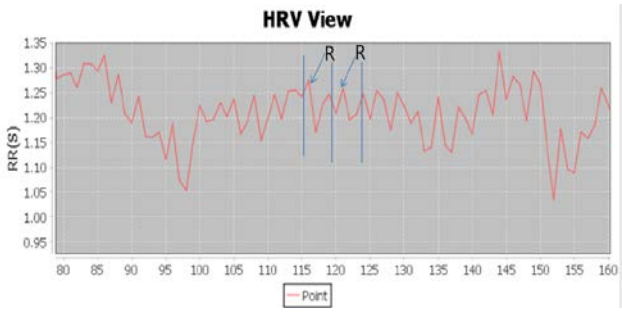

Figure 1: RR Interval in HRV

The frequency domain measure may show periodical signals which are hardly found by the time domain measure. The frequency domain measure can find total frequency (TF), low frequency (LF), high frequency (HF), and very low frequency (VLO) by applying Fast Fourier Transform (FFT) to the time series of the time domain.[5]The algorithm for diagnosing depression using HRV go through four phases as illustrated in Figure 2.

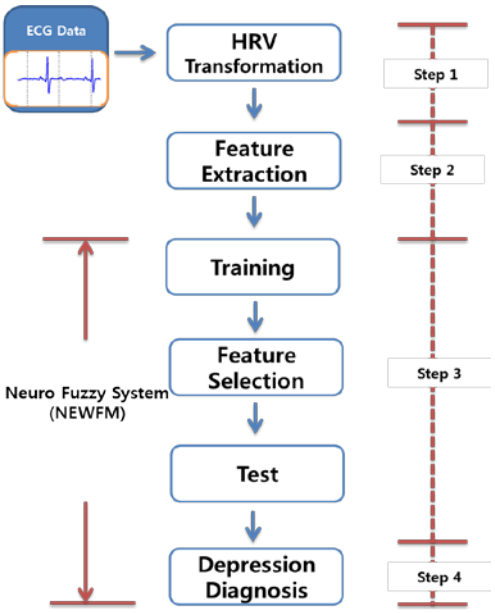

Figure 2: The Algorithm for Diagnosing Depression Using HRV

Step 1. : The algorithm collects ECG data and converts them into HRV data through QRS detection algorithm [6]

Step 2. : The algorithm extracts six features which suit well HRV.

Step 3. : In this stage, after extraction, the six features are trained in the neuro-fuzzy system and the algorithm selects the features best describing healthy and depressed cases. Then, it puts in test data and classifies them into the normal and depressed cases.

Step 4. : The algorithm diagnoses the results of training and testing from the NEWFM with normal and depressive conditions.

II. NEURO FUZZY SYSTEM

This paper employed the neuro-fuzzy system, called the NEWFM. The NEWFM creates the weighted fuzzy function set for each feature as illustrated in Figure 3. (Figure 3) Figure 3 describes that the NEWFM creates the fuzzy set by adding weight (w1, w2, w3) to the vertex of V[1], V[2], V[3]. And the NEWFM trains the fuzzy set while using it to differentiate normal and depressed conditions. [7, 8]

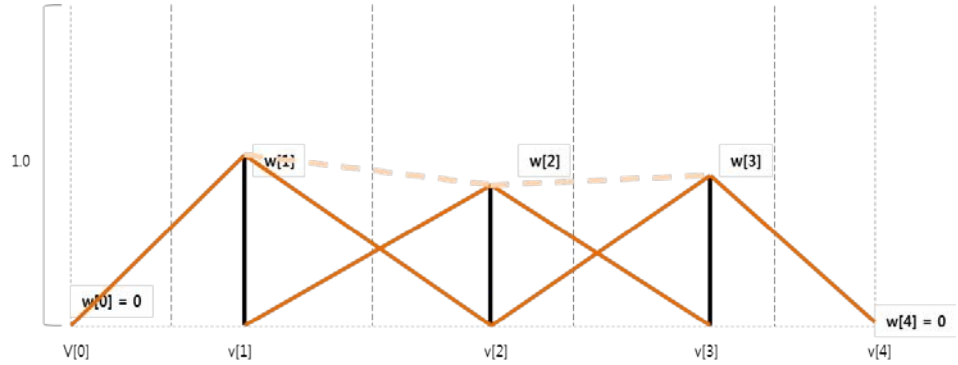

Figure 3: A NEWFM of Weighted Fuzzy Function Set

There are two ways to find out healthy and depressed conditions: average of weights (AOW) and Match Count Method (MCM). The former is to figure out the input values of each feature for each datum and with its average, categorize the classes of the non-overlap area between the overlap and non-overlap areas. The latter is MCM, which adds all the classes of each feature, which is accurately classified from the data put in Membership function, and categorizes those calculated sum. The algorithm diagnosing depression based on HRV data made classification by using MCM. It chooses the best feature after finding out the best and worst features through the non-overlap area.

III. MATERIALS AND METHODS

A. Feature Extraction

The data in this study include 22 normal healthy cases and 10 depressive cases, converted from ECG[9] to HRV data through the detection algorithm. The features were extracted by Time Domain Features (TDFs), Frequency Domain Features(FDFs), Wavelet Transformed Features (WEFs), and Poincaré Transformed Features(PTFs).

1) Time Domain Features(TDFs): TDFs use the standard deviation of RR. The major methods include SDANN, calculating the standard deviation of RR intervals by recording in every five minutes, SDNN, calculating through a long-term record of 24 hours, and RMSSD, which are described in Formula 1 and 2. In the formulas, N means total heart beats. And, pNN50 means the ratio of the number of adjacent RR intervals over 50ms to the total number of RR intervals, described in Formula 3. [10]

$$\mathrm{RMSSD} = \sqrt{\frac{1}{N-2}\sum_{n=3}^{n}[I(n) - I(n-1)]^2} \qquad (1)$$

$$SDNN = \sqrt{\frac{1}{\mathrm{N-1}}\sum_{\mathrm{n=2}}^{\mathrm{n}}[\mathrm{I(n-I)}]^2} \qquad (2)$$

2) Frequency domain Features (FDFs): When the time domain features go into fast Fourier transformation, you can figure out TF(0-0.4Hz), LF(0.04-0.15Hz), HF(0.15-0.4Hz), VLF(0.003-0.04Hz). It means when TF increases, so does HRV and when TF decreases, so does HRV. The LF/HF ratio shows balance between ANS and PNS, meaning the ratio will lean toward ANS if it increases. VLF is used as a feature.
3) Wavelet Transform Features (WTF): It is a method analyzing time domain in real time, which conducts wavelet transformation for discrete data elements. D2 and D3 are taken as features through systematic breaking-down process after breaking down high frequency (HF) features into Detail (D). [11]
4) Poincaré Transform Features (PTF): SD feature of Poincaré plot, which is one of the most basic one of nonlinear feature, was used and its formula is as Formula 3.

$$\text{pNN5} = \frac{\text{NN5}}{\text{N}-1}\text{X100} \qquad (3)$$

B. Feature Selection

In order to create the algorithm diagnosing depression, the study used the neural system, called the NEWFM. Also, it used HRV data for diagnosis and extracted six features from them. Those extracted six features (VLF, D2, D3, pNN100, SDNN, SD2) became the input values of the NEWFM. Each feature had the weighted fuzzy set for its two kinds of conditions (healthy vs. depressed) and was divided into two classes by the non-overlap area. It has two methods for classification: AOW and MCM. The former is to make classification by using the average of the weighted values. The latter is to classify each feature in terms of its sum of classes. After classification, it learned and selected the best and worst features. Among six features (VLF, D2, D3, pNN100, SDNN, SD2), four features, D2, D3, pNN100, and SDNN. The following Figure 4, 5, 6, and 7 show the non-overlap area of the selected features.

Figure 4: SDNN

Figure 5: pn100

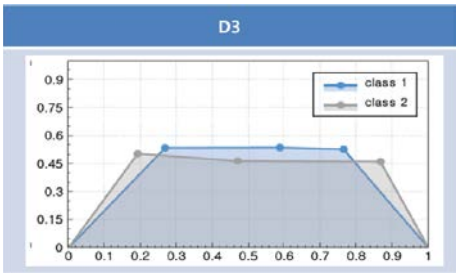

Figure 6: D3

Figure 7: D2

IV. CONCLUSION

The algorithm for depression diagnosis presented in this study is based on the NEWFM. Six features were extracted from four areas. The classification method was MCM, and though that, four best features, among the extracted ones, were selected by the non-overlap area. Its accuracy was 97.619%. As illustrated in the following Table1, the study of Hesseinlfard used KNN and logistics regression analysis as nonlinear analysis and as a result of its experiment analyzing EEG data with 15 features, its accuracy was 88.6%. The study of Li, where EEG data were analyzed with 18 features through ANN, earned an accuracy of 60%. In all, the NEWFM based on the neuro-fuzzy system, showed that MCM improved its accuracy compared to the previous studies.

ACKNOWLEDGMENT

This study was supported by the Research Program funded by the Jangan University, 2016.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Structural Control Strategy of Using Optimum Tuned Mass Damper System for a 12-story Reinforced Concrete Framed Structure

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Abstract---

Background/Objectives: This study explores the effectiveness of a passive Tuned Mass Damper(TMD) system as a seismic damping strategy to suppress structural vibrations for reinforced concrete structures and its advantages are introduced.

Methods/Statistical analysis: For the optimum structural control, the optimised TMD parameters or a curve-fitting scheme has been employed subjected to a series of earthquake excitations. The displacement performance of the target structures and the TMD used are examined and finally the effectiveness of the TMD is presented. Through the responses of the structure and the TMD, the mass ratios and the effects of the structural damping on optimum TMD parameters are investigated.

Findings: The optimum parameters with respect to displacement can be derived and the optimum frequency tuning ratio increases and the optimum TMD damping ratio decreases with increasing mass ratio. For a given level of critical damping in the structure, increasing the mass ratio makes the TMD more effective in reducing structural response. Despite of the some uncertainty due to the effectiveness of the TMD for the individual earthquakes, a suggested optimum TMD system reduces the inter-storey drifts clearly, especially for the earthquake records having large spectral displacements. From the viewpoint of the root-mean-square(RMS) values, for the some earthquake motions used, the RMS stroke lengths of the TMDs are relatively larger than under the other excitations and this response property of the TMDs corresponds to larger displacement of the corresponding top floors. Thus, it can be noted that the TMD stroke increases as the top floor displacement increases. As the response of the structure (top floor response) is increased, the corresponding TMD response is increased with regard to TMD stroke.

Improvements/Applications: The relatively out-of-phase response of the TMD with the target structure less mitigate the structural movement and this limitation could be overcome to take advantages of a semi-active TMD system.

Keywords--- Structural Control, Earthquake, Tuned Mass Damper, Inter-story Drift, TMD Stroke.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

One of the classical and widely verified dynamic vibration damping device is the Tuned Mass Damper (TMD), consisting of a sub-mass of around 1% of the mass of the target structure, located at the top of the building and connected through a passive spring and damper to control any undesirable vibrations. It is well known that the TMD will minimise the vibration if the TMD frequency is set equal to the frequency of the disturbing force, and there are still many medium-rise structures that can benefit by use of a passive TMD as a damping device rather than any other kind of damping device. Also, the TMD is relatively easy to implement in new buildings and in the retrofit of existing ones. It offers the advantages of portability and ease of installation (because of the small size of an individual damper), which makes it attractive not only for new installation, but also for temporary use during construction or for retrofit in existing structures. The TMD does not require an external power source to operate and does not interfere with vertical and horizontal load paths as do some other passive devices.

Because of the above advantages and properties of the TMD, the TMD system can be a suitable damping device for many structures. However, most TMD applications have been made to mitigate wind-induced motion, whereas the seismic effectiveness of TMD still remains an important issue for study and these facts have provided motivation for this study. Therefore, in this study, the optimum parameters of a TMD design that can reduce the response of a relatively medium-rise damped structure to a satisfactory level of displacement is developed. Furthermore, the suggested TMD parameters are adopted to a 12-storey bench-markable reinforced concrete to investigate the effectiveness of the TMD optimised.

II. REVIEW OF PREVIOUS STUDIES

Recently, numerical and experimental studies have been carried out on the effectiveness of TMDs in reducing seismic response of structures [1,2,3]. Numerical and experimental results show that the effectiveness of TMDs on reducing the response of the same structure during some earthquakes, or of different structures during the same earthquake is significantly different; some cases giving good performance and in others having little or even no effect. This implies that there is a dependency of the attained reduction in response on the characteristics of the ground motion that excites the structures. Recently, these response reduction effects have been increased by adopting active and semi-active control techniques and damping devices [4,5].

A number of practical considerations must be observed in the engineering design of a TMD system. First and foremost is the amount of added mass that can be practically placed on the top of a building. TMD travel relative to the building is another important design parameter. Large movements often need to be accommodated for a reasonable response reduction of the building. Another major engineering technique associated with a sliding mass arrangement is to provide a low-friction bearing surface so that the mass can respond to the building movement at low levels of excitation. This becomes more critical when TMD functions are used as an additional damper to improve occupant comfort. Noting that base-isolated system responses are dominated by the first-mode contribution and that TMDs are able to reduce the fundamental modal response, Palazzo and Petti [6] proposed a new idea of combining both properties into a unique system. Analytical results show that use of the TMD in a base-isolated system has the advantage of absorbing seismic energy without contaminating the isolating effect and the relative base displacement of the system may be reduced significantly.

III. PARAMETRIC OPTIMIZATION OF THE TMD

In general, the optimum parameters such as the 'damping ratio' and the 'frequency' of the TMD need to be determined to achieve the optimum structural performance. The optimum parameters can be derived for the required dynamic load depending on the control criteria such as displacement and acceleration. The classically suggested control criteria[7] were used by minimizing the displacement of the structure. Displacement essentially determines safety and integrity of a structure under external excitations. Meanwhile, large accelerations of a structure under excitations produce detrimental effects in functionality of non-structural components, base shear, and occupant comfort. Thus, minimizing structural acceleration can also be a viable control criterion. The TMD travel relative to the building is another important design criterion. However, the large movements of the TMD often need to be accommodated for a reasonable response reduction for the building.

Generally speaking, if a building is subjected to a far-field earthquake of long duration, the absolute acceleration of the TMD needs to be reduced to improve the comfort of occupants. However, for a near-field earthquake of strong intensity, the priority of the control objective changes to the reduction of the structure displacement to protect the structure itself. It is clear that some of the above criteria overlap with each other and have similarities.

In this study, the inter-storey drift the main structure and the displacement of the TMD will be examined to observe the effects of the TMD.

In the previous study[3], the author proposed the optimum TMD parameters and the corresponding responses for different mass ratios (μ=0.0 to 0.1), with five different critical damping ratios of the target structures (ξ_1=0, 0.01, 0.02, 0.03 and 0.05) as shown in Tables 1 and 2. Meanwhile, for convenience in future applications, explicit mathematical expressions that correspond to the computed optimum values are determined.

From the numerical data of Tables 1 and 2, four parametric closed form formulae are obtained using curve-fitting methods as shown in Table 2.

The optimum tuning frequency ratios (f_{2dopt}) and optimum TMD damping ratios (ξ_{2dopt}) in terms of the displacement response for the five different damped systems are listed (Table 1) and the curves of the closed-form expressions (Table 2).

From the above parameters, the optimum TMD damping stiffness (k_{2dopt}) and optimum TMD damping coefficient (ξ_{2dopt}) are also calculated and listed in Tables 1 and 2.

Table 1: Optimum TMD Parameters(Numerical Results)

μ	ξ_1	Displacement				Acceleration			
		f_{2dopt}	ξ_{2dopt}	k_{2dopt}	c_{2dopt}	f_{2aopt}	ξ_{2dopt}	k_{2aopt}	c_{2aopt}
0.003	0.00	0.9963	0.0274	50.370	0.8279	0.9978	0.0274	50.521	0.8292
	0.01	0.9947	0.0274	50.213	0.8262	0.9975	0.0274	50.494	0.8285
	0.02	0.9927	0.0274	50.015	0.8246	0.9972	0.0274	50.467	0.8283
	0.03	0.9904	0.0274	49.778	0.8227	0.9970	0.0274	50.440	0.8281
	0.05	0.9845	0.0274	49.187	0.8178	0.9965	0.0274	50.390	0.8279
0.01	0.00	0.9876	0.0498	165.01	4.9792	0.9926	0.0498	166.68	5.0041
	0.01	0.9850	0.0498	164.11	4.9662	0.9921	0.0498	166.50	5.0020
	0.02	0.9819	0.0498	163.10	4.9507	0.9916	0.0498	166.33	4.9996
	0.03	0.9784	0.0498	161.95	4.9335	0.9911	0.0498	166.17	4.9974
	0.05	0.9704	0.0498	159.30	4.8930	0.9902	0.0498	165.87	4.9937
0.02	0.00	0.9755	0.0702	321.94	13.864	0.9853	0.0702	328.44	13.993
	0.01	0.9718	0.0702	319.54	13.809	0.9846	0.0702	327.99	13.989
	0.02	0.9678	0.0702	316.90	13.752	0.9839	0.0702	327.54	13.980
	0.03	0.9634	0.0702	314.02	13.689	0.9833	0.0702	327.11	13.972
	0.05	0.9534	0.0702	307.56	13.549	0.9820	0.0702	326.28	13.957
0.05	0.00	0.9406	0.1097	748.34	52.243	0.9653	0.1095	788.14	53.495
	0.01	0.9350	0.1098	739.38	51.960	0.9632	0.1098	784.71	53.509
	0.02	0.9292	0.1098	730.22	51.640	0.9622	0.1098	783.09	53.456
	0.03	0.9230	0.1098	720.55	51.301	0.9612	0.1098	781.51	53.407
	0.05	0.9096	0.1098	699.75	50.563	0.9594	0.1098	778.50	53.323
0.1	0.00	0.8861	0.1527	1328.3	136.98	0.9316	0.1525	1468.2	143.83
	0.01	0.8789	0.1528	1306.7	135.88	0.9302	0.1525	1463.8	143.63
	0.02	0.8714	0.1528	1284.4	134.75	0.9289	0.1526	1459.8	143.44
	0.03	0.8635	0.1528	1261.3	133.56	0.9277	0.1526	1455.9	143.26
	0.05	0.8468	0.1529	1212.9	131.02	0.9253	0.1527	1448.5	142.98

Table 2: Optimum TMD parameters (curve-fitting equations)

Parameter Title	Optimum Parameters
Frequency tuning ratio	$f_{2dopt} = 1.00 - 1.24\mu + 1.0\mu^2 + (-0.13 - 11.36\mu + 55.84\mu^2)\xi_1 + (-2.04 + 11.26\mu - 72.89\mu^2)\xi_1^2$
Damping ratio	$\xi_{2dopt} = 0.03 + 2.24\mu - 9.68\mu^2 + (-0.002 + 0.15\mu - 1.08\mu^2)\xi_1 + (0.026 - 2.28\mu + 20.88\mu^2)\xi_1^2$
TMD stiffness	$k_{2dopt} = 1.68 + 16630\mu - 33654\mu^2 + (52.82 - 13972\mu - 77802\mu^2)\xi_1 + (-117 - 50079\mu + 135929\mu^2)\xi_1^2$
TMD damping coefficient	$c_{2dopt} = -2.67 + 762\mu + 6355\mu^2 + (0.22 - 59.8\mu - 10083\mu^2)\xi_1 + (11.15 - 2158\mu - 4521\mu^2)\xi_1^2$

IV. MODELLING OF FRAMED STRUCTURE AND EARTHQUAKE RECORDS USED

A 12-storey, reinforced concrete framed structure was adopted to demonstrate the effects of the TMD as shown in Figure 1. This model was designed originally by Jury [8] according to the New Zealand Loadings Code (NZS 4203)[9]. It was assumed that the frame would be required to resist the component of earthquake motion in the plane of the frame only. No torsional effects for the building as a whole were taken into account. According to the NZS Code, for beam design, all frames share in carrying gravity and seismic-induced loads, then moment redistribution was carried out using a method developed by Paulay [10] and the column dimensions were increased by Thomson [11].The dynamic properties of the frame, such as the natural frequency, modal effective mass, modal damping ratios, and participation factors, are calculated and listed in Table 3.

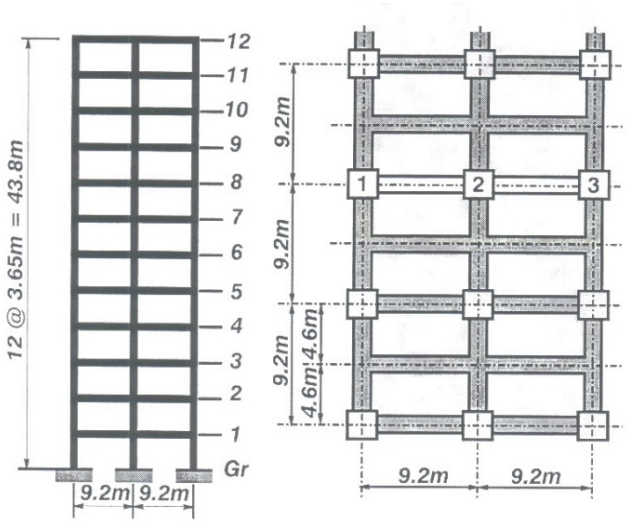

Figure 1: 12-storey Reinforced Concrete Target Structure

Table 3:Dynamic Properties of the Structure

Mode	Natural frequency (Hz)	Modal eff.mass (kN-s²/m)	Participation factor
1	0.532	1.514E+03	1.366E+00
2	1.533	2.527E+02	-5.321E-01
3	2.756	7.408E+01	-2.752E-01
4	3.853	7.899E-29	3.064E-16
5	3.885	3.596E+01	-1.700E-01
6	4.525	5.616E+00	-9.368E-02
7	5.131	1.944E-28	-4.722E-16
8	5.279	2.056E+01	-1.436E-01
9	6.652	1.548E+01	-1.118E-01

In the computational study, four different earthquake records which have various peak ground acceleration (PGA) levels are used. Only the first 20 seconds of these records (Figure 2) are used in the analyses and the excitations used as(1)1992, NZS4203 – Artificial, (2) 1940, Imperial Valley – El Centro (NS), (3) 1971, San Fernando – Pacoima Dam (S16E),(4) 1994, Northridge – Sylmar County Hospital (NS).

The artificial accelerogram is generated by the SIMQKE program [12]to produce an artificial accelerogram to match the spectra specified in the New Zealand Standard (NZS4203, 1976). It is specified that the target peak ground acceleration (PGA) is 0.5g, the time step size is 0.02 and the number of spectral points are 200. Then the record is multiplied by a zone factor of 1.2 which represents the highest zone factor value in the New Zealand Loadings Code. In order to observe the seismic responses under typical earthquakes, a design-based classical earthquake record, the El Centro, is used. This record has magnitudes of 6.4 on the Richter scale, and the accelerograph was recorded at sites 9 km from the epicentre and has PGA of 0.34g.The Pacoima Dam acceleration record, which has a magnitude of 6.6 on the Richter scale, is used to examine the large response of the structure. The PGA recorded is 1.17g.The 1994 Sylmar earthquake accelerogram is recorded at the ground floor in the Sylmar County Hospital on the site of the old Olive View hospital building which suffered major and irreparable damage during the 1971 San Fernando earthquake. A magnitude of 6.4 on the Richter scale is recorded and the epicentre distance is 15.0 km. A PGA recorded at the ground floor is 0.80g.

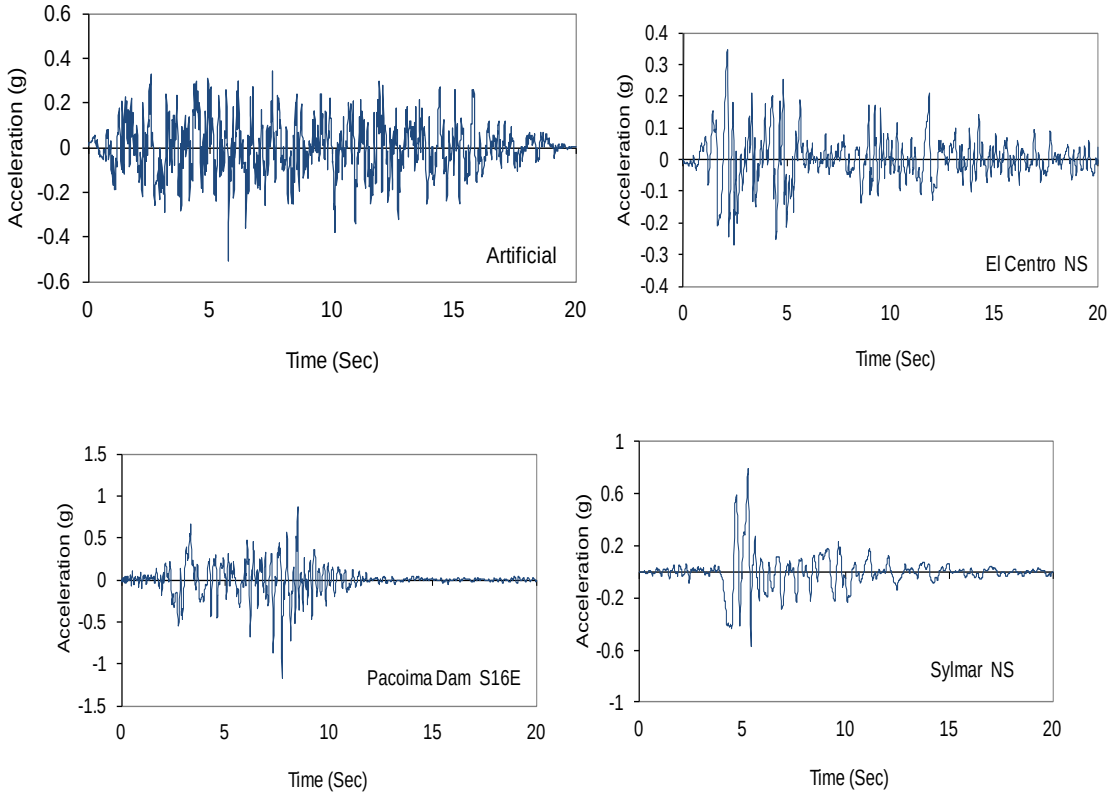

Figure 2: Earthquake Records Used

V. PERFORMANCE RESULTS

A. Maximum Inter-Storey Drift

Figure 3 shows the maximum inter-storey drifts without and with 2% and 5% TMD. In general, the efficiency of the TMD is higher for a 2% Rayleigh damped structure than a 5% Rayleigh damped structure. It is observed that at some storeys the higher reductions do not correspond to the higher mass ratio. From the profiles, the higher mass ratio seems to provide satisfactory reductions over the lower half of the height of the frame, but it can be seen that the envelopes have irregular or contrary shape in the upper part of the frames.

The envelopes for the artificial excitation show good reductions of inter-storey drift with the TMD except at mid-height levels for the 2% Rayleigh structure and at upper levels for the 5% Rayleigh structure. For the El Centro excitation, these exceptions are found over the upper level of the structure for both 2% and 5% Rayleigh structures. There are relatively large inter-storey drifts under the Pacoima Dam excitation but with exceptions at some storeys. The Sylmar excitation produces good reductions of inter-storey drift without any exception over the height of the structure.

In some cases, the specified TMD produced a negative effect and it amplifies the response slightly. This poor performance is attributed to the ineffectiveness of the TMD which has only linear properties and its inability to reach a resonant condition in the structure. When the structure experiences elasto-plastic deformations, the frequency of the system decreases so that the TMD loses part of its effectiveness due to this detuning effect. However, the investigated graphical results for the structure could be used to aid the design of the advanced inelastic system under seismic excitations.

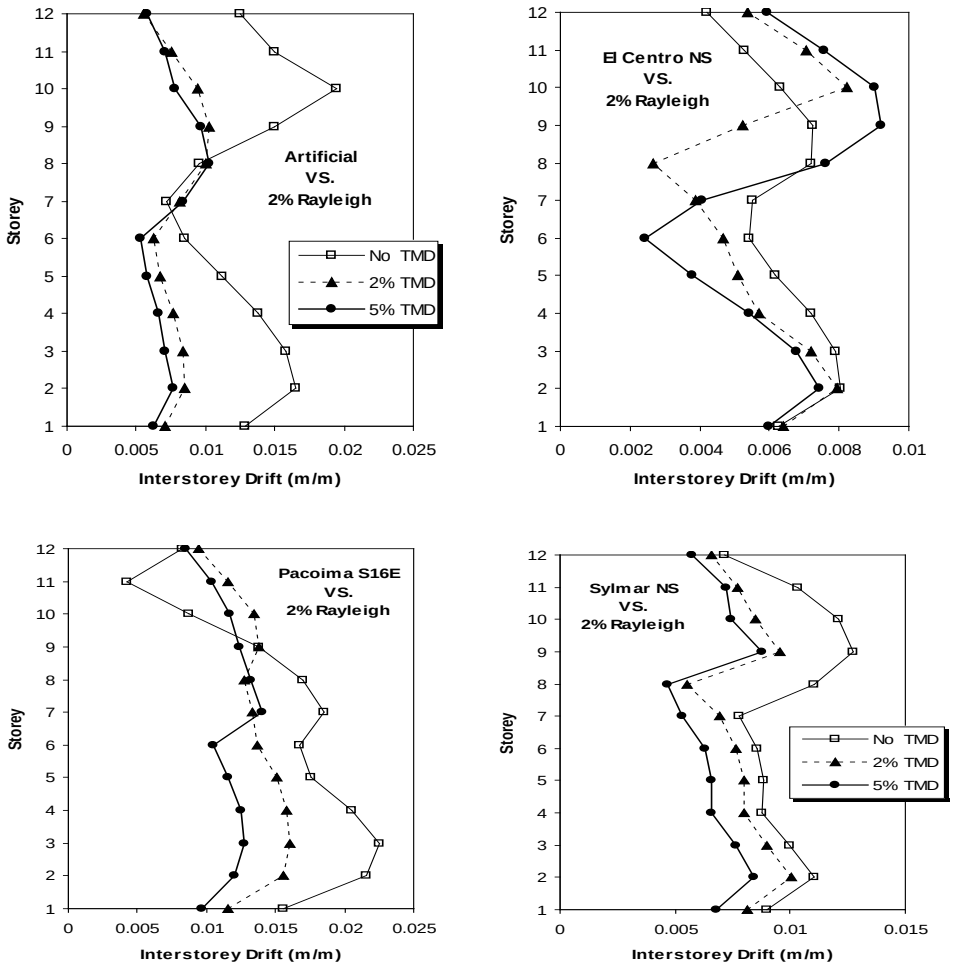

Figure 3: Inter-storey Drift (2% Rayleigh Damping)

B. Behaviour of the TMD

The large displacement of the TMD may contribute substantially to the costs of the TMD itself and to the costs of accommodating the displacements of the structures. Some TMDs require large strokes to be effective. Therefore, the TMD physical responses are usually an important design consideration. Through these parameters, the designer can check the property of TMD movement and it may give good information to help design an appropriate TMD system.

In this study, the travel of TMD relative to the top floor (the stroke) was also selected. The optimum damping is not the only constraint in the selection of the TMD. Available space will limit the travel of the TMD relative to the structure. The designer may wish to select a TMD damping larger than the optimum value to reduce the TMD travel. Hence, other control parameters in terms of the TMD behaviour were required and can be used.

The time-history behaviour of the TMD (the stroke – the relative displacement of the TMD to the top floor) is in Table 4, summarising the results of the TMD stroke in terms of root-mean-square(RMS) values. In the Table, the stroke ratio is defined as the RMS strokelength divided by the RMS displacement of the top floor. As it can be seen in the Table 4, increasing the mass ratio decreases the TMD stroke, and for the models with a given damping ratio(2%), the stroke length is larger. The stroke ratios for the 5% TMD is less than those of the 2% TMD. This means that the TMD relative motion is about 3 times and 2 times the motion of the structure model with the 2% TMD and the 5% TMD respectively.

In conclusion, with a larger mass ratio, the TMD inertia increases, causing the stroke to reduce. Also, with the TMD absorbing most of the energy of the excitation, its displacement is much larger than that of the top floor. Hence, it is noted that the stroke is dominated by the mass ratio. From the result data illustrating the response of the TMD stroke behaviour, a designer therefore can use the TMD response property as the important design factor for optimum TMD design.

Table 4: Summary of the TMD Stroke (2% Rayleigh damping)

Earthquake Record	2% TMD		5% TMD	
	RMS (m)	Stroke Ratio	RMS (m)	Stroke Ratio
Artificial	0.422	3.0	0.245	2.3
El Centro(NS)	0.275	3.5	0.141	2.5
Pacoima(N16E)	0.558	3.2	0.275	2.1
Sylmar(NS)	0.308	3.2	0.144	2.5

VI. CONCLUSION

Based on the parametric analysis described above, the structural analysis was conducted using the program RUAUMOKO and a 12-storey, two-bay reinforced concrete framed structure was adopted to demonstrate the effects of the TMD. As input excitations, four different earthquake records, including an artificially generated earthquake record according the spectra specified in the New Zealand Standard NZS4203(1992), were used.

For comparison, the response behaviours were simulated with 2% internal structural damping value was adopted for the inter-storey drift response case. From the viewpoint of the TMD, the mass ratios of 2% and 5% TMD were applied on the top floor to compare the effectiveness of the TMD.

With the specified conditions, some important practical information were derived as follows;

1) The optimum parameters with respect to displacement were derived and the optimal frequency tuning ratio increases and the optimal TMD damping ratio decreases with increasing mass ratio.
2) From the structural analysis for the 12-storey frame, the results with respect to the parameters such as mass ratio, frequency tuning ratio and TMD damping ratio, correspond to the results from the parametric analysis studies.
3) For a given level of critical damping in the structure, increasing the mass ratio makes the TMD more effective in reducing structural response. This implies that a system with higher intrinsic damping requires a TMD with a larger mass ratio to provide similar reduction to that needed for a system with lower damping.
4) Although there is some uncertainty as to the effectiveness of the TMD for the individual earthquakes, a proposed optimum TMD reduces the displacement responses, especially for the earthquake records having large spectral displacements.
5) As the response of the structure is increased, the corresponding TMD response is increased with regard to the both TMD stroke. This disadvantage is related to space limitations and construction facilities and should be solved in the future.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(NRF-2015R1D1A1A01057044).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on IoT Based Rescue System Regarding Marine Accidents

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Abstract---

Background/Objectives: Since the horrendous incident of Sewol ferry, Korean government suggested various measures and plans regarding marine accidents. It turned out that marine accidents and casualties increased steadily for the past 3 years. Since Korea Coast Guard(KCG) lacks both manpower and equipment, there is a limitation in performing a variety of tasks and taking prompt actions. In order to settle the issues concerning marine accidents, this study propose an IoT based Rescue System designed to minimize the casualty and bring prompt action in such events.

Methods/Statistical analysis: We have taken a close look at the cases utilizing IoT technology in marine police work such as an IoT jacket that informs the location and health status of the victims and missing children prevention band. We also analyzed the official statistics of the casualty and the type of marine accidents for the past 5 years. By practicing an official analysis on marine accidents, we must recognize the seriousness of such events to prevent the accidents and the sacrifice of human lives.

Findings: The proposed IoT based Rescue system is equipped with a 3G communication technology, a sensor for measuring heart rate, body temperature and built-in GPS for pointing out the location of the passengers. In result, it will be useful in determining the priority for rescue operations to take quick initial action in an emergency situation. Also, the data accumulated in each accident can be used to analyze and predict what KCG should do in the future events.

Improvements/Applications: By having passengers wear a water proof Smart band which has a built-in body index sensor and a GPS, KCG specifies the priority by comparative analysis on the victims' location and health status. It will also play an important role in dealing with the future situation with the help of accumulated information stored in the database.

Keywords--- IOT, Marine Accident, Korea Coast Guard, Rescue System, Smart Band.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Since the disaster of Sewol ferry, which sunk in April 16, 2014, our society have been making every effort to prevent and deal with such marine accidents or disasters. Nevertheless, marine accidents have risen from 1,330 cases in 2014 to 2,101 cases in 2015 showing 58% increase. The average number of accidents per year was 1,581 for the past 5 years and the average of 404 casualties was recorded from 2011 to 2015. What we should look more carefully is that these kinds of incidents are on the rise[1].

There are many reasons for the occurrence of marine accidents for example collision, fire, flood, stranding, and overturn etc. The first and foremost concern in a marine accident is that it causes serious damages like injury, missing person, and casualties. The incident of Sewol ferry in April 16, 2014 causing the death of 295 people and 9 missing from the total of 495 passengers had made our society to fall into despair[2]. Since this incident, government took various measures to improve the ability of Korea Coast Guard(KCG) for the purpose of prevention and response of marine accidents and disasters by restructuring and cooperating with government agency. As mentioned above, nevertheless, maritime accidents and casualties are still increasing.

Accordingly, this paper proposes a rescue system based on IoT that minimize the casualties in such incidents and strengthen early response capability through the cooperation with authorities.

IoT based rescue system IOT utilizes a wrist band equipped with a 3G communication technology and a GPS sensor that is capable of measuring heart rate and body temperature of each individual. In the case of a maritime accident, KCG easily locates the victims and analyzes the data transmitted from the physical index detector designed in the Smart band to determine the priority of emergency rescue. This initial response will become an effective solution in the process of keeping people alive in the maritime accidents. Also, the proposed system is anticipated to play an important role, if it is properly analyzed, in improving KCG's ability to cope with disaster situations.

II. RELATED WORKS

A. The Concept of IoT

ZigBee The definition of IoT(Internet of Things) refers to an intelligent technology and service that exchange information between objects through internet network[3]. The term was first used by Kevin Ashton, who was the director of Auto-ID Center, MIT, in 1999 and became popular since then[4]. IoT can be formed by comprehensively converging 3 different aspects as shown in <Fig. 1>.

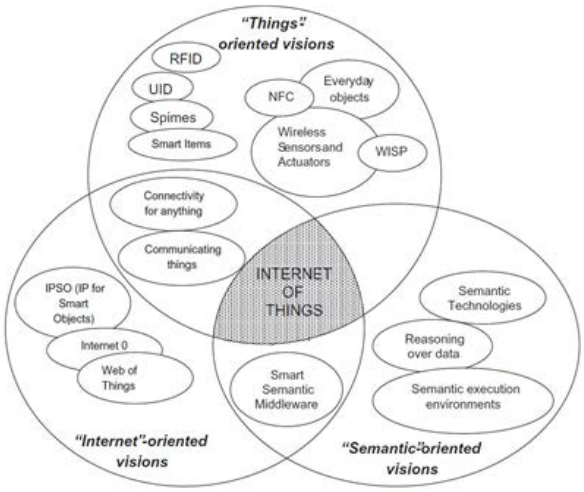

Figure 1: Conceptual Diagram of IoT

IoT is expected to be used in a variety of fields. According a study related to IoT, the field of IoT application can be divided into 4 groups which are Transportation and logistics, healthcare, Smart environment-home, office, plant etc., Personal and social and Futuristic field can be added in the category[5].

Therefore, the grafting and utilization of IoT in the field of KCG is necessary in order to minimize the casualties and effectively response in maritime accidents.

B. Case Study on IoT Utilization by KCG

IoT is already being used in various industry fields and actual life. Also, researches to improve the IoT environment and technology are constantly being conducted.

A Smart Gun that prevents friendly fire by utilizing IoT technology and devices like Smart wrist band and Smart apparel, which monitor and transmit the biometric information to the Police headquarters to acknowledge the signs of problems in advance, are already developed. In addition, the development of wearable smart devices for the K-9 is increasing the performance ability of the Police force[6]. KCG carries out various kinds of missions such as lifesaving, prevention of accidents, smuggling, illegal entry, drug trafficking, prevention and control of international crime and enforcement of illegal fishing action etc., Therefore, the utilization of IoT in case of a maritime accident will have a positive effect on saving people's lives and will also be effective in crime prevention and response occurred in the ocean.

Marine Safety Integrated Information system is designed to provide safety information, inspection information, security incident information, location etc., in real time by sharing information with related organizations. It is mainly devised for the purpose of minimizing the damage in the case of a maritime accident [7]. Through this system, each of the related organizations share the information and cooperate in the case of a marine accident. Also, rapid rescue and response becomes possible in such incidents reducing the secondary damage by receiving marine safety information in real-time.

Smart Child Prevention Service utilizing a wearable device in beach areas transmits the location of the missing child to the KCG making it possible to find the child in less than 10 minutes. Since this wearable band utilizes an IoT dedicated network, which is called LoRa, it has the advantage of low power consumption and wide communication range. As a result, it is suitable to pinpoint the location of a child in Haeundae Beach[8].

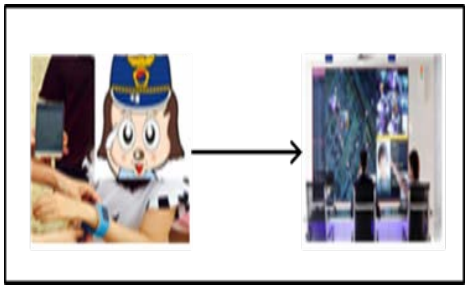

Figure 2: Prevention of a Missing Child Through Wearable Smart Band and Integrated Control Center

Maritime accident Rescue Jacket based on IoT is equipped with the feature of expanding automatically by checking the water pressure immediately in case the victim falls into the water. In addition, it checks the victim's health status through the heart rate sensor and transmits it to the disaster control by utilizing the IoT module. With the help of these wonderful features, the management of life-saving measures becomes more effective.

Figure 3: IoT based Rescue Jacket

C. Occurrence and Analysis of Marine Accidents

If we look at the number of marine accidents occurred in the past 5 years, the figures constantly rise from the year 2013 to double up in 2015 as shown in <TABLE. 1>. Looking at the number of accidents occurred this year, until the end of July 2016, the figure adds up to 1142 cases exceeding the total numbers of accidents in 2013. Especially, a total of 2021 casualties occurred in the maritime accident during the past 5 years.

Of the total 2101 accidents occurred in 2015, the number of fishing boat accident was 1461 and non-fishing boat accident was 640 accounted for 69.5% and 30.5% respectively. Also, the number of fishing boat accidents increased by 565 and non-fishing boat accidents increased by 206 cases showing 63.1% and 47.5% increase respectively compared with the previous year.

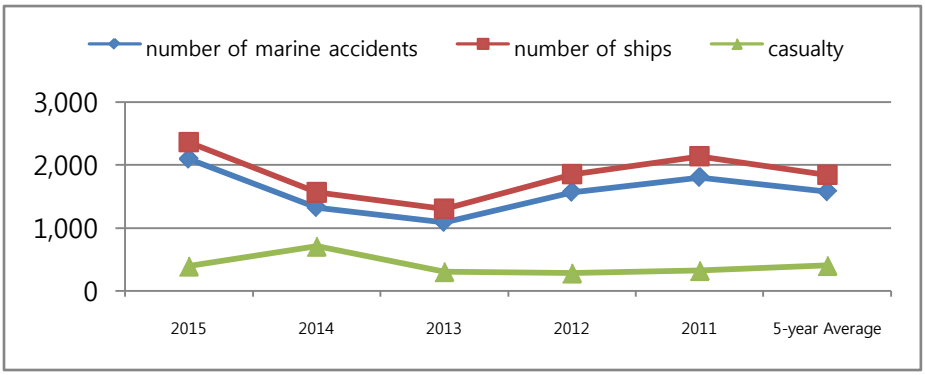

Figure 4: Case Report of Marine Accidents for The Past 5 Years

The following <TABLE.2> shows the occurrence of maritime accidents according to the types of accidents for the past 3 years. The most frequent accidents were collision(428), followed by fire/explosion(276), and stranding(271).

Even though there were various measures set up since the incident of Sewol ferry, the continuous increase of marine accidents and casualties caused by such events shows the absence of an effective system for solving a marine accident.

The occurrence of continuous marine accidents causing casualties means that it is necessary to develop an efficient response and prevention system to be used in such incidents. As we can see in <Table. 2>, the number of accidents regarding collision, fire/explosion, and stranding occur more often compared with other accidents. This means that countermeasures for these kinds of accidents should be arranged in order to deal with the events properly. Unless we make an appropriate strategy, we will keep on losing the precious lives of people and suffering economic loss.

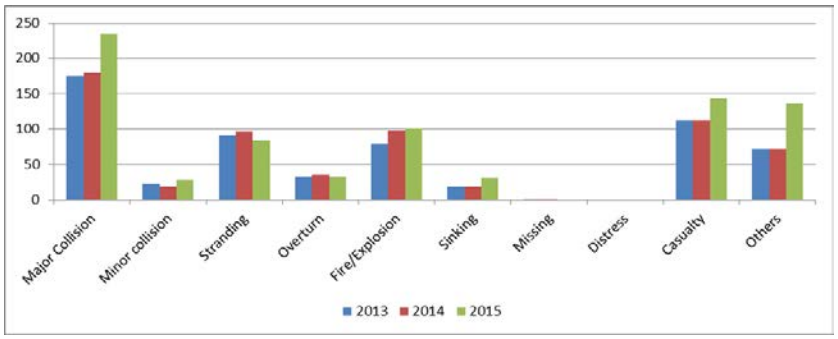

Figure 5: Marine Accidents Status by Type

. Consequently, it is imperative to develop a system that can take action for a quick initial response to minimize the casualty. Therefore, in this study, we propose an IoT based rescue system that makes effective and initial response possible. In order to obtain such results, the proposed system must be equipped with a body index detector that analyzes the data of each user and sends out a distress signal using the built-in GPS according to the emergency priority

III. IoT BASED RESCUE JACKET MODEL

In this part, we propose the IoT based rescue system that supplements the Marine Safety Integrated Information system to guarantee a more effective lifesaving method in the case of a marine accident.

Marine Safety Integrated Information system, that is designed to prevent accidents and minimize the casualties by identifying the exact coordinates of each ship, had already been constructed[7].

Marine Safety Integrated Information system controls and keeps track of each ship. The main factor of this system is to protect the marine environment and the lives of the people by sharing all kinds of information concerning the safety and security with the related organizations

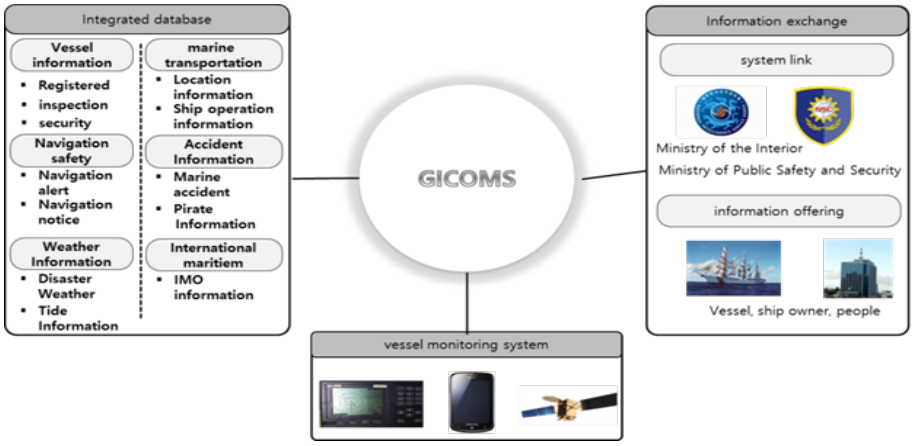

Figure 6: Marine Safety Integrated Information System

Marine Safety Integrated Information system consists of a monitoring system, integrated safety database and the situation control system. The monitoring system utilizes two-way data communication network to mark the location of the ship on the marine chart by analyzing the signals transmitted from the wireless device, like AIS, installed on the ship. The situation control system supports emergency response plan and the decision making process in case of a marine accident.

A. System Features and Functions

Smart Band

The smart band that is worn by every passenger on the ship is equipped with a heart rate sensor, a thermometer, and a built-in GPS etc., to locate and analyze the situation of the passengers. Also, it is has the capability to receive the text from the Marine Safety Integrated Information system in case of emergency and transmit the value of body index measure and the location of each passenger. As the device is mainly used for emergency situation in marine areas, it has the function of waterproof.

Rescue System

The rescue system proceeds comparative analysis on the passengers' body index and the location in case of an emergency. By calculating the survival index according to the change of body index, it determines the priority of emergency depending on the distance of each victim.

Accident Analysis Database

Since the data including the location of the event and the change of each passenger's body index depending on the time flow can be a useful asset for lifesaving in the future marine accident, it should be stored in a database to be used for other incidents in the future.

B. Proposed System

All the passengers on board should wear the smart band.

1) If the ship safely arrives at the destination without any incident, the passenger data stored in Marine Safety Integrated Information system is deleted.
2) In case of an emergency, the rescue system activates.
   a) The current location of the distressed ship is transmitted to the Vessel Monitoring System of Marine Safety Integrated Information system.
   b) The passenger data stored in the integrated database goes through a comparative analysis with the current data in real-time. Analyzed data includes heart rate, body temperature, and the exact location of the passenger's current situation.
   c) Analyzed data is transmitted to every related organization to be utilized for effective rescue operations.(heart rate and temperature information is used for setting the rescue priority

depending on the health status, real-time location is used for calculating the time and distance for the rescue to supplement the determination of the rescue priority.)

d) The location of the distressed ship and the value of victims' body index including the exact location are stored in the integrated database separately.

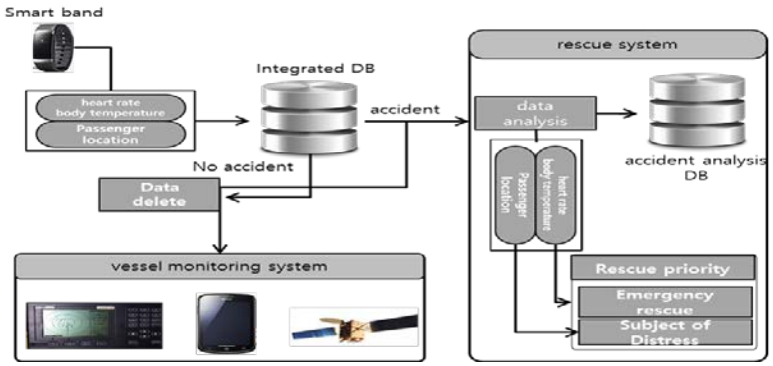

Figure7: Proposed Rescue System

IV. SYSTEM EVALUATION

This study proposes a system, tentatively named IoT based Rescue System, that is designed to be included in the Marine Safety Integrated Information system for lifesaving situation in case of a marine accident.

Marine Safety Integrated Information system consists of 3 components. The first component is the Vessel monitoring system that checks on the route, location and the status etc., of the ship. The second is an integrated database that consist marine disaster safety information. The final component is the comprehensive situation management system that cooperates with one another by sharing safety information to make a quick decision.

In this study, we propose a system to be added on the existing Marine Safety Integrated Information system for the purpose of minimizing the casualty in emergency situation.

The proposed Rescue System requires passengers to wear a smart band. The body index and location of the users are stored in the integrated DB that is one of the constituent of the Marine Safety Integrated Information system. If nothing happens, the stored data is deleted in order to prevent the personal information leakage. In case of an emergency, data stored in the integrated DB is transmitted to the proposed Rescue System then analyzed to be utilized for emergency rescue. Analyzed body index and the location information are used for determining the priority of the rescue plan in order not to waste the time in lifesaving operation.

When the emergency situation is over, the accumulated data regarding the body index and location change in an emergency situation is stored in the Accident analysis DB to be utilized in the distress situation that may occur in the future.

V. CONCLUSION

Recently, a marine officer was killed while controlling a foreign fishing boats illegally operating in NLL. Also, many casualties occurred continually in the incident of Sewol ferry and other marine accidents. Although many countermeasures against marine accidents have been established, the number of accidents and related casualties since 2013 are increasing rather than decreasing. Korea Coast Guard(KCG) have limitations in carrying out various tasks, such as rescue activity and marine accident response, due to the lack of budget and manpower in police force.

The activities and tasks of KCG have more of a risk factor compared with other fields because of the distinctiveness included in its duty requires agility to minimize the casualty and coping with an unexpected situation[9].

Taking this reality into consideration, therefore, we have proposed the IoT based Rescue System which plays a role in minimizing the casualty and preventing marine accidents by cooperating with related organizations for fast initial response.

For the proper operation and construction of the proposed IoT based Rescue System, information sharing and the cooperation from related organizations must be preceded. Also, securing sufficient budget and supplementation of maritime laws, which give the authority to KCG for becoming the control tower in such events, is another preliminary task to be resolved.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Geometric Feature Based Object Detection and Classification in Road Images

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Abstract---

Background/Objectives: This paper proposes an algorithm that can find the object appears on the road image and categorize whether the object is a vehicle, a pedestrian, fallen objects.

Methods/Statistical analysis: This method detects an object from the difference value between the current image and the background image and classifies the object based on geometric feature like the size and aspect ratio, fill-in ratio of the region. The acquisition of background, the detection of objects, the classification of detected objects and background image update process are performed sequentially.

Findings: The geometric feature of objects is used as a criterion of discrimination. According to camera setting position, the size of the same object is different depending on where the object appears on the screen. Therefore we propose a simple coordinate transformation method to normalize the size of the object. By using linear approximation method, coordinate transform ratio is calculated from the two lane width at the two points of screen. And reference criteria for classification from a geometric shape of the object are proposed.

Improvements/Applications: Experimental results show that effectively classify objects and this system will be helpful in the prevention of the additional road accident and the effective road management

Keywords--- Object Detection, Object Classification, Road Image, Coordinate Transform, Geometric Feature.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

There are several factors that obstruct the flow of traffic on the road. Fallen object or pedestrian on the road, abnormal vehicle stop of a road can disturb the traffic situation and can lead to an additional traffic accident. Therefore, it is important to detect objects on the road and to properly deal with the situations.

There are system to monitor the flow of traffic by Surveillance cameras, which are video image vehicle detector and incident monitoring system[1-5]. Video image vehicle detector is the device for measuring the speed and the occupancy ratio of the vehicle passing through a point on the road. Incident monitoring system has a function to estimate the existence of an accident from the abnormal flow of traffic or the traffic jam[1]

These systems are used to detect only vehicle that appear on the road images[1-5]. Therefore, to find out what causes accidents and to determine what action is needed to prevent additional accidents, it requires a system that can classify the various objects that appear on a road.

For the detection of an object in the road image, the method that obtains a difference between the current image and the motionless background image is used[6-9]. The pixels included in the moving vehicle have the large difference value and the feature value extracted from pixels boundary is used to discriminate whether an object is vehicle by comparison with a reference value.

This paper proposes the real-time image processing algorithms to detect and classify the vehicle and the pedestrian, fallen objects with a video surveillance camera. The results of these studies can be used in automatic alarm system for preventing additional accidents and for rapid incident response.

II. SYSTEM OVERVIEW

For the implement of the system that classify objects in sequential road images and transmit the result of the classification, as shown in figure1, it undergoes the following step : the acquisition of background image without motion, the detection of new objects, the classification of detected objects and background image update process except for the regions within the detected object.

The acquisition of the background image is the process of obtaining the image without vehicles, persons or fallen objects. If the background image is obtained, the difference image is generated by calculating the difference between the current image and background image. The pixels that have the difference value greater than the threshold is saved and these pixels represents the region large change occurred. To connect with partially broken pixels, closing operator is performed. To separate into a single object region, chain search is applied to pixels corresponding to the boundary.

The geometric shape of objects was used as a standard of determination whether detected objects are vehicles, pedestrians, falling objects. The object width, area, aspect ratio and fill-in ratio are used as the criteria for the classification. Last step is update process that the portion except the object region from the current image is updated in the background image. This makes it possible to reflect changes in the background image as the time passed by.

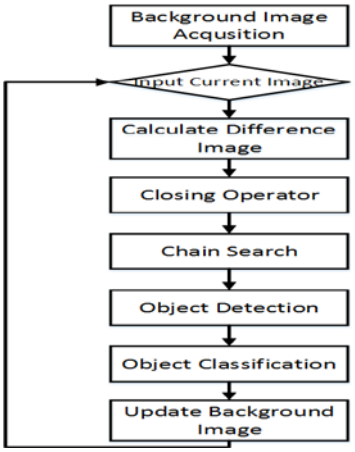


Figure 1: Flow Chart of Proposed Algorithm

III. PROPOSED IMAGE PROCESSING ALGORITHM FOR ROAD IMAGES

A. Background Image Acquisition and Updating

In a sequence of images, the initial background image is obtained from the difference between the current frame and the previous frame. Obtaining a difference between a previous frame and a current frame, in motion zone a large difference value is appeared and in the background zone does not move a small difference is appeared. In the region there is no movement the current image is directly copied to the background image, in the region there is movement, partial value of the current image is updated to the background value[4].

For acquisition of the background image, the method which store the number of frames and obtain the average value of each pixel value may be used for determining the background. But this method must store a number of images and through the complex calculation the value of each background pixel is calculated[8].

In this paper, we update the value to the background image as adjusting the refresh rate of the current image value and previous background image value. Repeating this process, only the part that does not move is left in the background image. Repeating this process for several frames, since only the image pixels that do not move is left, only the background portion can be extracted from the road image that include the appearance of the vehicle is traveling. Calculate background pixel value using the formula:

$$\mathrm{BG}_{t+1}(x,y) = \begin{cases} (1-\alpha)\mathrm{BG}_t(x,y) + \alpha I_t(x,y) & if\ diff_{pre-cur}(x,y) < Thresold \\ \mathrm{BG}_t(x,y) & othwewise \end{cases} \quad (1)$$

Here α represents a reflection ratio of the current image, as the value is larger, the background is achieved quickly.$diff_{pre-cur}(x,y)$represents the difference image between the current frame and the previous frame.

Also after the object classification is completed, background update process is performed so that the condition changes like change of illuminance or change of shadow is reflected to background image. At this time, the pixel values included in the region of the detected objects are partially updated to, and the other pixel values are copied to background. Updating the background pixel value, following equation is used.

$$\mathrm{BG}_{t+1}(x,y) = \begin{cases} \mathrm{BG}_t(x,y), & if(x,y) \subset Regionofobjects \\ (1-\alpha)\mathrm{BG}_t(x,y) + \alpha I_t(x,y) & otherwis \end{cases} \quad (2)$$

Figure 2: Background Image Acquisition

B. Coordinate Transform Ratio for Measuring the Size of the Objects

In general, surveillance camera in road is installed in high places and monitors a wide area of the road. For this reason, the size and shape of the target object appeared differently according to the installed height, angle and zoom factor of the camera. To use the geometric feature of object like size and area as the criterion of classification, these values must be normalized. However, for calculating the actual size and area of an object, we must measure the transform parameters of the installed camera and compute the complexconversion matrix for rotation, translation and zoom[10].

In this paper, the method is proposed to obtain the coordinates transformation ratio from the lane width of the two points on the road image, without measuring the parameters of a camera. Figure3 represents the linear approximation of the lane width at any y-position. Since the actual lane width is always constant, by using the relationship between the y-coordinate and the lane width in two points in road image, the coordinate transformation ratio of images is calculated from Eq. (3).

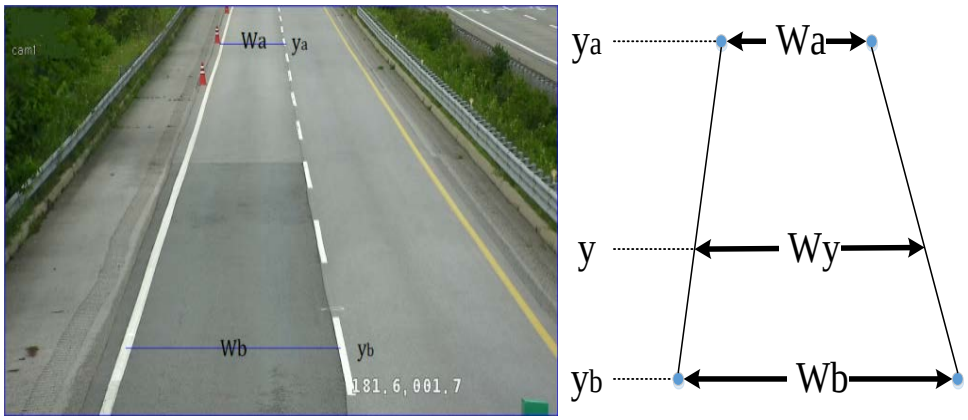


Figure 3: Linear Approximation of Lane Width

$$\text{Coordiate Transform Ratio(CTR)} = \frac{1}{W_b}\frac{(W_b - W_a)}{(y_b - y_a)}(y - y_b) + 1 \qquad (3)$$

In the road image as figure 3, when we enter the coordinate distance corresponding to each width of lane at two points y_a, y_b, the numbers of pixels W_a, W_b corresponding to the width of lane are measured. By using the linear approximation, coordinate transform ratio(CTR) is calculated, which W_b make 1 in y_b. Through this conversion process using the y-coordinates of the object locating, it can be normalized to the size corresponding to the fixed y-coordinates. Multiplying the coordinate distance W of an object in any y-coordinate and CTR corresponding to that y-coordinate, the coordinate distance can be obtained at the time of this object existing in y_b-point.

The length of an object must be obtained by multiplying CRT and the screen coordinates distance of the two points. The area of an object must be obtained by multiplying the square of CRT and area of the area calculated from the screen coordinates. Using the calculated CRT, It is converted into the length and area of the object in the same location from camera. In object detection process, in order to remove the noise pixel, the area and length of chain searched region is normalized and the region under the threshold regard as noise and the pixels is deleted. Also in object classification process, since the area and length used as criteria for classification, normalized area and length must be used.

C. Object Detection Using Background Subtraction

To detect an object from the image of the surveillance camera, we use the difference of the input image and the background image[9]. Pixels that are not included in the moving object region is stored in the background image, the difference value between the current image and the background image is calculated. All pixel value in the difference image having above threshold is set to white pixel. Closing operator is used for noise elimination in this image. Then Chain search for extracting the edge is performed and the inside pixels of edge is filled with white value. Difference image may include the changes of illuminance, the shadow component and the movement of boughs, as well as the desired objects. Thus the noise component is eliminated by reflecting the characteristics of the desired object. It is used the size, the aspect ratio, the area of object as the criteria for determining whether the object is noise or not.

As chain search be performed, CTR is used for normalizing the minimum size from the detected y-coordinate of the object. If the object size is below the threshold size or the aspect ratio is outside the threshold or the area is outside the allowable area, these pixels of the object are considered to be noise pixels and are eliminated. By this method, it is possible to detect an object only allowable size and area.

D. Classification of Detected Object

In order to classify whether the detected objects are vehicles, pedestrians, and fallen object, we use the geometric feature. Object width, area, aspect ratio and fill-in ratio is used as the criteria for the classification. The bottom point of the object region is obtained and the coordinate transformation ratio is calculated. This is used for normalizing geometric feature like the width and area. The width and area of the object is normalized by multiplying CTR. The aspect ratio is calculated from width/height. Fill-in ratio is calculated from the ratio of the number of white pixels to rectangular region pixels which exist in the object region. When these all values for decision are within allowable value of each object type, it is classified as each object type :a vehicle, pedestrians or fallen objects.

$$\begin{cases} \min_{widt\,h}(c) < D_i(c) < max_{widt\,h}(c) \\ \min_{area}(c) < D_i(c) < max_{area}(c) \\ \min_{aspect}(c) < D_i(c) < max_{aspect}(c) \\ \min_{fill-in}(c) < D_i(c) < max_{fill-in}(c) \end{cases} \quad (4)$$

Where c=1..3 each represent the object type (vehicles, pedestrians, fallen object). Here i represent detected object number, if only all condition is satisfied, i-th object classified to type c object. If even one condition is not satisfied, the next type is examined.

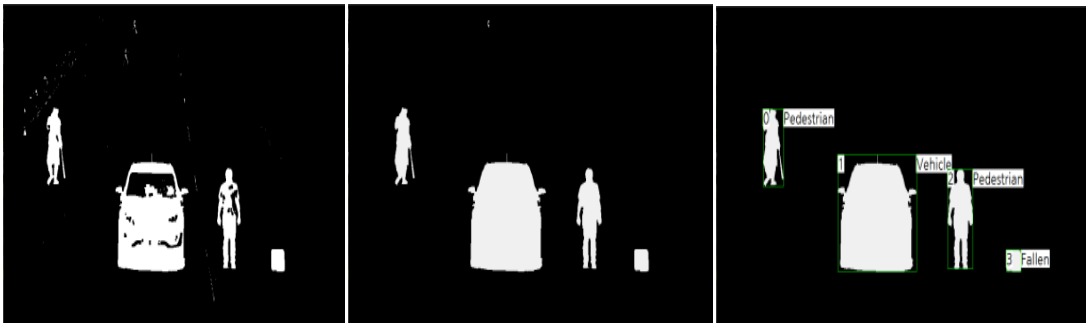
Except for the region in which objects exist, the remaining pixels are updated to the background image pixels, It is to reflect the pixel change to background image over time. When updating the background image, each weight is multiplied to the existing background pixels and new input pixels and the new background pixel value is calculated from the sum of these values. This is to prevent serious errors caused by object detection failure.

IV. IMPLEMENT AND EXPERIMENTAL RESULT

The camera with 1920*1080 resolutions is used for the implementation of the algorithm. For calculating the coordinate transformation ratio, it is used that the two x-point distance of the lane width at the y-point 100 and y-point 900 each. To make the initial background image, a background image is collected for three minutes from the difference between the previous image and the current image in the road image. The reference width of each object was defined as the value at the y-point 900 position. We used the relative proportion of the lane width as a reference value, the minimum and maximum range of values was determined at 25% of the reference value.

The reference vehicle width was 0.75*LW, pedestrian 0.3*LW, fallen objects 0.1*LW. LW represents the x-point distance of the lane width at the y-point 900. The aspect ratio is defined as width/height of an object. A vehicle aspect ratio is set to 0.8, a pedestrian 0.4, fallen objects 1. In object classification process, if it does not satisfy any classification criteria then the object is classified as unknown object.

(a) (b) (c)



(d) (e) (f)

Figure 4: (a) Input Image, (b) Background Image, (c) Difference Image, (d) Result of Closing Operator, (e) result of Chain-Search, (f) Result of Classification

Figure 4 shows the step-by-step process results and each object have been classified as vehicle and pedestrian, fallen object. The program was executed in the test road and the actual road. The experimental results were obtained as shown in Table 1.

Table 1: Accuracy of Proposed Algorithm.

objects	No. of objects	result of classification	no. of misclassifications	Accuracy of classification(%)
vehicle	463	424	29	91.6
pedestrian	63	57	6	90.4
fallen object	55	53	2	96.3

In experimental result, there was a case of misclassification due to the shadow of object and object color. This is because the object has not been properly classified under the influence of the shadows and the object region overlap. If the color of the object is similar to the ground color, it is difficult to classify.

V. CONCLUSION

In this paper, the proposed algorithm can detect a number of objects that appear in the road image and classify these objects. An object was classified based on the geometric feature of the object region. We have used a coordinate transformation method to normalize the size of the object. Object detection and classification of the road image, will be helpful in the preventing the additional road incident and in the effective road management.

In order to reduce the misclassification, a suitable algorithm for detecting a shadow of the image will be able to get a better performance. Also in successive frames, if the location of the object in the next frame is estimated from the object information detection in the previous frame it is believed that get better performance[11].

ACKNOWLEDGEMENT

This work was supported by the Shinhan University Research Fund.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Formal Methods for Group Key Management Scheme Using Counting Bloom Filter in VANET

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Abstract---

Background/Objectives: Vehicular Ad-hoc Network(VANET) is a kind of ad hoc networks. In VANET, group signature schemes for user privacy have been studied by many researchers. Many results require lots of computational overhead of RSU(Road-Side Unit) and the vehicle(V) in group key generation and update phases. Therefore, we propose efficient group key management scheme which can reduce computational overhead of the RSU and the vehicle.

Methods/Statistical analysis: In this paper, we propose a group key management scheme using the Counting Bloom Filter(CBF) for VANET. It is to manage to generate and to update group key itself between RSU and V. Counting Bloom Filter provides a way to implement a delete operation on a counting bloom filter without recreating the filter a fresh. Therefore, proposed scheme provides that it generates a new group key itself through a group key that you own

Findings: It is important to guarantee the safety of this group key and to reduce computational overhead of the RSU(Road-Side Unit) and the vehicle(V) in the group communication. In VANET, it required the weight group key management. Therefore, using the Counting Bloom Filter(CBF) in the RSU(Road-Side Unit) and the vehicle(V), to generate and update of the group key is suitable for VANET.

Applications: In addition, we analyze a stability verification of proposed scheme using Casper/FDR approach among formal methods. The Casper/FDR approach translates a high-level description of a security protocol. It will give a better idea about designing group key management with minimum cost, communication and computation parameters when the group members join/lead from the groups.

Keywords--- Vehicular Ad-hoc Network, Counting Bloom Filter, Self-organized Group Key Management, Casper, FDR, Formal Verification.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

In roads, traffic congestion is more and accidents occur due to it. Rash driving causes loss of lives so to prevent that safety driving applications are made. To avoid accidents VEHICULAR ad hoc networks (VANETs) are used which have attracted a lot of attention due to their interesting and promising functionalities including vehicular safety, traffic congestion avoidance, and location based services.

VANET is a network environment which provides the communication between vehicles and between vehicles and RSU using wireless communication. Vehicle-to-Vehicle(V2V) and Vehicle-to-Infrastructure(V2I) communications are two basic communication modes in VANET

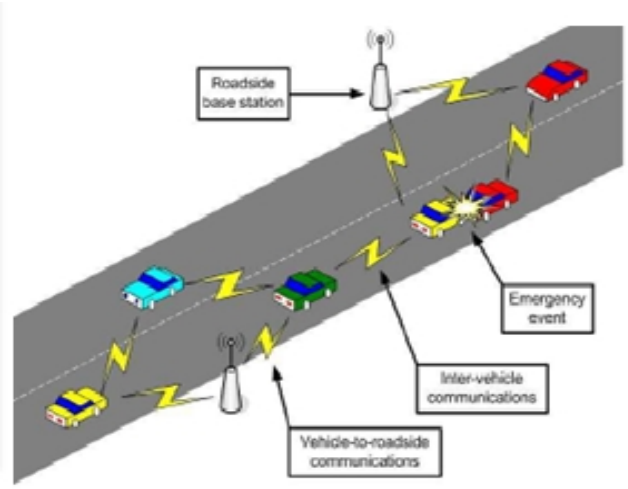

Figure 1: VANET Model

VANET is very important to protect safety and life of people. Because of a vehicle movement information can be easily exposed. Therefore, the occurrence of user privacy issues.

Specially, in V2I, many results require lots of computational overhead of the RSU and the vehicle in group key generation and group key update phases. In this paper, we propose a self-organized group key management scheme using the Counting Bloom Filter(*CBF*) and we use the Casper/FDR-approach among formal methods for a stability analysis of the proposed protocol.

The remainder of this paper is organized as follows. SectionII introduces related works. Section III describes self-organized group key management scheme using a counting bloom filter and analyze a stability of proposed protocol using formal methods. Section IV gives the concluding remarks.

II. RELATED WORKS

A. Security Requirements[1,7]

Authentication

To verify the identity between vehicles and RSUs Authentication is required and also for the validation of the integrity of the information exchange. It also ensures that all the nodes are the authenticated vehicles to communicate within the network. To establish connection between vehicles, RSUs and AS, public or private keys with certificate authority are proposed. On the other hand, as an authentication method, password is used to access to the RSUs and AS.

Non-repudiation

It ensures the sender and receiver so that later on it cannot deny ever sending and receiving the message such as accident messages. Non-repudiation is also called audit ability in certain areas.

Integrity

Data integrity is very essential because it assures that the data received by nodes, RSUs and AS is similarto the data which has been generated during the exchanges of the message. Digital signature, which is integrated with password access, is used to protect the integrity of the message.

Key exchange

A vehicle that requires a secret communication, to make sure the mutual identity verification of the vehicle you wish to secret communicate. There after, it is necessary to generate a session key for protecting the data and the session key should be safe from various attacks.

B. Group Member Requirements[13]

Low Storage

It means minimum number of keys required for communication, so that key server will be working efficiently and fast access from the memory. In high storage may require more memory and computation for key management.

Low Computation

If the minimum number of keys is used by key server and group members, so that it required low computation. A benefit of low computation has increased efficiency and response time of key servers to group members.

C. Groupkey Signature Scheme

Existing group key management approach, the vehicle that attempts to join the group sends a request message to RSU at regular time intervals. The RSU if the message to more than one receiver, it is determined to be similar to their speed and direction, and transmits a message for accepting join the group. RSU is to issue a group keyusing the key issuing protocol such as the following,

1) Vehicle transmit the request message of the group key to RSU.
2) Group manager encrypts a group key by the public key of the vehicle and add a digital signature of the group manager sent to the vehicle.
3) Vehicle acquires the group key to decrypt the message by private key. Vehicle transmit all of the messages that have been encrypted using the issued group key to the group manager and acquires traffic information by decrypts the received messages using the issued group key. Also, there is a need for a periodic group key update in order to protect the key to safety at a malicious attacker.

In Lin et al.[2] proposed a system using group signature and the ID-based public key systems proposed by Boneh[2]. In system, its usegroup signature in communication between vehicles and use ID-based public key signature when RSU transmits a message to a vehicle. This scheme, as well as the anonymous ID–based public key system, because it is a form to withdraw by transmitting the revocation list to each vehicle, is not appropriate to be used in VANET. Also, this scheme since the signature uses the zero knowledge technique is not efficient.

Calanzelle et al.[3] used a group signature scheme like Lin. However, they propose a schemethat each vehicle creates pseudonym certificate itself using the group signature key rather than each vehicle exchange a message by using the group signature.

However, this scheme must confirm the group signature in order to use the generated pseudonym certificate. Then, it must confirm the signed message using the pseudonym certificate. Therefore, a relatively large cost use for checking each message.

III. PROPOSED SCHEME

A. Counting Bloom Filter

A bloom filter[6] is a data structure used to support membership queries. Simply put, a bloom filter is used to test whether an element is a member of a given set or not. Its main properties are:

- The amount of space needed to store the bloom filter is small compared to the amount of date belonging to the set being tested.
- The time needed to check whether an element is a member of a given set is independent of the number of elements contained in the set.
- False negative are not possible.
- False positives are possible, but their frequency can be controlled. In practice, it is a tradeoff between space/time efficiency and the false positive frequency.

A bloom filter is based on an array of *m* bits (b_1, b_2,…., b_m) that are initially set to 0. To understand how a bloom filter works, it is essential to describe how these bits are set and checked, For this purpose, k independent hash functions (h_1, h_2,…., h_k) each returning a value between *1* and *m*, are used. In order to "store" a given element into the bit array, each hash function must be applied to it and based on the return value r of each function (r_1, r_2,…., r_k), the bit with the offset *r* is set to 1. The following figure 2 is an example where *m*=16, *k*=4 and *e* is the element to be "stored" in the bit array.

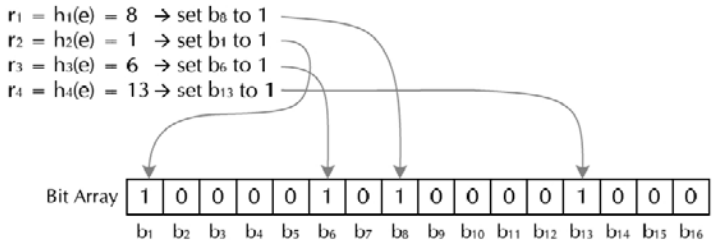

Figure 2: Bloom Filter

Counting Bloom Filter(CBF) provides a way to implement a delete operation on a counting bloom filter without recreating the filter afresh. In a counting bloom filter the array positions (buckets) are extended from being a single bit of being a n-bit counter. In fact, regular bloom filters can be considered as counting bloom filter with a bucket size of one bit. The counting bloom filter was introduced by Fan et al.(2000).

Deleting elements from a bloom filter cannot be done simply by changing ones back to zeros, as a single bit may correspond to multiple elements. To allow for deletions counting bloom filter uses an array of *n*counters instead of bits; the counters track the number of elements currently hashed to that location. Deletions can now be safely done by decrementing the relevant counters. A standard bloom filter can be derived from a counting bloom filter by setting allnon-zero counts to 1. Counters must be chosen large enough to avoid overflow.

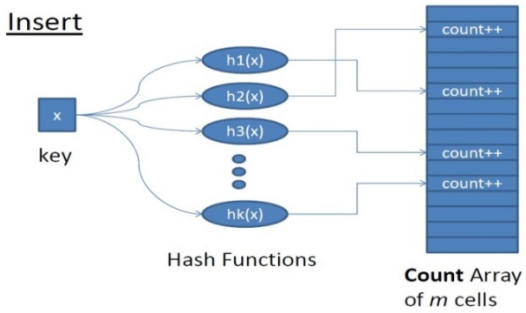

Figure 3: Counting Bloom Filter(insert)

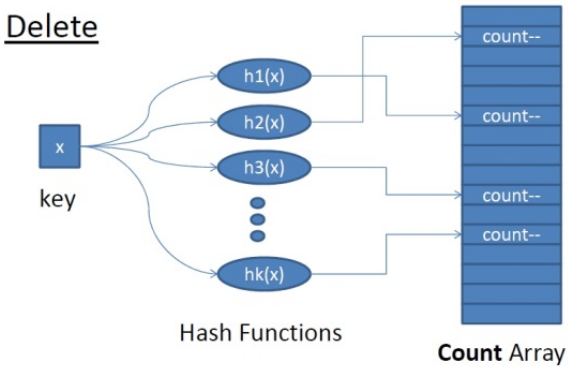

Figure 4: Counting Bloom Filter(delete)

B. Self-Organized Group Key Management Scheme using a Counting Bloom Filter

Group manager(*RSU*) and vehicle(*V*) have used the Counting Bloom Filter(*CBF*). Using *CBF*, *RSU* and *V* are reducing the computational overhead and decreasing the communication traffic. The proposed scheme is composed of a group key generation and issuephases, a group key update and authentication phases.

Step 1: Pre-stage

Each *RSU* and *V* is a pre-registration with the trusted authority(*TA*) before they are deployed on the network. *RSU* will receive a personal key through the registration process and *V* is generated by using the private key value received from the *TA. V* and *RSU* registration process are assumed to have been carried out through a secure network.

Step 2: Group key generation and issue phase

It is separate group initial creation stage and join stage of the new vehicle after creation stage.

1) Group key initial creation stage

$$RSU \rightarrow V_0 : E_{KS}(IV)$$

Entered intothe new vehicle(V_0) group, *RSU* is sent to the vehicle by encrypting the *IV* value with the public key of the vehicle

$$V_0: C \rightarrow CBF(IV) + CBF(ID)$$

The new vehicle(V_0) will be generated by the CBF their *ID* and *IV* value and it uses the value of *C*. *C* is a bit vector value

2) Group key creation at the time of join process of new the vehicle after group key initial creation

$$RSU \rightarrow V_n : E_{KS}(C_{old})$$

RSU is sent to the new vehicle(Vn) by encrypting initial group key(C_{old}) with the public key of the new vehicle

$$RSU \rightarrow * : ID = C_{old +} V_{id}$$

RSU sends a new identity(*ID*) by bit operation the previous group key(C_{old}) and the identity of the vehicle (V_{id}) to all vehicles(*)

$$* : Extract\ Vid\ from\ ID$$

$$V_{id} = ID - C_{old}$$

$$C_n = C_{old} + CBF(V_{id})$$

The vehicles within a group can obtain the new vehicle ID by deflating the previous group key (C_{old}) from the vehicle ID come from RSU. Also, the new group key(Cn) is generated by the previous group key(C_{old}) and the new vehicle ID using CBF.

$$Vn \text{ create } Cn \text{ with } C_{old}$$

$$Cn = C_{old} + CBF(V_{id})$$

The new vehicle is generated new group key(Cn) by the previous group key(C_{old}) and the new vehicle ID using CBF.

Step 3: Group key update phase

It is a new group key creation process when the vehicle leaves the group

$$RSU \rightarrow * : E_c(V_{id})$$

RSU transmit to all vehicles by encrypting the vehicle ID withdrawal using the group key(*C*).

$$V: C_n = C_{old} - CBF(V_{\mathrm{id}})$$

All the vehicles have generated new group key(C_n) by subtracting the value of CBF generated by the vehicle ID from an existing group key(C_{old})

Step 4: Group key authentication phase

The vehicle authenticates the new group key(C_n) how it transmits the vehicle ID received from RSU by encrypting with group key and it generates itself through a group key(C_{old}) that you own

C. Formal Methods

Formal methods are mathematically-based techniques for the specification, development and verification of software and hardware systems. We will use the formal verification of proposed scheme using the

Casper/FDR-approach. The Casper tool, developed by Lowe, translates a high-level description of a protocol into CSP, the process algebra of Communicating Sequential Processes developed by Hoare and co-workers. The CSP-program comprises various processes representing the agents involved in the protocol that run in parallel with an intruder that controls the network. Additionally the CSP-program contains the specification of the security requirements the protocol should meet. The CSP-program is fed into the FDR-tool, an industrial-size model checker for CSP. A Casper input file consists of a general part (variable and process declaration, protocol description and specification of requirement) and a specific part that instantiates the general part and specifies the intruder knowledge.

The proposed scheme show only some of the section header portion, such as an act and validation attribute of the security protocol among Casper specification. In other words, it represents #free variables, #protocol description, #intruder information. Other specifications parts will be omitted because of a very simple and clear.

#Free variables

A, B: Agent

sk: Agent → SecreteKey

pk: Agent → PublicKey

C_1,C_2 : group key

ID : identity

H : Hash function

Inverseakeys = (pk, sk)(H,H)

#Free variables section header defines the type and function of the free variables used in the protocol description. Agent A and B means identifier of the vehicle and the RSU and sk and pk mean secret key of the new vehicle and public key of the new vehicle. C_1 and C_2 mean group key of the vehicles and the inversekeys means the encryption and decryption of the message and H means hash function.

#Protocol description

0. → A : B
1. A → B : {A, C_1}{ pk(B)}
2. A → * : { H(C_1,ID)}
3. *→: {B, C_2}{ sk(A)} { H(C_1,ID)}
4. B → A : {B, C_2}{ H(C_1,ID)}

#Protocol description section header is to indicate that the exchange operation of the protocol. In the expression, {A, C_1}{ { pk(B)} means that A to encrypt the group key(C_1) with the public key of B.{ H(C_1,ID)} means that A is calculated using the hash function to the ID and the group key. {B, C_2}{ sk(A)} means that B to encrypt the group key(C_2) with the secret key of A. The hash function means a value using CBF.

Intruder information

Intruder = Mallory

Intruderknowledge = { Mallory, A,B, C_1}

Intruder information section header represents a priori information for the intruder to attack the protocol. For example, Mallorymean intruders and A and B meansthe vehicle and RSU.In this paper, we assume that an intruder can eavesdrop on all the identifiers of the agent.

D. Analysis

In this section, we verify the two properties privacy protection and efficiency.

1) Secret(A, sk(A,B), [A])
2) Secret(A, sk(A,B), [B])
3) Agreement(A,B,[sk,H, C_2])

The first expression, A is that know sk(A,B) information the only Aand the second expression, A is that know sk (A,B) information the only B. The third expression, A is that authenticate the sk, H, C_2 from B

Privacy

Because the vehicle ID(V_{id}) was created by a previous group key(C_{old}) through $RSU \rightarrow * : ID = C_{old+} Vid$ in the join process after group creation, even if the intruder joins group using the intruder ID, it cannot join in the group because it cannot know the previous group key(C_{old}).

Efficiency

RSU and *V* reduced the computational overhead in group key generation and update phase how remove of encryption and signature that the existing group key signature scheme of a new group key. In other words, since using *CBF* only the calculation of the hash function and the bit sequence is performed, it increased computational efficiency. Also, during *RSU* and *V*, by using the group key(C_{old}) previously used, since the new group key self-generate and updates the new group key(C_{new}) uniquely generated and, also made the reduction of traffic within a group

IV. CONCLUSION

In this paper, we propose an efficient group key management scheme in order to protect the privacy of VANET. The proposed scheme by using CBF is an efficient group key authentication. In other words, *RSU* and *V* in the group key generation and update phase were computed using only bit columns and hash function. Also, by updating the group key itself between *RSU* and *V*occur traffic decrease.In addition, the proposed scheme is more effective compared with conventional methods of addressing the problem that vehicle registration and authentication server must store the vehicle private key. Also, we analyze a stability verification of proposed scheme using Casper/FDR approach among formal methods. The results of the analysis show that the proposed scheme is secure privacy and high efficiency. In the future, the simulation performance analysis to prove the superiority of the proposed method will provide.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

The Study of Intel Xeon Phi Coprocessor's Performance Using Intel MKL Library and Open MP

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Abstract---

Background/Objectives: Intel Many Integrated Core (MIC) architecture includes 61 cores on a chip. Intel MIC, named Intel Xeon Phi, is twice faster in single precision floating point operation than Xeon E5 CPU. Intel MIC is optimized in numerical operation.

Methods/Statistical analysis: We did a few benchmarking tests with Intel Xeon Phi 7120P which has 61 cores of 1.238GHz clock speed, and 4 threads per core. We are going to make parallel programs using OpenMP and Intel MKL (Math Kernel Library).

Findings: we will compare the performance of Xeon Phi with that of Xeon E5 while increasing the number of threads in the programs. Additionally, we will test how the performance will be affected by clock speed, a number of cores and vector unit size in a parallel programming environment using OpenMP and Intel MKL. The program can reach its peak performance when it has the same number of threads as the physical cores.

Improvements/Applications: In Native mode Xeon Phi programming, the performance increases rapidly until 120 threads, and the performance is increasing from 120 to 240 threads, but not as fast as until 120 threads.

Keywords--- High-Performance Computing, Xeon Phi, SIMD, Parallelism, OpenMP.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

DKnights Corner with the brand name of Xeon Phi 7120P is a many-core processor made in 22nm assembly line. It has 2TFLPS of Single precision floating operation and 1 Tflops of double precision floating operation. The performance of Xeon Phi 7120P is similar to the performance of high end GPU, but still using CPU type instruction set. 61 cores in 62 cores of Xeon Phi 7120P are active and working at 1.238GHz. Each core has 512 -bit FMA vector unit, and 4 thread SMT (Simultaneous Multithreading), resulting 240 workable threads. We will test the effect of the clock speed, the number of cores, and the size of a vector unit to the performance.

In Fig 1, Xeon E5 has 256-bit vector unit, and Xeon Phi has 512-bit vector unit. The cores have their own memory that is cache coherent using a full MESI coherency protocol. Remote memory accesses are managed by the communication network (a full-duplex ring among the cores). The instruction set is based on the classical x86 instruction set with specific extensions to address SIMD capabilities and large vector operations[1]. Moreover, the processor does not reorder memory read and write instructions, which releases the application programmer from guarding memory accesses with expensive memory barriers.

Table 1: The Change of SIMD Vector Register

Instruction Set	Year	Intel Processor	Vector registers
MMX	1997	Pentium	64-bit
SSE	1999	PentiumIII	128-bit
SSE2	2001	Pentium4	128-bit
SSE3-SSE4.2	2004-2009		128-bit
AVX	2011	Sandy Bridge	256-bit
AVX2	2013	Haswell	256-bit
IMCI	2012	Knights Corner	512-bit

This is floating calculation that can be run at one time operation, and the eight Xeon E5 Xeon Phi twice with 16 of the differences. SIMD (Single Instruction Multiple Data) if the vector instruction to perform a two-fold difference in the speed indicates. Xeon E5 Xeon Phi and according to the specifications and the performance difference between the different hardware architectures OpenMP and Intel MKL (Math kernel library) to write code to use the hardware architecture of the performance and characteristics of each will be discussed.

The key point is Xeon Phi MIC must have used to optimize the performance of the architecture that will. Xeon Phi memory (typically RAM) was not designed for intensive operations, floating point vector arithmetic instruction is designed to allow a better handling. Therefore, the low-bandwidth memory Xeon Phi requiring a numerical calculation suitable. Therefore, for the calculation of the Xeon Phi architecture of optimized vector math library, you need to use one. So, we have OpenMP and Intel MKL (Math kernel library) to create a parallel program using the Host Exclusive mode (Xeon E5) and Native mode (Xeon Phi), respectively, the number of threads from 1 to 300 for each performance measure by increasing.

II. RELATED WORK

A. Xeon Phi Coprocessor

Intel has introduced a Xeon Phi Coprocessor as products based on a MIC (Many Integrated Core) architecture. The Xeon Phi Coprocessors are symmetric many-core processors; they look like a General-Purpose GPU. They plug into a host system via PCI Express. They have a µOS Simplified Linux OS System. But, a Xeon Phi coprocessor cannot be used as a stand-alone Operating System, and requires a host machine to operate. In terms of architecture, they also have many likenesses to General-Purpose GPUs. Xeon Phi Coprocessor core is based on an Intel x86 Pentium core architecture from the early 1990's. This is a much simplified, and so smaller core compared to modern Intel x86 Architectures. To make the integrated cores more powerful, 512-bit (64-byte) wide vector units (VPU) have been added to the core. Each coprocessor features 57 cores to 61 cores clocked about 1 GHz, supporting x86 64-bit IMCI instructions. The number of cores depends on the model type and the product's generation. These in order type many-cores, it has more than 240 cores, support four-way hyper-threading performance. The Xeon Phi coprocessor (MIC) is interconnected by a bi-directional ring architecture, which combines the L2 caches of the cores into an aggregate cache over 30 MB.

The Xeon Phi coprocessor has 6 to16GB of on board GDDR5 High band width memory. Speed and energy efficiency of the Xeon Phi Coprocessor from the vector unit. Each core contains a SIMD vector processing unit, which be called VPU in general, with 512-bit (64-byte) Single Instruction Multiple Data (SIMD) vectors supporting a new instruction set (IMCI). And that is called Intel Initial Many-Core Instructions. See Figure 1.

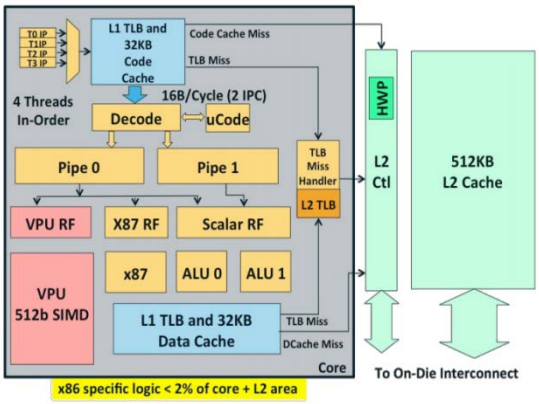

Figure 1: Intel Xeon Phi Coprocessor(MIC) Architecture

The Intel Xeon Phi IMCI include, among other instructions the Fused Multiply. And These FMA instruction set Typically used to add a physical modeling and statistical analysis (FMA) cross, square root, exponential and power operations. The theoretical peak performance of a Xeon Phi coprocessor is about 1 TFLOP/s in double precision and about 2 TFLOP/s in single precision. The Xeon Phi power consumption is just same two-socket Xeon system that 2-3 times less GFLOP/s than Xeon Phi system.The Xeon Phi programming model is especially attractive when the applications developed in heterogeneous computing environments.

B. OpenMP

OpenMP is a specification for parallel programming on shared memory environment. That can be used to specify the parallelism of memory - OpenMP is shared in Fortran, C, C ++ program pragma, execution of the routine, and provides environment variables. The OpenMP API has received the strong support of suppliers, including industry standards, IBM, Intel and Sun Microsystems for shared memory parallel programming loop level. C/C ++, and Fortran OpenMP standard binding is carried out in a wide range of current commercial research compiler. In this study, we will expand the research compiler for OpenMP. The OpenMP API of generally parallel support region, a parallel section and a parallel loop. We expect the basic concepts and syntax of the OpenMP known. OpenMP has come out over the past few years as a dominant applicable programming interface that represents a level of parallelism of the loop for shared memory systems. Using a simple parallel forehead plaque designed to increase parallelization of sequential applications. OpenMP is supported by the increase of the hardware and software vendors, and many performance evaluable groups.

C. MKL (Intel Math Kernel Library)

Use the highly optimized vector/matrix functions in Intel's Math Kernel Library (MKL) or lower level Vector Math library (VML) [5]. These libraries use optimized assembly language that takes advantage of the SIMD vector instruction set for the Xeon Phi. So far, I've only could run things faster on the Xeon Phi (than on the host) when using MKL routines. In the end, all arithmetic operations on data arrays can be performed using vector/matrix operations so it is advised to use these whenever possible. One finding with MKL (see benchmarking below) is that computations run more efficiently for relatively large input vectors and matrices. This establishes the power of the Xeon Phi. More threads are automatically spawned for big jobs.

D. SIMD (Single Instruction Multiple Data)

SIMD is an abbreviation of the term Single Instruction, Multiple Data streams. It describes a computer architecture that deals with multiple data streams simultaneously by a single instruction. Despite recent CPUs support SIMD instructions, plain C/C++ codes are composed of SISD (Single Instruction, Single Data streams) instructions. However, with SIMD instructions, one can sum multiple numbers simultaneously, or can calculate a product of vectors with fewer loops. Since the large SIMD width of 64 Bytes vectorization is more important for the Xeon Phi MIC architecture than for the Intel X86 Xeon system. The MIC architecture offers

new instructions like gather/scatter, fused multiply-add, masked vector instructions, etc. which allow more loops to be parallelized on the coprocessor than on an Intel Xeon based host. In 2006 Intel started developing an many-core design (Codename Larrabee), initially targeted as an alternative to existing graphics processors. It uses a 512-bit SIMD instruction set called IMCI (Initial Many-Core Instructions).

E. FMA (Fused Multiply and Add)

FMA represents the number of arithmetic operations in a "Fused-Multiply Add" instruction. That is, these Intel processors can execute a "multiply and add" (two separate operations) as a single instruction, at the same clock rate.

III. PROPOSED WORK

Intel Xeon Phi Coprocessors Intel recently announced the Intel R Xeon Phi TM coprocessor platform that is based on the concepts of the Intel Architecture and that provides a standard shared-memory architecture [2]. The coprocessor prototype used for the evaluation has 61cores clocked at 1090MHz and offers full cache coherency across all cores. Every core offers four-way hyper threading and 512-bit wide SIMD (Single Input Multiple Data) vector processing units (VPU), which corresponds to eight double-precision (DP) or sixteen single precision (SP) floating point numbers [3]. Figure. 1 shows the Intel Xeon Phi coprocessor architecture. So, these vectorization capabilities and the large number of cores, the coprocessor can deliver 1063.84 TFlops of DP performance. In the system, we used, the coprocessor card contained 8GB of GDDR5 memory and it was connected via PCI Express bus to a host system with two 10-core Intel R Xeon TM E5-2690 processors and 16GB of host main memory [3].

During the test for Xeon Phi we have two Compile/Run mode to study:

a. "Native-MIC (Xeon Phi)" MIC O / S so that you can run on Xeon Phi compiled into the binary. This is the code I / O and memory-intensive tasks with low levels suitable for operations.
b. "Host-exclusive (Xeon)" Host Xeon E5 CPU Xeon E5 CPU, so you can run compiled into a binary file in this way the data is high host processor / memory I / O is suitable for demanding tasks as shown in Figure 2, Many options are available for communication between the host system and the Xeon Phi Coprocessor. The Xeon Phi coprocessor driver provides network interfaces, so we can simply use the TCP/IP network stack. In terms of management and compatibility with existing applications, this is a good thing. Because of the network stack is designed for a different purpose and communication via the PCI Express, on the other hand, it can't provide the best performance [4].

The Linux Host with the Intel Xeon Phi coprocessor of the hardware and the communication via PCI Express Bus, SSH protocols to the communication.

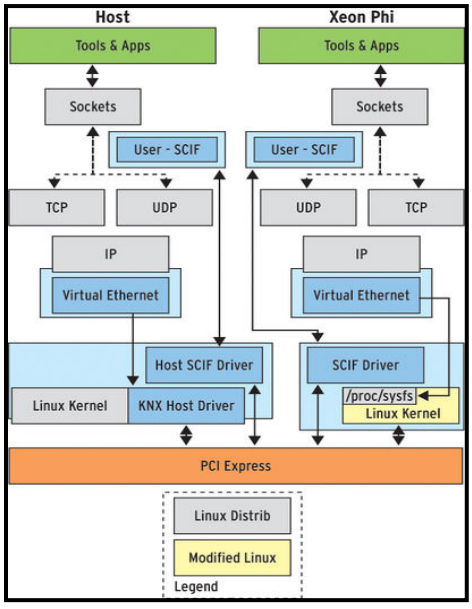

Figure 2: Xeon Phi and Xeon E5 System Architecture

A. Programming Approaches on Intel® Xeon Phi™ Coprocessors

- Offloading: For heterogeneous compilation, the programmer needs to add pragmas and directives to the code in such a way that enables the highly parallel compute intensive section to run on the Intel® Xeon Phi™ coprocessor. The offload directives are available for C, C++ and FORTRAN. The Compiler generates a binary when compiled with "offload-build" compiler flag. When the program executes, it causes two compilations, the host compiler generates code that sends input data to the target and receives results from the target. The target compiler generates code that receives input data from the host, performs the computation and then returns results to the host [5].
- Native compilation: Standalone application is to be built which will be directly executed on the Intel® Xeon Phi™ coprocessor. This is also known as implicit compilation as programmer need not change single line of source code. "- mmic" compiler flag is used while compilation. Additionally, programmer needs to set environment variable "MIC_LD_LIBRARY_PATH" to point to own target library. To execute natively compiled code on the Intel® Xeon Phi™ coprocessor, end users need to copy the executable and the required data, libraries directly onto the Intel® Xeon Phi™ coprocessor.

B. Execute Benchmark

We first conducted a simple test that multiplies two matrices with 3000 × 3000 × 20 elements each. We call this test "naïve" since it's programmed using nested loops over each matrix element and carrying out the arithmetic as we go along, i.e., as the textbooks say when multiplying matrices. The multiplication operation was repeated 10 times and the performance metrics were averaged at the end. We have also parallelized the loop computations using OpenMP pragmas [6,7,8]. We were suspicious from the outset that this approach was non-optimal for the Xeon Phi, but we wanted to see where this would take us. Such code is typical of heritage software lying around for performing matrix computations (without the multithreading of course). The theoretical performance one expects from the Xeon Phi is:

#GFlops/sec = 8[#double precision floats in SIMD vector unit] × 2[FMA] × 1.238[GHz] × 61[cores]

= 1208.42 GFlops/sec

~ 1.2 Tflops /sec.

The theoretical performance one expects from the Xeon E5 2690 is:

#GFlops/sec = 4[#double precision floats in SIMD vector unit] × 2[FMA] × 2.90[GHz] × 20[cores]

= 430.642 GFlops/sec

~ 0.43 Tflops /sec.

C. The Results of Benchmark

Intel matrix operations when we MKL (Math Kernel Library) was used to write the code. Intel MKL library is 512-bit SIMD (single input multiple data) instructions, optimized for use with threaded code compilation step because it is operating in SIMD Auto Vectorization, CPU internally FMA (Fused Multiply and add) instruction set to use becomes [9,10].

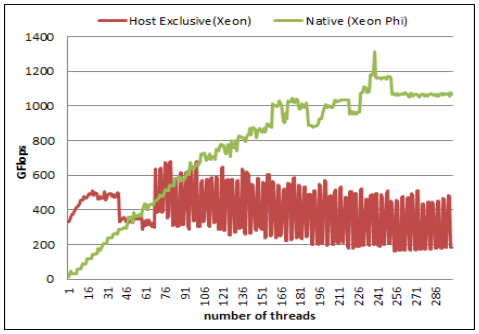

Figure 3: Host Exclusive-Xeon and Native-Xeon Phi Mode Threads from 1 to 300 While Increasing performance Figures Shown (GFlops)

Host Exclusive-Xeon and Native-Xeon Phi mode threads from 1 to 300 while increasing performance figures shown (GFlops)

Figure 3 look "Host exclusive (Xeon)" mode, the thread closes to the number of more than 20 can be seen that the result of the above does not have a great relationship. Performance figures are the number of threads up to 101 days was measured in the 682.256 GFlops. This is compared to 79% of the theoretical maximum performance of 861.184 GFlops of performance figures.

"Native (Xeon Phi)" mode, the number of threads with more than 120 having a linear function of the relationship more than 120 up to 120 up to 240, but weaker than the slope of the number of threads increases, the performance figures of the relationship will continue to grow it to. Increase of more than 240 the number of threads in the change of the performance figures virtually does not occur. For maximum performance and the value of the number of threads 1312.25 GFlops when 239 threads, respectively. This is the theoretical maximum performance of 54% compared to 2416.84 GFlops of performance figures.

IV. CONCLUSION

In Figure 3, we could find out that the performance of Host Exclusive Xeon 5 was increasing until 20 threads, and there is no increase in performance when the program has more than 20 threads. Therefor it says that the program can reach its peak performance when it has the same number of threads as the physical cores. In Native mode Xeon Phi programming, the performance increases rapidly until 120 threads, and the performance is increasing from 120 to 240 threads, but not as fast as until 120 threads. And when the program has more than 240 threads, there is not much change in performance. Xeon Phi has 61 physical cores and 4 threads per core. 2 ALU (arithmetical and logical unit) are included in one physical core. Until 120 threads, each thread can operate independently and until 240 threads, threads shared ALU in cores. When over 240 threads, there is no performance gain. And, when using Intel MKL library which is optimized in Intel architecture and vector operation, we could get about 1.3 Tflops peak performance, which is the double of Xeon E5 (2.9 GHz, 20 cores).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Successful Strategy of Online P2P lending Using ANP-Fuzzy TOPSIS Method: Focusing on Updated IS Success Model

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Abstract---

Background/Objectives: This study investigates core factors that influence the online P2P lending and their relationships in selecting the most preferred online P2P lending website.

Methods/Statistical analysis: Based on IS success model with ANP and Fuzzy TOPSIS, our research conducts an evaluation model. The ANP is used for determining weights of updated IS success model's criteria, fuzzy sets are adopted to recommend ambiguity with linguistic values and TOPSIS is a useful tool to get final ranking on the list. The study was examined by 6 e-business specialists

Findings: This paper investigates the online P2P lending with updated IS success model. The major results of this paper offer the online P2P lending company decision makers with valuable information to enhance business quality. First, Trust is an extremely essential factor than others within an online P2P lending website. Because all transactions are conducted in the virtual space, lenders and borrowers can only meet in the online platform during the financial transactions. If they don't trust these websites, they can't deal with a contract. Second, in the online P2P lending, the information quality posted has much influence on trust and satisfaction. The investors who participate in this online market intend to investigate borrowers' information from this site before making investment decisions. Finally, this study suggests efficient operating scheme in this field. The results provide guidance so that decision makers can obtain competitive power via the investigation in their limited capability and resources.

Improvements/Applications: This study provides a research framework for easy understanding, which can be followed by practitioners and researcher to determine the suitable environment for online P2P lending.

Keywords--- The Online P2P Lending, Updated IS Success Model, ANP, Fuzzy TOPSIS.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Online P2P lending brings transformed businesses and redefines the roles of traditional financial intermediaries[7]. It is a virtual marketplace where both lenders and borrowers can meet for loans. There are several online P2P lending platforms in South Korea, such as Auction money, Pop funding, Keeping funding, 8 percent, Tera funding, Lendit, Funda, etc. It is expected that loans lead by the P2P lenders in the South Korea alone will reach 110 million dollars by 2016[21]. The online P2P lending relies on the integrated information system, which has the possibility to increase cost-efficiency of the financial market[7]. On the other side, the online P2P lending involves high risks because most lenders of the online P2P lending are lack of financial know-how and these transactions are processes without enough collateral [11]. Thus, new decision-making factors are necessary to discuss for the online P2P lending such as IS success model.

This paper includes three objectives: First, measuring the relative importance of the online P2P lending success factors by using updated IS success model[4]. Second, investigating alternatives ofthe online P2P lending and designing a more accurate online P2P lending business model for loan service which deriving personal investors to optimize investment decisions[7]. Finally, suggesting online P2P lending strategy and providing decision support framework for assessing online P2P business strategy carefully.

II. LITERATURE REVIEW

A. Evaluating Online P2P Lending Success

IS Success Model is an often cited model that considers with e-business success including the information system quality[4]. This model can be measured in core categories of the new e-commerce environment. Especially, Updated IS Success Model can prove the relationships of mutual information system dimensions including system quality, information quality, and service quality. These will in turn have directand indirect effects on use and user satisfaction. Additionally, use and user satisfaction are antecedents tonet-benefit singularly and jointly. This model does not have a general linear structure but a network cycle structure[14]. Lee &Kozar[10]applied IS success model including vender-specific quality for investigating the most preferred website. Keramati&Salehi[9]evaluated website quality using integrated tools of IS Success model and ANP.

B. Online P2P Lending Success Strategy ANP fuzzy TOPSIS Framework

ANP, developed by Saaty[20],has been adopted for tracking Multiple Criteria Decision Making (MCDM) of the real applications[9,14]. MCDM methods are suggested to be one of the most useful methodologies for important decision makings of vague and ill-defined problems. It is ANP to measure network structure and feedback mechanism by ratio scale. The TOPSIS is a MCDM tool based on distance that adopted for determining alternatives[20]. Fuzzy TOPSIS is extended to the fuzzy calculations and fuzzy index[13]. Furthermore, MCDM such as fuzzy TOPIS has been adopted by a list of alternatives under uncertain or conflicting attributes[14,16]. As indicated in Figure 1, a five-step configuration of ANP and fuzzy TOPSIS was integrated to build a model to analyze online P2P lending success.

Figure 1: The Online P2P Lending Success Strategy

III. RESEARCH MODEL

The IS success model was appropriate for measuring the quality of the general websites. However, as the online P2P lending belongs to the emerging commerce so that it needs a fresh method for conceptualizing

quality[11]. Based on the previous literatures of the evaluation of IS success[4], such as quality of website on e-business success[10], success of website comparison perspective of ANP[9], evaluation of e-commerce based on E-S-QUAL[8]. As a result, we developed the online P2P lending success model by classifying attributions into the seven dimensions and 10 sub-criteria set of table 1: *Information quality, system quality, service quality, satisfaction, trust, and use.* This study presents a research model for online P2P lending criteria weights (see Figure 2).

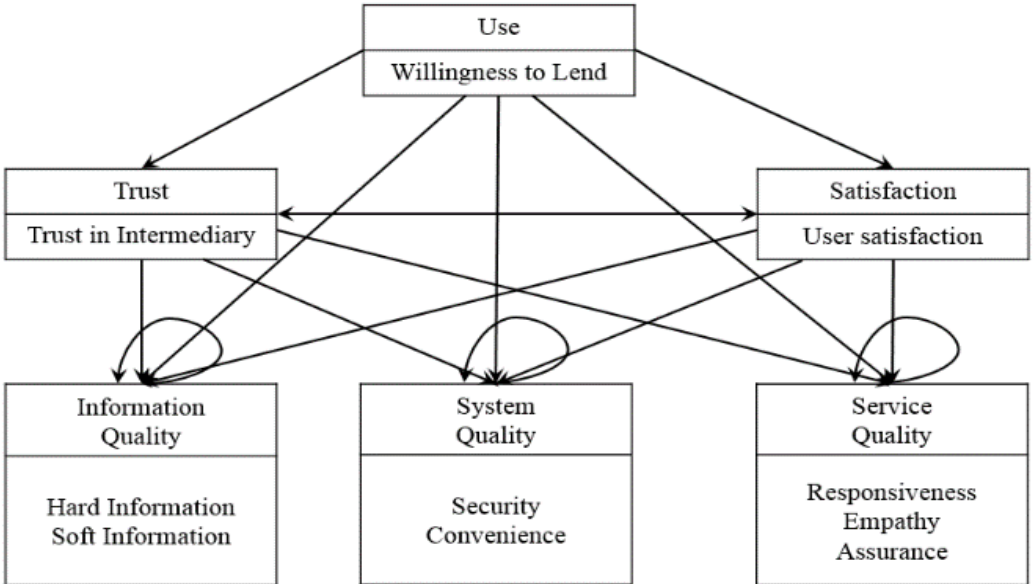


Figure 2: ANP Model for Using P2P Lending

According to Keramati&Salehi[9] Updated IS Success Model has a network structure. They adopt this model with ANP method for investigating the importance of each IS factor in alternative websites. The detailed discussions are as follows: Information quality of information producing and delivering takes account of a core factor for IS success. Traditionally, information quality is measured through information relevance, currency, and understandability. But hard information (such as personal deposit certification, the reimbursement record) and soft information (such as frequency of communication on the online channel), more importantly, they are measured within online transaction[11]. System quality, considering derives fromIS performance related to the prompt and accurate process, also is a primary reason that influencing adoption[10] of technology. Here, we consider two factors that are Security and Convenience[9]. Service quality refers to supportive activities, direct and indirect, such as the kind and quick client response, useful functions[3]. This can provide more smooth and pleasant experience. Guoetal.[7] have stated that it is necessary to support the valuable and pleasant experience to elicit an investment. Therefore, many researchers refer to the importance of trust in an e-commerce environment. It can reduce the risk of uncertainty related with anonymous online transaction[5]. The online transaction has three trust parties involved with the intermediary, the seller and the buyer[12]. In the online P2P marketplace, transaction processes consider, not only vendor's various characteristics but also information of the intermediary[6]. Previous studies indicate that user-satisfaction is a critical factor for system adoption[9]. Satisfaction has been often defined as a feel of happiness or contentment. When a customer gets enough satisfaction from the vendor, they feel stable and tend to stay in a business[1]. The online P2P lending is based on the mutual trust and using satisfaction by lenders, borrowers and Intermediary. Both who have used the website and who continue to share the idea with others originate from individual experiences[2]. Table 1 shows the measurement items and operation definitions.

Table 1: Online P2P Lending Success Measures

Reference	Updated IS Success Model	Online P2P Lending success measures	Definition
Lee & Lee [11]	Information Quality	Hard Information	The history of whether payments were made in right time, stock returns, and vast output numbers on the online P2P lending
		Soft Information	The history of frequent communications in bulletin board on online the P2P lending
Keramati& Salehi[9]	System Quality	Security	Protection of personal information when using the online P2P lending
		Convenience	Ease of navigation
Keramati& Salehi[9]	Service Quality	Responsiveness	Giving prompt service, amount of time it takes to get information about the borrower
		Empathy	Virtual assistant, offering online P2P lending product and services to lender
		Assurance	Report of experience of other lenders
Keramati&Salehi[9]	Satisfaction	User satisfaction	The experience of satisfaction about the online P2P lending
Chen et al. [3]	-	Trust / Trust in Intermediary	Protection of the interests of lenders in the online P2P lending
Chen et al. [3]	Use	Willingness to Lend	Willingness to lend through the online P2P lending

IV. METHODS

A. Calculating the Criteria Weights Using ANP

ANP is the MCDM allowing decision makers to deal with the complicated problem in a network structure[13]. ANP is the feedback approach which is appropriate for deriving priorities into interdependent influences. The ANP is founded on the following:

Step 1: *ANP is composed as a network structure*. ANP is decomposed into a network structure such as hierarchy structure of intertwined with decision criteria. Within the ANP, the objectives, criteria and alternatives have been arranged in a network framework. Figure2 shows overall goal (use) and numerous criteria that defined alternatives as *trust, satisfaction, information quality, system quality, service quality.*

Step 2: *set up a pair-wise comparison matrix*. Since the pair-wise comparison can identify the vis-a-vis weight of criteria, all criteria are assigned to pair-wise matrix on the basis of their influential relationship into the network structural.

$$W = \begin{array}{c} \\ C_1 \\ C_2 \\ C_m \end{array} \begin{array}{c} \begin{array}{ccc} C_1 & C_2 & C_m \end{array} \\ \begin{bmatrix} w_{11} & w_{12} & w_{1m} \\ w_{21} & w_{22} & w_{2m} \\ w_{m1} & w_{m2} & w_{mm} \end{bmatrix} \end{array} \quad (1) \qquad \lim_{k\to\infty} W^k \quad (2)$$

Step 3: *W is a transformation matrix. It entries are structured of the vectors calculated from this matrix*. Wrefers to a column stochastic matrix, its limited priorities reliance upon the reduce and network group of that matrix. If the matrix is irreducible, the limited figure is attained viarising W to powers such as in *Eq. (2)*for obtaining the global priority vectors. Finally, each assessor has been conducted through pairwise comparisons for calculating each criterion weights based on table 1. The calculation of each pairwise comparison was conducted with nine-point scale. Consistency ratio of the pair-wise comparison was less than 0.1 (see table 2).

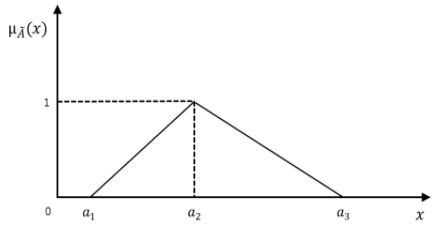
Table 2: Online P2P Lending Criteria Weight by Updated IS Success Model

C1	C2	C3	C4	C5
Information Quality	Service Quality	System Quality	Trust	Satisfaction
0.106121	0.034185	0.066497	0.531609	0.261587

B. Linguistic Variables and Fuzzy Numbers

In fuzzy MCDM, the key performance indicator is usually outlined by fuzzy sets. The alternative has been evaluated through a total of all criteria weights and alternatives ratings in which alternatives with a higher utility are preferential. According to fuzzy sets, steps are outlined in the following:

Step 1: *Establishing fuzzy number.* In the universe of discourse X,A fuzzy sets$\widetilde{A}$is dominated by a fuzzy membership function$\mu_{\tilde{a}}(x)$. It relates with each component$x$ in X a real value in the range of 0 to 1.The function value $\mu_{\tilde{a}}(x)$ is ranked by membership function of $x$in$\widetilde{A}$. This study concentrates on triangular fuzzy numbers (Figure3).Thea_1 and$a_3$refer tointerval of low and high the fuzzy number.$\widetilde{A}$, and $a_2$refers to the modal value for $\widetilde{A}$(Eq.*3)*.



$$\mu_{\tilde{a}}(x) = \begin{cases} 0, & x \le a_1, \\ \frac{x-a_1}{a_2-a_1}, & a_1 < x \le a_2, \\ \frac{a_3-x}{a_3-a_2}, & a_2 < x \le a_3, \\ 0, & x > a_3 \end{cases} \quad (3)$$

Figure 3: The Membership Functions of the Triangular Fuzzy Number

Step 2: E*valuating the linguistic values* (x_{ij}).Figure4 shows linguistic variables that were used as ratings of triangular fuzzy numbers consist of [0,1] with normalization. The triangular fuzzy numbers listed in Table 3 were incorporated into the computation.

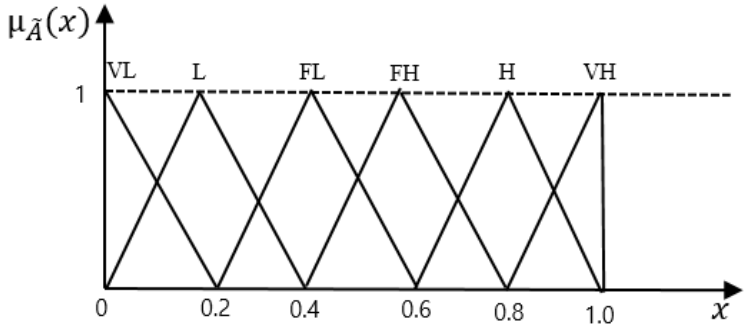


Figure 4: The Membership Functions of Linguistic Variables

Table 3: Linguistic Value and Triangular Fuzzy Number

Linguistic value	Triangular fuzzy number
Very low (VL)	(0,0,0.2)
Low (L)	(0,0.2,0.4)
Fairly low (FL)	(0.2,0.4,0.6)
Fairly high (FH)	(0.4,0.6,0.8)
High (H)	(0.6,0.8,1)
Very high (VH)	(0.8,1,1)

Step 3:*Constructing the weighted fuzzy matrix with normalization.* The weighted fuzzy matrix value is derived via *Eq. (4)*. Wherew_j can be get in ANP.

$$\upsilon_{ij} = x_{ij} * w_j \quad i = 1, 2, 3, \cdots, m;\ j = 1, 2, 3, \cdots, n \quad (4)$$

Finally, 6 specialists participated in this investigation. They are evaluated online P2P lending criteria. And we transformed linguistic variables in the Table 3. It is conducted through comparing five alternatives under five cluster criteria that i*nformation quality, service quality, system quality, trust, and satisfaction*. The matrix is showed in the Table 4. According to *Eq. (4)*, a fuzzy weighted decision matrix has been demonstrated in Table 5.

Table 4: Fuzzy Evaluation Results for 5 Alternatives

	A1	A2	A3	A4	A5
C1	FH (0.4,0.6,0.8)	H (0.6,0.8,1)	VH (0.8,1,1)	FL (0.2,0.4,0.6)	VH (0.8,1,1)
C2	H (0.6,0.8,1)	H (0.6,0.8,1)	VH (0.8,1,1)	FL (0.2,0.4,0.6)	H (0.6,0.8,1)
C3	FH (0.4,0.6,0.8)	H (0.6,0.8,1)	H (0.6,0.8,1)	L (0,0.2,0.4)	H (0.6,0.8,1)
C4	VH (0.8,1,1)	FH (0.4,0.6,0.8)	VH (0.8,1,1)	FH (0.4,0.6,0.8)	H (0.6,0.8,1)
C5	H (0.6,0.8,1)	FH (0.4,0.6,0.8)	H (0.6,0.8,1)	FL (0.2,0.4,0.6)	H (0.6,0.8,1)

Table 5: Result from Fuzzy Evaluation and Weight

	A1	A2	A3	A4	A5
C1	0.042 0.064 0.085	0.021 0.027 0.034	0.053 0.066 0.066	0.106 0.213 0.319	0.209 0.262 0.262
C2	0.064 0.085 0.106	0.021 0.027 0.034	0.053 0.066 0.066	0.106 0.213 0.319	0.157 0.209 0.262
C3	0.042 0.064 0.085	0.021 0.027 0.034	0.040 0.053 0.066	0.000 0.106 0.213	0.157 0.209 0.262
C4	0.085 0.106 0.106	0.014 0.021 0.027	0.053 0.066 0.066	0.213 0.319 0.425	0.157 0.209 0.262
C5	0.064 0.085 0.106	0.014 0.021 0.027	0.040 0.053 0.066	0.106 0.213 0.319	0.157 0.209 0.262

C. Ranking Online P2P Lending Alternatives Using fuzzy-TOPSIS

The TOPSIS measurement tool has been proposed by Chen and Hwang[15, 17].The selected alternative should be the minimum distance between the ideal solution (or positive-ideal solution; PIS). It can obtain the maximized benefit. In contrary, the maxima distance is the negative-ideal solution (NIS). It is the worst performance values of the alternatives.

Although TOPSIS is a kind of useful MCDM, this approach also has some potential defects, which related to the unpredictability of human perception and vagueness. The fuzzy TOPSIS has been used to solve these problems. Since fuzzy TOPSIS use fuzzy sets which are linguistic value, decision-makers can handle complication, fragmentary information, and insufficient evidence of the facts. The fuzzy TOPSIS supports better modeling method in the complex environment. The fuzzy TOPSIS has been conducted with steps based on the following:

Step 1:*Determinefuzzy positive-ideal solution (FPIS) and the fuzzy negative-ideal solution (FNIS).*The FPIS (A^*) and FNIS (A^-) are indicated in the following *eq. (5) and (6)*. WhereA^* is relevant to benefit criteria, and $A^*$is relevant to cost criteria. Table 6 shows FPIS ($\tilde{v}_i^*$) and FNIS($\tilde{v}_i^-$).

$$A^* = \{v_1^*, \cdots, v_m^*\} = \{(\max_j v_{ij} | \, i \in I'), (\min_j v_{ij} | \, i \in I'')\} \;\; i = 1, 2, \cdots, \text{m}; j = 1, 2, \cdots, \text{n} \quad (5)$$

$$A^- = \{v_1^-, \cdots, v_n^-\} = \{(\min_j v_{ij} | \, i \in I'), (\max_j v_{ij} | \, i \in I'')\} \;\; i = 1, 2, \cdots, \text{m}; j = 1, 2, \cdots, \text{n} \quad (6)$$

Step 2:E*stimate the TOPSIS values of each alternative from*$A^*(\tilde{v}_m^*)$ *and*$A^-(\tilde{v}_n^-)$*using the following eq.(7) and (8).* Fuzzy TOPSIS operation base on the two triangular fuzzy members that suppose a =(a_1, a_2, a_3)in table 6 and b =(b_1, b_2, b_3) in table 5. The distance between them is calculated as *Eq. (9)*. Table 7 shows the fuzzy setD_i^* and D_i^- result.

$D_i^* = \sum_{j=1}^{n} d(v_{ij}, v_j^*)\ i = 1, 2, \cdots, \text{m},$ (7)

$D_i^- = \sum_{j=1}^{n} d(v_{ij}, v_j^-)\ i = 1, 2, \cdots, \text{m}.$ (8)

$$\mathrm{d}(\tilde{a}, \tilde{b}) = \sqrt{\frac{1}{3}[(a_1 - b_1)^2 + (a_2 - b_2)^2 + (a_3 - b_3)^2]} \quad (9)$$

Step 3:E*stimatesimilarities to ideal solution by the following eq. (10).*

$$CC_i = \frac{D_i^-}{D_i^* + D_i^-} \quad (10)$$

Finally, similarities to ideal solution calculations can be fulfilled for the other online P2P lending and the results are summarized in Table 7.As value of theCC_i, the online P2P lending ranking is A4, A5, A1, A2 and A3in descending order.

Table 6: $\tilde{v}_i^*$and $\tilde{v}_i^-$ for Nine Criteria

	$\tilde{v}_i^*$	$\tilde{v}_i^-$
C1	(0.8, 1, 1)	(0.2, 0.4, 0.6)
C2	(0.8, 1, 1)	(0.2, 0.4, 0.6)
C3	(0.6, 0.8, 1)	(0, 0.2, 0.4)
C5	(0.8, 1, 1)	(0.4, 0.6, 0.8)
C6	(0.6, 0.8, 1)	(0.2, 0.4, 0.6)

Table 7: Fuzzy TOPSIS Result

	D_i^*	D_i^-	CC_i	Rank
A1	4.074	1.558	0.277	3
A2	4.087	1.553	0.275	4
A3	3.602	0.887	0.198	5
A4	3.974	2.386	0.375	1
A5	3.483	1.565	0.310	2

V. DISCUSSION

In this study, we suggest an evaluation model that integrates updated IS success model and ANP fuzzy TOPSIS for the online P2P lending websites. This study composed of five main stages. First, we suggested research framework. It is important to evaluate alternatives with regard toareal phenomenon which derive investment intention. Second, we defined the research problem. In detail, the online P2P lending has been selected as the evaluating alternatives, and the updated IS success's evaluation tool has been identified. Third, the updated IS success factors have been computed. In this stage, a decision structure composing of ANP has been illustrated, and the major dimensions and their components have been calculated. Forth, fuzzy sets evaluation of this value. In detail, the weights obtained from ANP with decision-making process via fuzzy TOPSIS calculation. Finally, the ranking order has been decided according to the weights.

The major contributions of this study are summarized as follows. First, as an improvement of previous studies which focusing on the appraisal of the online P2P lending websites with ANP fuzzy TOPSIS methods, we proposed our study based on updated IS success model. This method is the most important one that can acquire networks between the major dimensions and other sub-components through conserving the key concepts of the updated IS success quality, and can enable more meaningful explanations. Second, from the results of our study, we found a useful tool, the ANP fuzzy TOPSIS for ranking the online P2P lending websites. This method can evaluate ambiguity and subjectivity with linguistic values parameterized. Finally, the proposed approach method is more reasonable than other MCDM, and it can be applied to the online commerce evaluation. This approach can extend the evaluation method of e-commerce websites, which offers suggestions forother information systems to improve their operations.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES
IJPBS

ISSN
0975-6299

Encryption Algorithm Selection to Protect IoT Devices from Local Network Attacking Using Analytic Network Process and BCR Model

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Abstract---

Background/Objectives: From the beginning, the importance of IoT device's security was not considered as it should be. Now, this issue poses challenges for smart device manufacturers and software developers to improve their device's reliability.

Methods/Statistical analysis: This study used the combination between Analytic Network Process methodology and Benefit-Cost-Risk (BCR - a derived version of BCOR) model. To evaluate and select the most appropriate encryption algorithms applied for IoT devices, this combination is very suitable: The strength of ANP approach, providing a mathematical and logical way to take decision without affection of human emotion, combined with BCR, a ranking tools model, to find out the right decision.

Findings: A lot of being-wearied-IoT-devices are still using unsecured connection such as Bluetooth or poor security encryption system. These are the gold mine for hacker to dig users' private information. The most efficient method is applying more secure connection method using reliable encryption algorithm without losing the performance and cost. And among types of encryption algorithms, each of them has its own strength and weakness, it is not easy for IoT devices maker and programmers to choose the good algorithm to deploy on their device. The security requirements in this study are based on IoT device users and programmers point of view. Therefore, this study keeps well the objectivity and suggests a good viewpoint to evaluate encryption method for IoT device. This framework provides a useful, significant and comprehensive tool for IoT software developer, hardware manufacturers to solve the same or similar security problems.

Improvements/Applications: This research will be valuable for IoT devices manufactures and IoT devices software developers to find the most economical and efficient way to secure their devices.

Keywords--- Internet of Things (IoT), Local Attacking, Encryption Algorithm, Analytic Network Process (ANP), BCR Model, Cryptography.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

In recent decades, Internet of Things (IoT) changed the way the businesses, governments, customers interact with the physical world. With the number of IoT devices reported to hit billions in the next couple of years[1], households will become fully automated and interconnected, and wearable devices will become vital in tracking and optimizing our daily activities. The IoT could prove transformative, and there are huge possibilities for companies to be more efficient and bring exciting products to market. However, recent security research has shown many of these smart devices are prone to security vulnerabilities that might compromise users' privacy, and even the entire network security of their household. Most have been deemed bot only privacy hazards, but they have also been tagged as inherently insecure by design. As the IoT market size increases–research analyst Gartner predicted there will be 26 billion units by 2020–hackers have an expanded surface area, and protecting company intellectual property, customer data and operational infrastructures is more urgent than ever. According to IoT technology's outburst, the security issues have become a vital problem with all device manufacturers, software developers, and users as well.

Encryption is the process of encoding information in such a way that hackers cannot read it. There are two types of encryption techniques; symmetric and asymmetric. Symmetric cryptography, also called private-key cryptography uses only one key for encryption and decryption. Asymmetric key cryptography, also called public-key cryptography requires special keys to encrypt and decrypt messages. Both symmetric and asymmetric cryptographic techniques offer advantages and disadvantages. Symmetric encryption techniques provide cost-effective and efficient methods of securing data without compromising security however; sharing the secret key is a problem. On the other hand, asymmetric techniques solve the problem of distributing the key for encryption however; they are slow compared to symmetric encryption and consume more computer resources. Therefore, the best possible solution for encryption is the complementary use of both symmetric and asymmetric encryption techniques. Hybrid encryption attempts to exploit the advantages of both kinds of techniques while avoiding their disadvantages[2]. The purpose of this research is to suggest and clear, reasonable and efficient decision making framework to select the best encryption algorithm to protect IoT devices from local network attacking by using the Analytic Network Process incorporated with BCR model. We expect that the results of this research will be useful for IoT device software developer, manufacturer to improve the security of their devices.

II. LITERATURE REVIEW

Cryptographic mechanisms are one of the most important tools to protect IT applications, communication protocols, and infrastructures. Cryptographic techniques enable a large number of security features; they include data confidentiality, data integrity, entity authentication, and non-repudiation. The effectiveness of cryptographic protection depends on a variety of issues such as cryptographic key size, mechanism, protocol design, implementation aspects, and password management. All of them are has similar importance. For example, if the key size is too small, or mechanism is poorly designed, or implementd incorrectly, or the shared key is poorly protected and deliveried, the security of a system is at risk. In most of cases, the mechanism design and key size get most attention; however, most sussessful attacks are not due to inadequate mechanism strengths or keysize, but to other deficiencies. In this research we tried to explore all of such deficiencies and suggest a mathematical point of view about secure IoT devices over network.

A. IoT Device

Physical devices, vehicles, buildings, clothes, hand watch, and other items-embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data calledIoT devices. They are smart phones, smart houses, cars, sensors, watches or eye glasses etc. And connecting methods are bluetooth, wifi network, cable network and so on.

B. Analytic Network Process

The analytic network process (ANP) is a more general form of the analytic hierarchy process (AHP) used in multi-criteria decision analysis[3]. AHP structures a decision problem into a hierarchy with a goal, decision criteria, and alternatives, while the ANP structures it as a network. Both then use a system of pairwise comparisons to measure the weights of the components of the structure, and finally to rank the alternatives in the decision Saaty[3]. ANP is a mathematical theory that allows one to reduce dependency and systematic feedback that can capture and combine the tangible and intangible factors[4]. A holistic approach in which all the clusters of parameters involved are laid out in a network system that allows for dependencies [5]. ANP

approach to qualitative methods, used for the process of decision-making and provide a common framework in treating decisions without making assumptions about the independence of the elements at higher levels of the elements with the low levels and the independence of the elements in one level itself.

C. BCR Model

In BCR approach, the alternatives are pairwise compared with respect to each criterion on the lowest level of each hierarchy; their derived priorities are expressed on a ratio scale as well, again usually normalized to the unity sum per criterion. Synthesis of the alternative priorities and the criteria weights using a weighted sum produces composite alternative priorities for each hierarchy[6].

For each alternative, its composite benefit priority is then divided by its composite cost priority. The resulting ratio value serves as a means to rank the alternatives and choose the best one, i.e. The alternative with the highest benefit/cost-priority ratio[7]. Examples of benefit/cost analysis using the ANP were published in Saaty[8, 9].

In other research, Wijnmalen[7]discussed about Benefit, Cost, Risk (BCR) model and the helpfulness against ANP model find out the right decision. It is a good way to find out a good encryption algorithm by considering alternatives' Benefit, Cost and Risk.

D. Data Encryption Algorithms

Symmetric Key Cryptography

This algorithm uses only one key for encrypting and decrypting data[10]. So there is potential risk in sharing the key progress. Symmetric key cryptography uses a trivially related, identical key instead of two key i.e. Public key and private key for encryption and decryption. In Symmetric key cryptography sender encrypts the plain text using a secret key and receiver decrypt the cipher text using the same key. So there is a requirement to send the guarded key to the receiver along with the cipher text. Secrecy of information in symmetric key cryptography depends on the secrecy and size of secret key [11]. Some example of this algorithm is DES, 3DES, DESX, AES, Blowfish and so on.

Asymmetric Key Cryptography

According to[12], the asymmetric key cryptography is known as public key cryptography. Asymmetric key cryptography use two different keys, i.e. Public key and private key, which are complementary in function. The communication data, which is encrypted using public key, can only be decrypted using the corresponding private key [11]. In this technique, the sender uses a public key of the receiver for encryption and the receiver uses his private key to decrypt the message. Common Asymmetric key algorithm system are RSA, D-H,DSA, ECC.

Hybrid Encryption Algorithm

Both of above algorithms have their own strength and weakness, so Alkady et al.[13]has suggested the using of hybrid algorithm to deal with each disadvantage of them. A hybrid cryptosystem is one which combines the convenience of a public-key (asymmetric) cryptosystem with the efficiency of a symmetric-key cryptosystem. Some example of hybrid encryption systems are openpgp, SSL, TLS XOR-Dual RSA.

E. Research Model

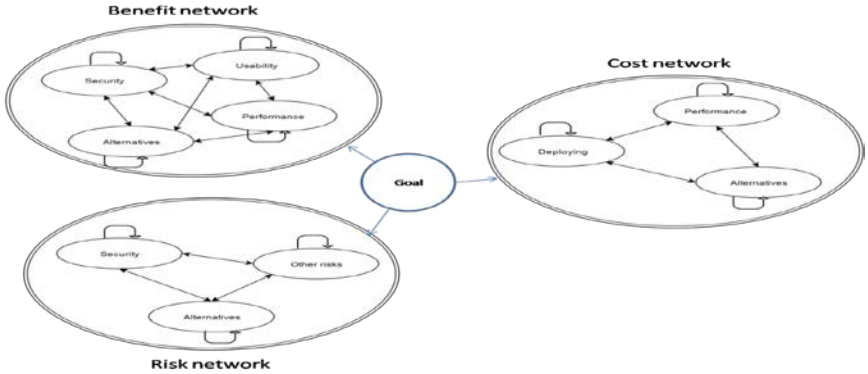

Figure 1: The Research Model

III. PROPOSED WORK

In this research, we used super decision version 2.7 as a support tool. Whenever making a decision with AHP or ANP methodology, super decision is the most powerful tool designed specifically for AHP and ANP theory. In 2012, He et al.[14] have applied this software and ANP theory in their research. Their research proved super decision software package is powerful and suitable to solve decision making problem with AHP or ANP methodology. Based on the ANP and BCR model for selecting the most appropriate encryption algorithm discussed in above section, the network criterions collected via interviews will be passed into super decision software as research networks.

The research progress is shown as <Figure 2>.

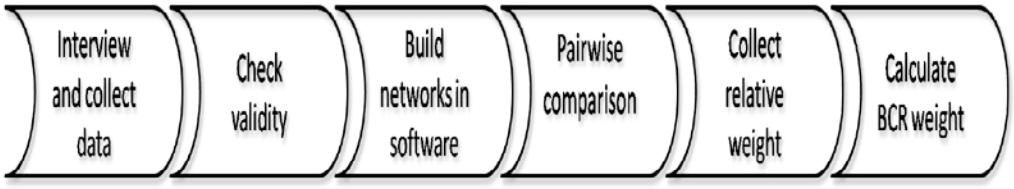

Figure 2: The Detail Steps in Empirical Research

Step 1: Interview and Collect Data

The interview questionnaire was sent to the respondents, include IoT software developers, manufactures, and user as well. The respondents answered the questionnaire by explaining their judgment for each pair of criterions. This research we used the questionnaire base on nine-point scale, from equally important (1 point) to extremely more important than (9 points). The respondents then performed pairwise comparison between criterions of cluster and between clusters follow this scale. For more reliability, we prepared a sample answer as instruction for respondents. They can look and follow the sample to answer more correctly the question. Then the pairwise comparison result is gathered.

Step 2: Check Validity

When the respondents' answered data received, the data was checked for validity before being used. All of comparison data of each respondent was passed into the super decision version 2.7 software package. Then the validity of answered data checked by considering the inconsistency value. In ANP theory, the inconsistency ratio must be less than 0.1 to ensure the validity of data. This value is automatically calculated by software. Thus, all of answers which have inconsistency ratio greater than 0.1 must be rejected. In this research, we only used valid answers of respondents.

Step 3: Build Networks in Software

Networks of security requirements and relationship between them were built in super decision software. Each network has its own cluster and criterions underneath. Clusters and criterions are built based on the requirements of users, devices manufactures or software developers' point of view, thus the objectivity is conserved.

Step 4: Pairwise Comparison

The early step's answer of each question was used to calculate geometric mean value. This value was used as the most common answer of respondents. These values are data that we set when perform pairwise comparison in super decision software.

Step 5: Collect Relative Weight

When all necessary data passed into the super decision software, the weights of criterion, cluster, and alternatives are automatically calculated. First, all pairwise comparison data of elements within clusters of each network will be synthesized using eigenvalue method, and put into super matrix table. The super matrix table then will be multiplied with clusters' weigh, in respect to the network, to form the weighted super matrix. Finally, The Weighted super matrix is raised to power to get Limiting matrix. The weight of elements in Limiting matrix is the relative weight.

The relative weight of elements is displayed as <Table 1>.

Table 1: Relative Weight of Cluster's Element

Network	Cluster	Name	Normalized By Cluster	Limiting
Benefit network	Alternatives	Asymmetric	**0,26458**	0,07148
		Hybrid	**0,55286**	0,14936
		Symmetric	**0,18256**	0,04932
	Performance	Latency	0,35600	0,08221
		Memory Efficiency	0,33582	0,07755
		Speed	0,30819	0,07117
	Security	Bruce speed	0,22210	0,05451
		Key size	0,77790	0,19092
	Usability	Compatibility	0,51840	0,1314
		Controllability	0,39839	0,10098
		Implement ability	0,08321	0,02109
Cost network	Alternatives	Asymmetric	**0,32010**	0,02613
		Hybrid	**0,25640**	0,02093
		Symmetric	**0,42350**	0,03457
	Deploying	Cost	0,41920	0,16164
		Resources	0,39731	0,1532
		Time	0,18349	0,07075
	Performance	Latency	0,23854	0,12709
		Memory Efficiency	0,76146	0,4057
Risk network	Alternatives	Asymmetric	**0,26345**	0,07071
		Hybrid	**0,31990**	0,08586
		Symmetric	**0,41665**	0,11183
	Other risks	Controllability	0,41613	0,15269
		System crash	0,40512	0,14865
		User ability	0,17875	0,06559
	Security	Bruce speed	0,30022	0,10948
		Key delivery	0,08260	0,03012
		Key size	0,50308	0,18346
		Key storing	0,11410	0,04161

According to relative weight table, the Hybrid alternative has greatest score, followed by Asymmetric (0.26458) and Symmetric (0.18253). In benefit network, in Cost network, the greatest score alternative is Symmetric with 0.4235 then Asymmetric (0.3201), Hybrid (0.2564). And in Risk Network Symmetric with 0.41665 score, Hybrid with 0.3199 is at 2nd position, the last one is Asymmetric with 0.26345.

Step 6: Calculate BCR Weight

In BCR model theory, the final score of each alternative is calculated with the following equation:

$$\mathbf{W}_{\text{Alternative}}=\mathbf{W}_{\text{benefit}} / (\mathbf{W}_{\text{cost}}*\mathbf{W}_{\text{risk}})$$

Thus, based on the relative weight shown in above step, we calculated the final score of each alternative, shown in <Table 2>.

Table 2: The Final Score of Alternatives

Alternatives	*Benefit Score*	*Cost*Risk Score*	*Final Score*
Asymmetric	0,26458	0,08433	3,13742
Hybrid	0,55286	0,08202	6,74036
Symmetric	0,18256	0,17645	1,03462

Finally, <Table 3> shows the sequence of alternatives' weight by each network and compare to final score sequence.

Table 3: Alternatives' Sequence

Network	1st	2nd	3rd
Benefit	Hybrid **0,55286**	Asymmetric **0,26458**	Symmetric **0,18256**
Cost	Symmetric **0,4235**	Asymmetric **0,3201**	Hybrid **0,2564**
Risk	Symmetric **0,41665**	Hybrid **0,3199**	Asymmetric **0,26345**
Final	Hybrid **6,740357142**	Asymmetric **3,137423427**	Symmetric **1,034619897**

IV. CONCLUSION

Both symmetric and asymmetric cryptography has their own advantages and disadvantages, the hybrid algorithm can combine the convenience of a public-key (asymmetric) cryptosystem with the efficiency of a symmetric-key cryptosystem to form a better encryption algorithm. Therefore, hybrid encryption algorithm should be used to encrypt the communication data between IoT devices. Through this study, programmers or IoT device manufacturers can more exactly evaluate and choose good encryption method for their devices communication, build the rational and consistent networks to rightly point out the concerns of IoT devices security problems and the assessment in respect to benefit-cost-opportunity-risk dimension.

The ANP methodology has been shown to be a powerful technique to solve the decision making problem in general and to choose the appropriate encryption algorithm in particular. It means we totally can apply this useful tool for other decision making problem as well. With the support of super decision software, and BCR model, it is easy to solve the complex problems such as resource allocation, planning, making choice, investment decision and so on. All practitioners have to do is just construct the networks, determine relationship between elements, and perform pairwise comparison.

Also, through this research, researchers not only gain the knowledge about IoT devices, encrypt cryptography, security but also the knowledge about ANP theory as well. They totally can apply this scientific methodology in security or IoT research domain.

This framework provides a useful, significant and comprehensive tool for IoT software developers, hardware manufacturers to solve the same or similar security problems, the practitioners can apply it flexibly (modify the clusters, change the elements and upgrade the networks, or even though make their own framework). The researchers could get an idea to utilize the different other scientific methodologies like AHP, BCOR, ANP; or enhance the finding in this paper by continuing the further research.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Analysis of BIM related Technologies and BIM Adopted Future Process

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Abstract---

Background/Objectives: Long-term roadmaps for facilitating BIM will be developed pertaining to Korea and other countries. The current status and the time frame for BIM adoption will be analyzed, especially in Korea.

Methods/Statistical analysis: BIM can be utilized in the practices and business area in many building construction projects. In order to analyze the current status and future trend of BIM in Korea, survey and expert interview techniques are used in this study. Major technologies which could be used with BIM are identified, and when these technologies could be fully adopted in each area is asked in the survey and interview.

Findings: BIM has limitations for practical application in Korea. However, it is an essential technology for technological advance and efficiency improvement in building construction projects. In order to maximize the efficiency of BIM, it is required to applicate with ICT convergence technologies. In this study, ICT convergence technologies which can be used with BIM are identified, and the approximate time in which applied BIM technologies could be available is surveyed. For example, according to the survey, applied BIM technologies in the Design and Engineering phase could be widely adopted in 5 to 10 years, and BIM in the construction and facility management phase could be adopted in 10 to 20 years.

Improvements/Applications: The applied BIM technologies and the time frame which they could be available in the future were identified and surveyed in this study. It will be useful for those who are preparing a BIM application strategy and are planning for their future.

Keywords--- Building Information Modeling, BIM, Information and Communications Technologies, ICT, Lifecycle, Process.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Currently, the 2D design system is used for most building construction projects. This system has a high level of dependence on manual work and there is a large potential for error, omission, inconsistency and other problems in drawings. These problems cannot be found easily and they are usually handed down to the engineering design and construction phase. In the construction phase, they could appear in design change, rework and delay. It is much easier to find design problems and improve design quality with BIM (Building Information Modeling), and it could be solution for current design problems. Currently, many designers and engineers are trying to adopt BIM into their business and practices, and get less effect than expected. In order to maximize the effect of using BIM, the project management process also has to be modified considering BIM.In this study, the current process, practice and technologies used in each phase are analyzed with literature review and interview and future technologies which could be developed and used in the future are surveyed. We try to develop the future process which BIM related technologies are fully used.

II. LITERATURE REVIEW

BIM facilitation roadmaps have been developed in the UK, Singapore, Canada, and some other countries. Although BIM related technology development roadmaps are hard to find, some construction automation or U-City service related roadmaps were found in the literature review.

Lee[1] studied automation technology roadmap development cases and developed Hume Pipe Laying automation equipment development roadmap. Jeong[2] has developed a template for U-Service Assessment and SRM (Service Roadmap). In this study, the 228 U-City services are identified, the classification structure is defined, and a service relation map and service unit roadmap has been developed. Lee[3] studied the status of the overseas construction market and the research development of domestic construction technologies. Also, he defined the construction technologies customized by overseas area (country) items for winning more overseas contracts. Kang (2014) studied the current Facility Management scenario and suggested using BIM based FM system concepts in order to develop the future FM system.

Kumar[4] studied the costs and benefits of applying the proposed robot system for construction works. In his study, he considered the robotization of on-site reinforcement mat preparation, interior/floor finishing, quality inspection, and drones for carrying loads and proximity detection sensors.

Son[5]proposes an integrated system development methodology of design and LCC process for an information-oriented design and LCC management system, which allows architects and LCC planners to easily access information to be provided in each design stage and its relevant LCC planning process, and for design and cost management companies to improve their performance through the systematic storage and usage of data after the completion of an educational project.

Kalyani[6] suggested important milestones in the construction of Multi Cloud Computing Systems (MCCS). He emphasizes on the design issues to be considered for multi cloud architecture, requirements for various groups involved in the development of MCCS and types of architectures such as cloud hosted proxy, proxy as a service, point-to-point proxy and on-premises proxy for MCCS.

Varun[7] presents the implementation of one such WSN useful for industrial applications. The advent of Wireless Sensor Networks (WSNs) has revolutionized the field of automation in many ways. These WSN clusters can be used for automation of various industries with the possibility of easy modification or expansion in the future.

III. CONVERGED BIM TECHNOLOGIES

In order to develop the BIM adopted improved process, future technologies which areadoptable and canbe further developed must identified. In this study, we surveyed and studied various new technology development cases and research reports. The categorized BIM related future technologies are identified in Figure 1.

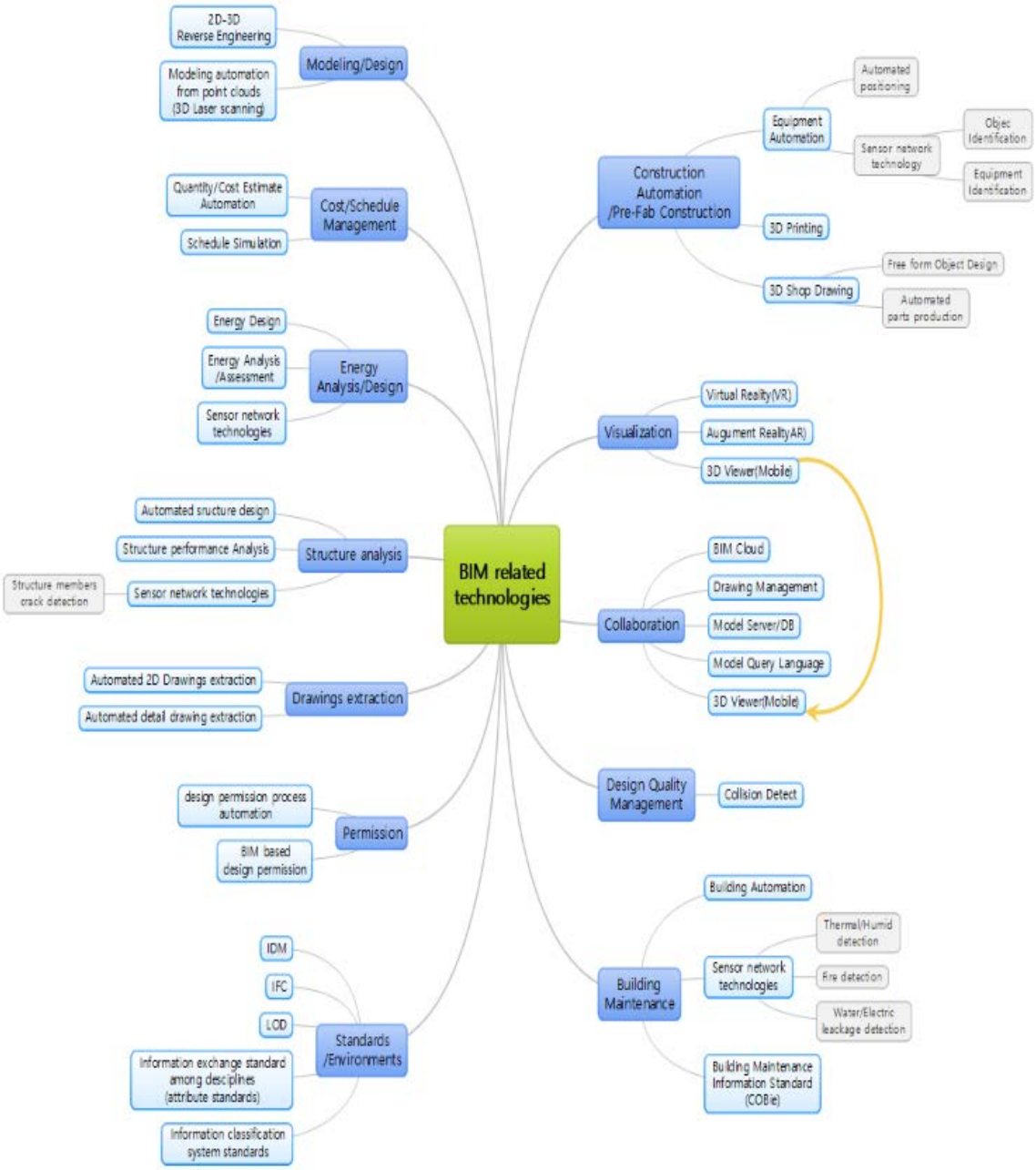

Figure 1: BIM Related Future Technologies

IV. BIM ADOPTED IMPROVED PROCESS

BIM could be adopted in the whole lifecycle of the construction project, and could be utilized by all participants in all of the disciplines, so it is difficult to identify and analyze all the technologies used through the construction project lifecycle. For this reason, it is difficult to find BIM related technology roadmap development studies.

For adopting BIM in building construction industries, it is required to consider systematic plans and strategies for applying BIM technologies to the lifecycle of a building construction project. For this, it is necessary to anticipate and design future practices when BIM is fully adopted in building construction projects. As a result of analysis of current reports and papers of BIM technologies, the process of a building construction project is developed as Figure 2.

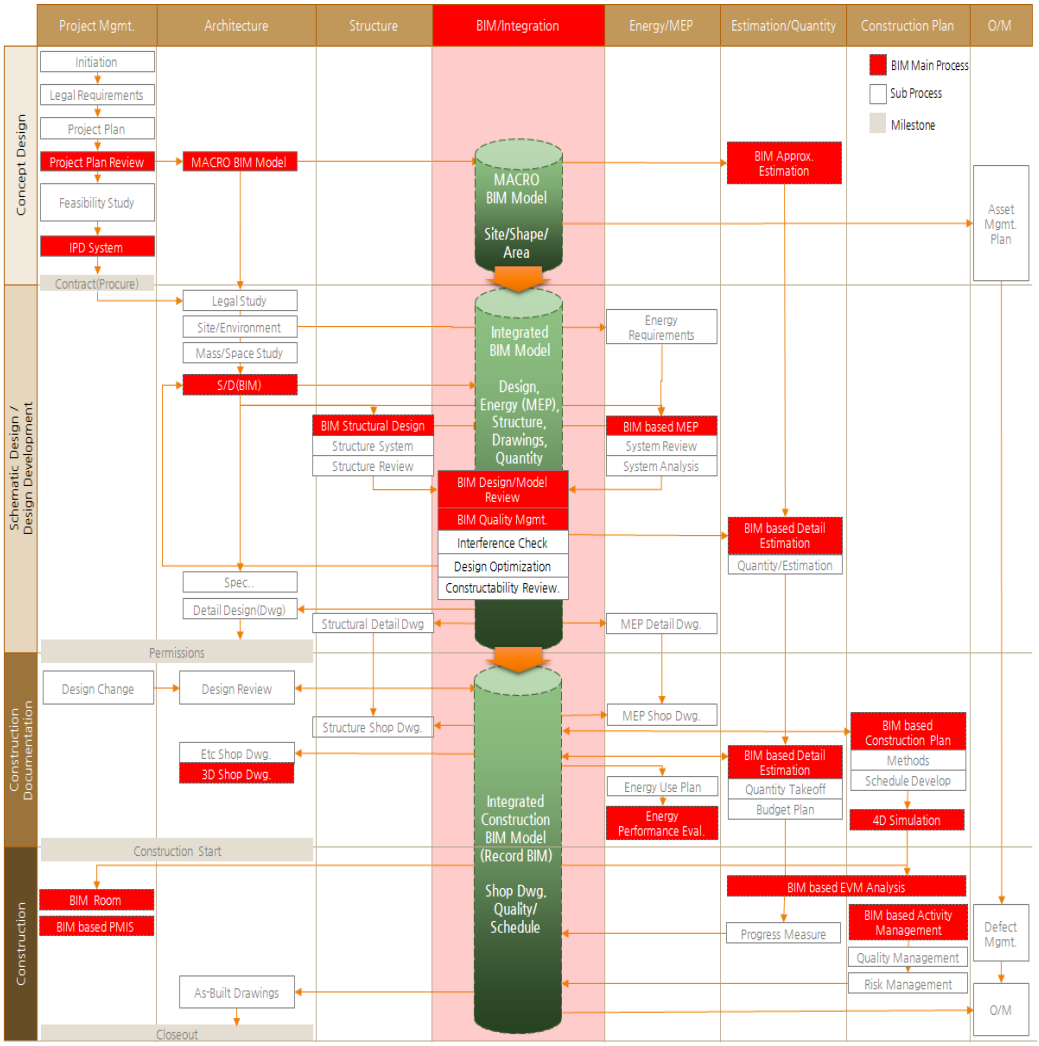

Figure 2: BIM Adopted Future Process

V. SURVEY OF BIM ADOPTION

In order to analyze the future trends of BIM, the future time frame to analyze is to be defined. In this study, 5, 10 and 20 years are selected as a short term, midterm and long term period. 30 Experts who have experiences of BIM are selected in design, engineering and construction area and are surveyed for the current status and future time frame when BIM related technologies could be fully adopted in each area.

1. BIM Adoption Time

BIM is already mandatory in design-build public construction projects from 2002. However, BIM engineers and environments such as software, hardware and guidelines are not ready for BIM adoption. 3D modeling is the only BIM technology that they use in their projects for constructability and design review such as collision detection. With this experience, many engineers do not know why BIM is required and think BIM is useless. If they followed the newer standards and guidelines for BIM modeling and data exchange, they could use other modeling data in their practices, and receive the full benefits of BIM.

According to the survey, BIM can be fully used in design practices in 5 years as shown in figure X. At that time, architects could design buildings with 3D models instead of 2D drawings. Most design documents could be extracted from the 3Dmodel and the more accurate 3Dmodel could get priorities over2D drawings ifthey are different. Furthermore, experts anticipate that design automation technologies could be developed and utilized within10 years as shown in figure 3.

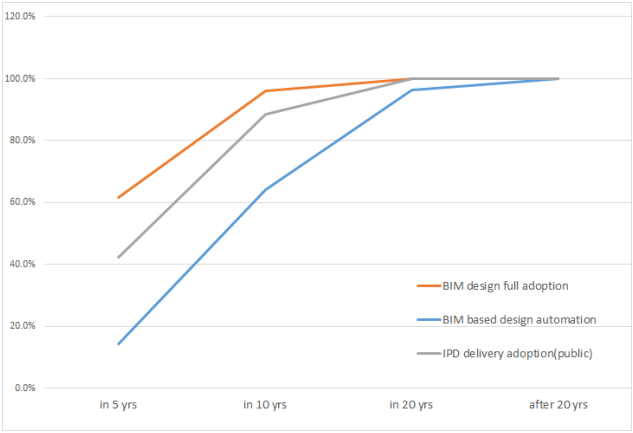

Figure 3: BIM Adoption Time

2. BIM Technology Adoption in Design Phase

In the design phase, BIM could be used with a project feasibility study, code check, and site analysis. With BIM, architects can design buildings easily using 3D libraries such as LEGO blocks, and they could use 3D data from laser scanning and drone for site analysis. Architects could analyze the 3Dmodel with a standard model query language, and they could get design analysis reports such as design area and quantity takeoff automatically. According to the survey results, design supporting technologies could be available in 5 years, and automated design and analysis technologies could be available in 10 years as shown in figure 4.

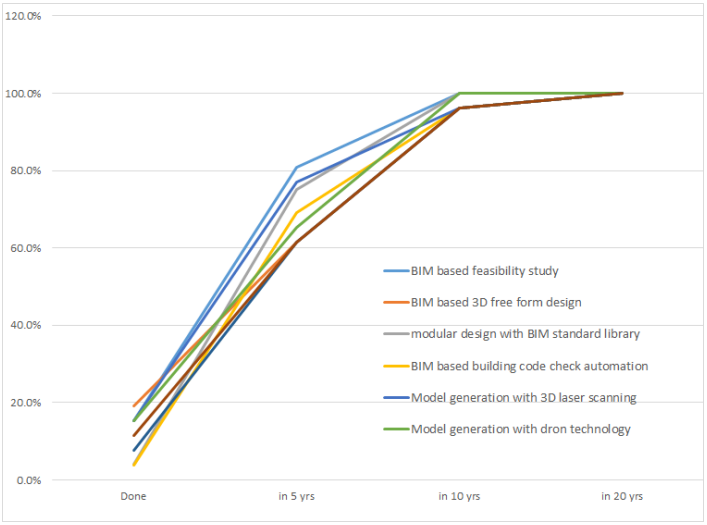

Figure 4: BIM Technology Adoption in Design Phase

3. BIM Technology Adoption in Engineering Design Phase

The engineering area mainly includes structure, environment and energy design and analysis technologies. Although detail engineering parts are different in subjects and contents, the basic processes are consist of requirements analysis, engineering design and interpretation process in common. Also, this area includes the process of producing detailed drawings. BIM application technologies supporting engineering processes are actively developed by many organizations, and they could simplify the process of engineering analysis and design. According to the survey, standards for energy and environment analysis such as the data exchange standard, templates and libraries, and automated engineering design technologies could be available in 5 years. Also, Structural engineering analysis and design automation technologies and standards could also be available in 5 to10 years as shown in figure 5.Some automated engineering and detail drawing-producing technologies are already available and more intelligent drawing production technologies will be developed in the near future.

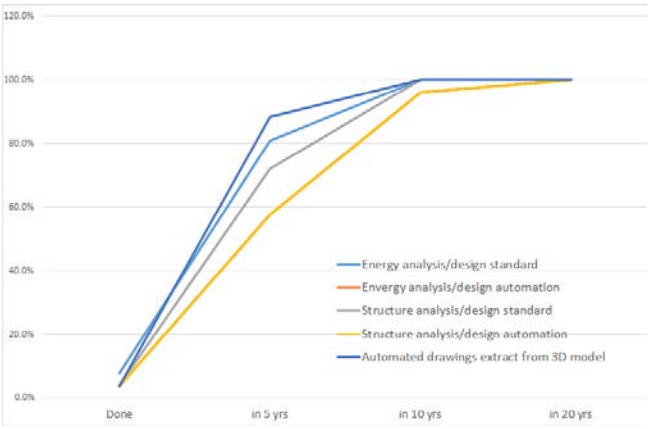

Figure 5: BIM Technology Adoption in Engineering Design Phase

4. BIM Technology Adoption in Construction Phase

In the construction phase, the construction plan should be developed and shop drawings and other construction documents are to be produced. During construction, many automation and Information and Communications Technologies (ICT) related technologies are used in order to improve efficiency and quality level. Also, ICT related technologies can be used for gathering construction project information. Because BIM models, drawings and documents produced in design and engineering phase can be utilized in the construction phases, BIM technologies supporting design and engineering should be developed earlier than those for construction. In the construction phase, the building components are produced and they are required to be constructed or assembled by construction equipment as designed in the design phase. Also, the BIM supporting construction technologies should include automated building construction or producing building technologies such as automated construction equipment or 3D printing technologies. These BIM related technologies for construction phase maybe available in 10 years or later as shown in figure 6.

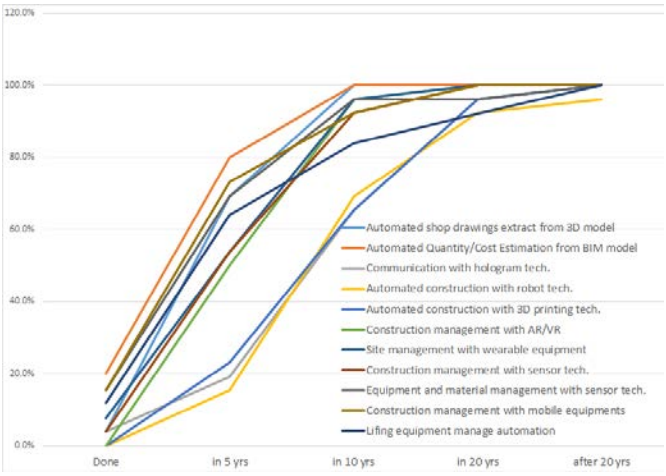

Figure 6: BIM Technology Adoption in Construction Phase

5. BIM Technology Adoption in Facility Management Phase

Space management, building repair, clear and security management are included in the facility management phase. Financial management and asset management are also included in the in the broader view of facility management. Because of this, the work scope and the period of facility management are the widest, the longest, and is the most expensive during the building life cycle; the facility management is the most important process in building construction projects. However, facility management technology is less developed than its importance. Some energy usage analysis technologies have been developed and could be used with BIM model data, and other technologies for automated and more efficient facility management could be available in 10 years or later as shown in figure 7.

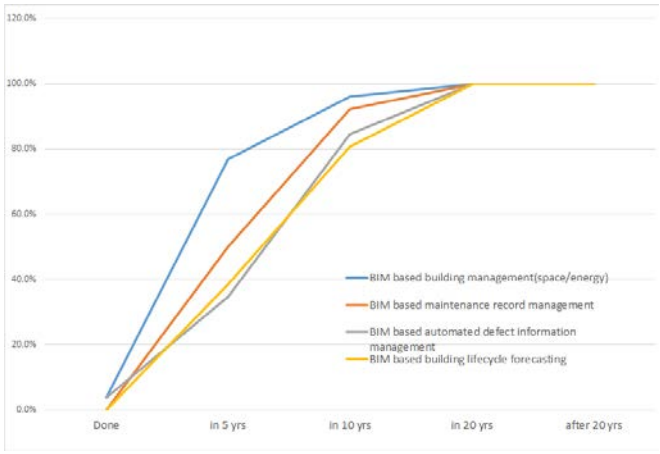

Figure 7: BIM Technology Adoption in Facility Management Phase

VI. CONCLUSION

In order to solve the problems and overcome limitations of current design and construction practices, BIM technologies will be essential to the construction process. In order to maximize the efficiency of BIM application, a redesign of the overall process and environments in building construction projects is needed, and BIM could be used with applied ICT technologies for efficiency improvement. Although many designers and engineers are trying to adopt BIM in their business practices, many of them received less benefits from using BIM than expected. In order to maximize the benefits of using BIM, the process of building construction projects has to be modified or redesigned considering BIM.

In this study, the current process practices in each phase are analyzed with a literature review and survey, and the technologies which could be developed and made available in the future are identified. The ICT convergence technologies which could be used with BIM are identified, and the future process for which applied BIM technologies can be fully adopted are developed. Although some of them are available now, most of them are being developed and will be further available in the near future. In order to develop a plan or strategy of BIM adoption, it is required to anticipate when they could be available. In this study, the approximate time in which applied BIM technologies could be available in future is surveyed and analyzed. According to the survey, applied BIM technologies in Design and Engineering area could be available in 5 to10 years, and those in construction and facility management could be available in 10 to20 years.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (No. NRF-2015R1D1A1A01057570).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

IoT Based Modeling of Closed Transition Transfer Switch in IEC 61850

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Abstract---

Background/Objectives: The power demand of utility electrical power has stimulated the use of distributed energy for peak shaving. Distributed energy resources need to be monitored and controlled like Internet of Things.

Methods/Statistical analysis: Distributed Energy Resources(DERs) are small scale electric energy system like Micro Turbine, Photovoltaic, Wind power, Small Generator and widely spread in Korea. For utilizing electrical device with Internet of Things, we need integrated system and adapt International Electrical Code like IEC 61850.

Findings: To connect DERs with uninterrupted grid system, it required Closed Transition Transfer Switch (CTTS). Existing International Electrical Code presented some distributed energy resource by IEC 61850-7-420. However the switch like CTTS is not presented. So, we described modeling of CTTS in IEC 61850 and verified monitoring data with TCP/IP.

Improvements/Applications: The proposed modeling of CTTS not only combines the DERs with grid system but also conjugates smart grid system with IoT Technology.

Keywords--- IoT, Closed Transition Transfer Switch, IEC 61850, Smart Grid, Uninterrupted System.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Recently, peak power demand has been renewed to the maximum and backup power has dropped to a critical level, aggravating power supply-demand situation such as rolling blackouts[1]. To solve the problems the usage of Distributed Energy Resource (DER) which are connected with grid[2].

DER is a small power system like Micro Turbine, Photovoltaic, Wind power system, small generator. Each of DERs has own standard by manufactures. Integration of DERs such as wind, energy storage, and DR to existing electrical networks can help companies eliminate the investment cost related to transmission line expansion and establishment of new conventional power plants[3]. To accommodate toe DERs into the existing system, it is required in uninterrupted connection technology like Closed Transition Transfer Switch (CTTS). Existing connection system of Automatic Transfer Switch (ATS) makes interruption because the system has single switch. In order to solve the problem, CTTS is composed two switches for each power source. The advantages are that DERs can be operated without interrupting power to loads and power can be retransferred to the utility after a failure without interrupting power to loads. The system will be connected with various DERs and required a flexible and reliable communication protocol for control and monitor functions of CTTS. Micro gird system has many power source and needs integrated standardization for Internet of Things. IEC 61850 is standard communication of power system and integrated devices of different types into the system. IEC 61850-7-420 is committed to the principle of standards to support the various DERs[4]. However, interconnection for DERs with switch has not been presented. So, this paper describes the configuration and function of CTTS for mapping to IEC 61850 and considers existing logical nodes and uses new logical nodes (LNs).

A. Technical Background

The CTTS consists of two switches for the grid and generator as shown in Figure 1.

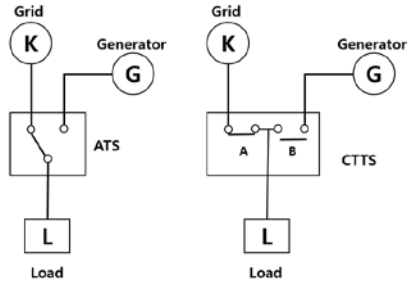

Figure 1: Diagram of ATS & CTTS

If synchronization conditions with grid power is satisfied after generator is activated, it is transferred to the generator power after parallel operation within 100ms[5]. The CTTS synchronization conditions are designed as stated in Table 1.

Table 1: Synchronization Condition & Parallel Operation Times

Category	Conditions
Voltage Phase Difference	<10°
Frequency Difference	<1Hz
Voltage Difference	<5%
Parallel Operation Times	<100ms

CTTS is generally utilized for interconnected reciprocating engine system like emergency generator in Smart grid system. According to the Korea Electrical Safety Corporation's statistics dated June 2013, the country had 69,986 emergency generator with a total capacity of 21GW, which is equivalent to the capacity of approximately 20 nuclear power generating unit. According to Table 2 below, operating hours vary depending on the ratio of investment cost. Despite the support (3 years, 100%), if an emergency generator is operated for more than 70.9 hours per years, it is more efficient than Demand Resource Market operating costs. If business models beneficial to customers are developed and grid-connection technology is secured, it would be a very effective demand resources[6].

Table 2: Emergency Generator Required Operating Hours Equal to the Operating Cost of the DRM

Investment Support Ratio	Compulsory Participation Commitment Period for Demand Management		
	3 year	5 year	10 year
50%	35.4 h/year	22.5 h/year	13.0 h/year
70%	49.6 h/year	31.6 h/year	18.2 h/year
100%	70.9 h/year	45.1 h/year	26.1 h/year

Therefore some of emergency generator utilized as demand resources, they might significantly decrease peak power. For utilizing emergency generator, the system must be uninterrupted status. So, it required Closed Transition Transfer Switch and International Standardization for making Smart grid system based on IoT technology

B. Proposed Modeling of CTTS

The proposed modeling of CTTS described International Electrotechnical Commission Standards. The international standard IEC 61850 has been recognized as a globally accepted solution enabling integration of heterogeneous devices and applications in the power system automation domain[7]. So we will describe CTTS with IEC 61850 standards using existing Logical Nodes and new Logical Nodes.

C. Organization of the Paper

Section 2 define mapping CTTS data classes and attributes. Section 3and Section 4 are the hardware & software implementation detail. Section 5 compare between CTTS Modbus data and Mapping data in IEC 61850. Section 6 concludes the paper.

II. CTTS MAPPING TO IEC 61850

IEC 61850 allow to user can use the modeling method and Common Data Classes(CDC) in IEC 61850-7-1. The description of each logical nodes is Figure 2 as follows

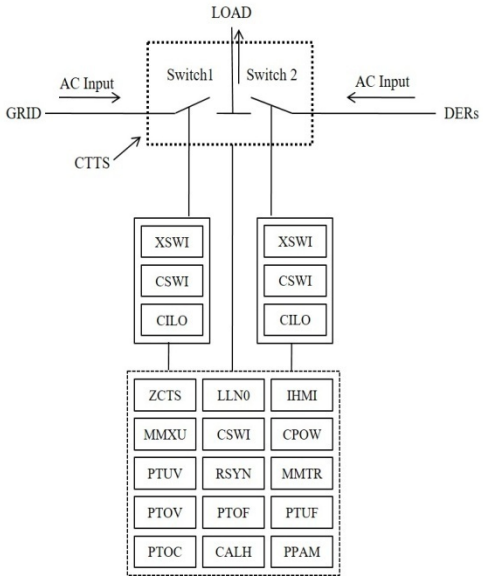

Figure 2: CTTS Mapping to IEC 61850

1) ZCTS is the logical node (LN) defines the characteristics of the Closed switch in CTTS. There is new logical node ZCTS which is inherited from logical node class, Z denotes to the LN group for further equipment. C is meaning of Closed and TS is Transfer Switch.
2) LLN0 logical node device for CTTS that includes common information for logical device.
3) MMXU & MMTR are Grid and DERs values at CTTS
4) PTUV(Under Voltage), PTOV(Over Voltage), PTOF(Over Frequency), PTUF(Under Frequency), PTOC(Over Current), PPAM(Phase Angle) are protection logical nodes.
5) CPOW is the point-on –wave breaker controller LN provides all functionality to close or open a circuit breaker at a certain instant of time.

6) CSWI is the switch control LN handles all switchgear operations from the operators and from related automatics.
7) IHMI is front panel operator interface at bay level to be used for configuration, i.e. local control
8) RSYN is a synchronizing function that produces a release for a closing command of circuit breaker between two circuits whose voltages are within prescribed limits of magnitude, phase angle, and frequency.

Table 3 shows the new proposed LN to characterize a closed transition transfer switch. The letter "T" is Transient data object. The status of data objects with this designation is momentary and must be logged or reported to provide evidence of their momentary state. The column specified with M/O/C defines whether data objects are mandatory(M) or optional(O) or conditional(C) for the instantiation of a specific logical node[4].

Table 3: CTTS ZCTS Class

ZCTS class				
Data object name	Common data class	Explanation	T	M/O/C
Measured values				
DERtyp	ING	Type of DER Unit		M
OpTmh	INS	Operation time		M
AutoManCtl	SPC	Automatic or Manual Mode		M
FltAck	SPC	Acknowledge fault clearing		O
GnSync	SPS	Generator is synchronized		O
AVR	MV	Automatic Voltage Regulator		O
GnCtl	DPC	Starts or stops the generator		O
HzRtg	ASG	Nominal frequency		O
VRtg	ASG	Voltage level rating		O
ARtg	ASG	Current rating under nominal voltage		O

III. HARDWARE IMPLEMENTATION

CTTS internal interconnection used CAN communication and output data used RS 485 connection. And the data type of CTTS output is Modbus serial communication protocol. Modbus enables communication among many devices connected to the same network. To convert Modus data to IEC 61850, we installed gateway. The IEC 61850 gateway has ARM Cortex M5 Series 500Mhz CPU, 512MB Ram, 512MB, Flash memory. It supported IEC 61840 Group 1 MMS protocol and RS 485 based 2 Channel communication (Half Duplex Mode). Main VPN has Quad Core CPU, 4GB memory, dual redundant power supply system. It supported standard IPSec Protocol, IKE V1,V2, IKE Diffie-Helman Group 1,2,5,14,15,16,17,18, Bandwidth-based load-balancing. Figure 3 displays the hardware implementation.

Figure 3: Hardware Implementation

IV. SOFTWARE IMPLEMENTATION

Modeling of CTTS started to make a modeling Markup language based on XML considering Intelligent Electrical Devices characteristic and attributes. This modeling define IEC 61850 Class and FC details. We use the SCL Forge software and verified standard compliance.

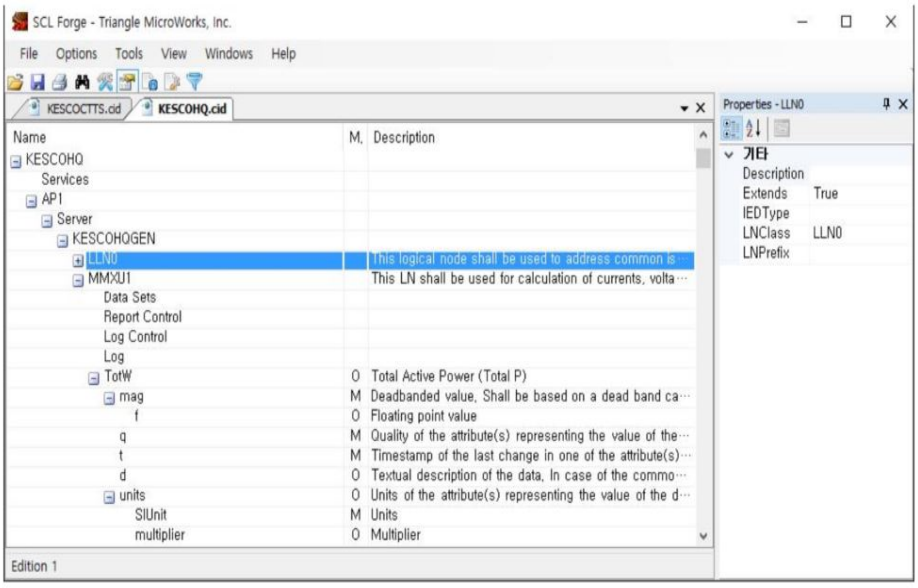

Figure 4: IED Modeling of SCL Tool(SCL Forge)

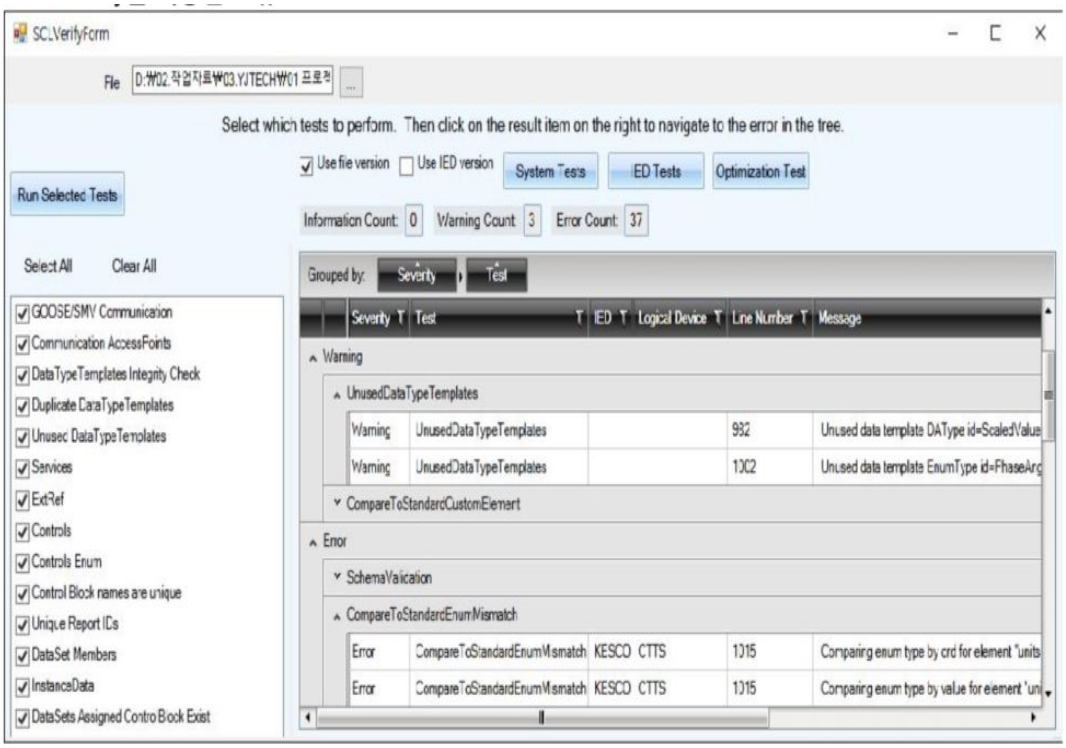

Figure 5: SCL Verify Error Check

Figure 6 is Modbus data of Closed Transition Transfer Switch connected by generator and Figure 7 converts to IEC 61850 data format from Modbus data.

40220	10645	Mains V	V	Unsigned	2	0	0	8277*	Mains values				
40221	9628	Mains V L1-L2	V	Unsigned	2	0	0	9673*	Mains values				
40222	9629	Mains V L2-L3	V	Unsigned	2	0	0	9673*	Mains values				
40223	9630	Mains V L3-L1	V	Unsigned	2	0	0	9673*	Mains values				
40224	8210	Mains freq	Hz	Unsigned	2	1	400	700	Mains values				
40226	8198	Mains curr L1	A	Unsigned	2	0	0	8275*	Mains values				
40227	8199	Mains curr L2	A	Unsigned	2	0	0	8275*	Mains values				
40228	8200	Mains curr L3	A	Unsigned	2	0	0	8275*	Mains values				
40229	8204	Mains PF		Integer	1	2	-100	100	Mains values				
40230	8395	Mains Ld char		Char	1	-	-	-	Mains values				
40232	8202	MainsImport	kW	Integer	2	0	0	8276*	Mains values				
40234	8524	MP L1	kW	Integer	2	0	0	8276*	Mains values				
40235	8525	MP L2	kW	Integer	2	0	0	8276*	Mains values				
40236	8526	MP L3	kW	Integer	2	0	0	8276*	Mains values				
40237	8203	Mains Q	kVAr	Integer	2	0	-32768	32767	Mains values				
40239	8527	MQ L1	kVAr	Integer	2	0	-32768	32767	Mains values				
40240	8528	MQ L2	kVAr	Integer	2	0	-32768	32767	Mains values				
40241	8529	MQ L3	kVAr	Integer	2	0	-32768	32767	Mains values				
40242	8565	Mains A	kVA	Integer	2	0	-32768	32767	Mains values				
40243	8530	MA L1	kVA	Integer	2	0	-32768	32767	Mains values				
40244	8531	MA L2	kVA	Integer	2	0	-32768	32767	Mains values				
40245	8532	MA L3	kVA	Integer	2	0	-32768	32767	Mains values				
40246	8533	MPf L1		Integer	1	2	-100	100	Mains values				
40247	8534	MPf L2		Integer	1	2	-100	100	Mains values				
40248	8535	MPf L3		Integer	1	2	-100	100	Mains values				
40249	10548	Mains V unbal	%	Unsigned	2	0	0	200	Mains values				
40250	10550	Mains I unbal	%	Unsigned	2	0	0	200	Mains values				
40251	8445	WiringCheck		Unsigned	2	0	0	65535	Invisible				
40253	8626	M Ld char L1		Char	1	-	-	-	Mains values				
40254	8627	M Ld char L2		Char	1	-	-	-	Mains values				
40255	8628	M Ld char L3		Char	1	-	-	-	Mains values				
40256	8195	Bus V L1-N	V	Unsigned	2	0	0	9888*	Bus values				
40257	8196	Bus V L2-N	V	Unsigned	2	0	0	9888*	Bus values				
40258	8197	Bus V L3-N	V	Unsigned	2	0	0	9888*	Bus values				
40259	10666	Bus V	V	Unsigned	2	0	0	9888*	Bus values				
40260	9631	Bus V L1-L2	V	Unsigned	2	0	0	9907*	Bus values				
40261	9632	Bus V L2-L3	V	Unsigned	2	0	0	9907*	Bus values				
40262	9633	Bus V L3-L1	V	Unsigned	2	0	0	9907*	Bus values				
40263	8208	I Aux	A	Unsigned	2	0	0	8566*	Bus values				
40264	8211	Bus freq	Hz	Unsigned	2	1	400	700	Bus values				

Generator Data

Grid Data

Figure 6: Modbus Address of CTTS

Type		Variation	Dimension	Data Type	Modbus Address	Modbus Description	IEC61850 data location
CTTS	Generator	genAphaseVoltage	V	float	40217	GEN_VOLT_R_RMS	KESCOCTTS/MMXU1MXPhV$phsA$cValmagf
		genBphaseVoltage	V	float	40218	GEN_VOLT_S_RMS	KESCOCTTS/MMXU1MXPhV$phsB$cValmagf
		genCphaseVoltage	V	float	40219	GeN_VOLT_T_RMS	KESCOCTTS/MMXU1MXPhV$phsC$cValmagf
		genVoltage	V	float	40220	GEN_NOMIN_VOLT	KESCOCTTS/MMXU1MXPhVnetcValmagf
		genVoltage12	V	float	40221	GEN_VOLT_RS_PH_PH	KESCOCTTS/MMXU1MXPPV$phsAB$cValmagf
		genVoltage23	V	float	40222	GEN_VOLT_ST_PH_PH	KESCOCTTS/MMXU1MXPPV$phsBC$cValmagf
		genVolatage31	V	float	40223	GEN_VOLT_TR_PH_PH	KESCOCTTS/MMXU1MXPPV$phsCA$cValmagf
		genFrequency	Hz	float	40224	GEN_FREQ_R	KESCOCTTS/MMXU1MXHzmagf
		genAphaseCurrent	A	float	40226	GEN_CRNT_R_RMS_A	KESCOCTTS/MMXU1MXA$phsA$cValmagf
		genBphaseCurrent	A	float	40227	GEN_CRNT_S_RMS_A	KESCOCTTS/MMXU1MXA$phsB$cValmagf
		genCphaseCurrent	A	float	40228	GEN_CRNT_T_RMS_A	KESCOCTTS/MMXU1MXA$phsC$cValmagf
		genAphasePowerFactor	-	float	40246	IN_PF_R_POWER_FACT	KESCOCTTS/MMXU1MXPF$phsA$cValmagf
		genBphasePowerFactor	-	float	40247	IN_PF_S_POWER_FACT	KESCOCTTS/MMXU1MXPF$phsB$cValmagf
		genCphasePowerFactor	-	float	40248	IN_PF_T_POWER_FACT	KESCOCTTS/MMXU1MXPF$phsC$cValmagf
		genActivePower	kW	float	40232	GEN_TOTAL_W	KESCOCTTS/MMXU1MXTotWmagf
		genAphaseActivePower	kW	float	40234	GEN_POWER_R_W	KESCOCTTS/MMXU1MXW$phsA$cValmagf
		genBphaseActivePower	kW	float	40235	GEN_POWER_S_W	KESCOCTTS/MMXU1MXW$phsB$cValmagf
		genCphaseActivePower	kW	float	40236	GEN_POWER_T_W	KESCOCTTS/MMXU1MXW$phsC$cValmagf
		genReactivePower	kVAr	float	40237	GEN_TOTAL_VAR	KESCOCTTS/MMXU1MXTotVArmagf
		genAphaseReactivePower	kVAr	float	40239	GEN_POWER_R_VAR	KESCOCTTS/MMXU1MXVAr$phsA$cValmagf
		genBphaseReactivePower	kVAr	float	40240	GEN_POWER_S_VAR	KESCOCTTS/MMXU1MXVAr$phsB$cValmagf
		genCphaseReactivePower	kVAr	float	40241	GEN_POWER_T_VAR	KESCOCTTS/MMXU1MXVAr$phsC$cValmagf
		genApparentPower	kVA	float	40242	GEN_TOTAL_VA	KESCOCTTS/MMXU1MXTotVAmagf
		genAphaseApparentPower	kVA	float	40244	GEN_POWER_R_VA	KESCOCTTS/MMXU1MXVA$phsA$cValmagf
		genBphaseApparentPower	kVA	float	40245	GEN_POWER_S_VA	KESCOCTTS/MMXU1MXVA$phsB$cValmagf
		genCphaseApparentPower	kVA	float	40246	GEN_POWER_T_VA	KESCOCTTS/MMXU1MXVA$phsC$cValmagf
	Grid	mainAphaseVoltage	V	float	40256	MAIN_VOLT_R_RMS	KESCOCTTS/MMXU2MXPhV$phsA$cValmagf
		mainBphaseVoltage	V	float	40257	MAIN_VOLT_S_RMS	KESCOCTTS/MMXU2MXPhV$phsB$cValmagf
		mainCphaseVoltage	V	float	40258	MAIN_VOLT_T_RMS	KESCOCTTS/MMXU2MXPhV$phsC$cValmagf
		mainVoltage	V	float	40259	MAIN_NOMIN_VOLT	KESCOCTTS/MMXU2MXPhVnetcValmagf
		mainVoltage12	V	float	40260	MAIN_VOLT_RS_PH_PH	KESCOCTTS/MMXU2MXPPV$phsAB$cValmagf
		mainVoltage23	V	float	40261	MAIN_VOLT_ST_PH_PH	KESCOCTTS/MMXU2MXPPV$phsBC$cValmagf
		mainVoltage31	V	float	40262	MAIN_VOLT_TR_PH_PH	KESCOCTTS/MMXU2MXPPV$phsCA$cValmagf
		mainFrequency	Hz	float	40264	MAIN_FREQ_R	KESCOCTTS/MMXU2MXHzmagf
		mainAphaseCurrent	A	float	40265	MAIN_CRNT_R_RMS_A	KESCOCTTS/MMXU2MXA$phsA$cValmagf
		mainBphaseCurrent	A	float	40266	MAIN_CRNT_S_RMS_A	KESCOCTTS/MMXU2MXA$phsB$cValmagf

Figure 7: IEC 61850 Data

V. RESULTS

Figure 8 represents accurately convert an existing communication protocol (Modbus) and IEC 61850. The Grid Phase to Voltage show 217V(Phase A), 216V(Phase B), 217V(Phase C) and Voltage to Voltage is 380V. And The Grid Frequency is 59.9Hz.

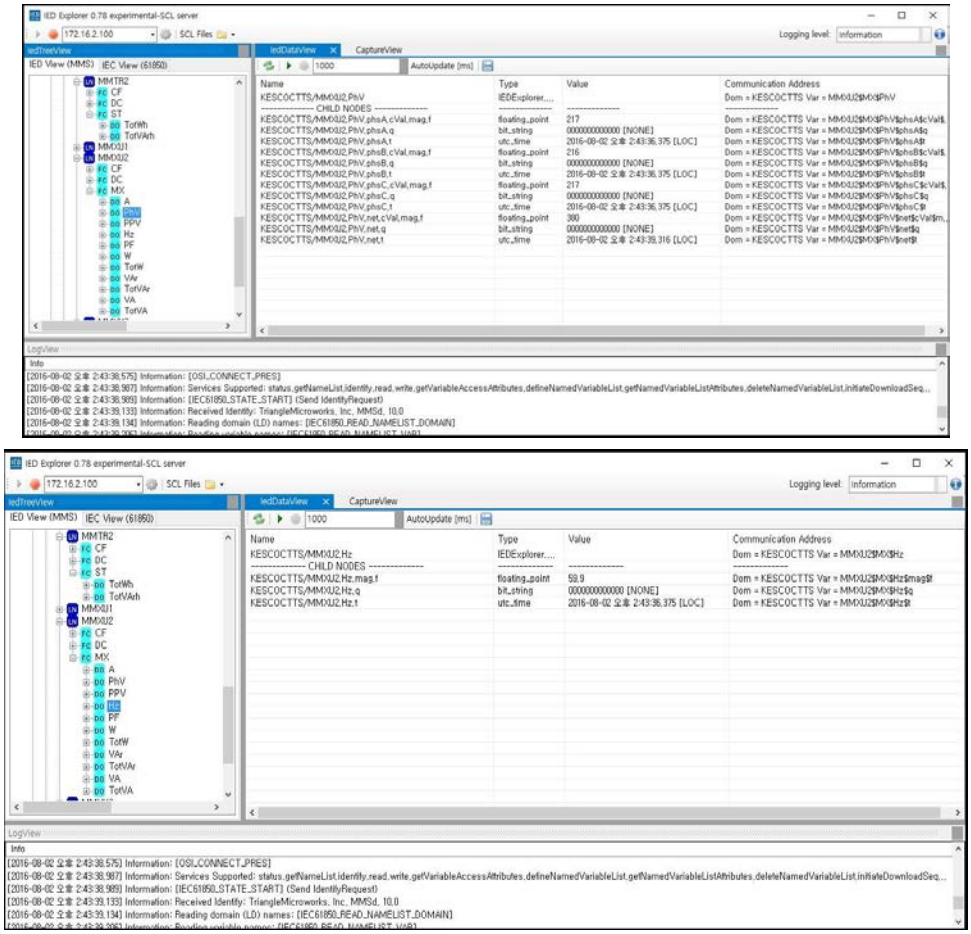

Figure 8: Testing Result

VI. CONCLUSION

This paper proposed mapping CTTS to IEC 61850 for using IoT Technology. First we defined the CTTS data classes and attributes. We used new logical node like ZCTS because there is not defined switch system in IEC 61850 standard. The CTTS system support output data in RS485 and the data type is Modbus data. So, we convert to the IEC 61850 standard data type from Modbus data. And then the comparison data has same result with onsite and remote site. Therefore, the proposed scheme can be applied to remote system like IoT.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Study of Applicability on Smart Window according to Media Façade on Image Content Realization

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Abstract---

Background/Objectives: Smart glass looks like an outdoor glass but it is capable to retain dynamic images on the transparent glass and it is a transparent LED display glass. The purpose of this study is to discuss about development of next-generation media-façade and its application through developing new materials for G-glass which is a popular smart glass developed as the development of smart window has expanded to study of glass.

Methods/Statistical analysis: Smart Window(Smart Glass, Metal Fabric, LED Cluster, Linear Type, LED Display) Smart glass media-façade advantage(transparent electronic lighting glass, electric charge costs an only 1/50 of electric board, construct a building with a unique design) Smart glass usability(National and international expandability through development of image design contents in terms of publicity, architecture, and advertising)

Findings: Media characteristics of media-façade which can be actualized on smart glass are as follows. Firstly, media-façade plays a role of signage of public event space. Secondly, media-façade is able to decorate landmark exterior appearance of building. Thirdly, media-façade enhances value added of space with commercialized contents.

Improvements/Applications: With the development of modern science, video media centering on new materials are developing. In particular, the smart window field has been developed in accordance with the necessity of living space and urban beauty combined with architecture. Video design is developing various contents according to the technical base of new technology, new material, and new media.

Keywords--- G-glass, Smart Window, Media Façade, Applicability, New Material.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Media Façade[1]is the reflection technique to show the features of the different objects by projecting to them, and it has been developed in the contents and technological aspects together with image media.

With advancement of technology, LED light was equipped on outdoor wall of buildings and this even plays a role to deliver city's beauty[2] and information and this can be regarded as a development in technology and continuously evolving future trend.[3] The purpose of this study is to discuss about development of next-generation media-façade and its application through developing new materials for G-glass which is a popular smart glass developed as the development of smart window has expanded to study of glass.

Smart window has been studied in the aspect to control solar energy and apply daily life by the research and development of advanced materials. One example was the introduction of smart window with battery function changing the transparency by situation according to the publication in Nature Communications journal by Prof. Sun Xiaowei et al from NTU (http://blog.naver.com/jjy0501/220213575479).[4]

In the technical aspect, G-Smart Global Company developed the smart window with the resin-filled structure between the windows called G-Glass(In figure 1), and commercialized it with more improvements in the transparency, resolution, and durability.

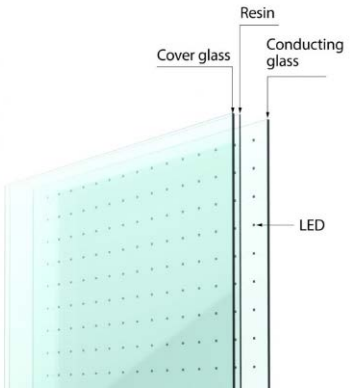


Figure 1: Smart Glass LUMI-G

(http://blog.naver.com/qkqn3019/220500060894)

Due to G-Glass, the image quality and flexibility of screen size were improved between the expression of Media Façade and the reality. Moreover, the transparent sense of volume could be secured since it is the method to conserve the transparency of the window.

As the space to be consisted with the glasses was expanded, the usability of G-Glass in G Smart Global Company has been increased to produce the media on the glass. The next is the example of recent installation with G-Glass that was installed diversely according to the space and the purposes

(http://www.popsign.co.kr/index _media_view.php?BRD=5&NUM=50).

Example, Festival space <Light Chorong Festival 2014 >, <Water Plaza and Light Plaza in PyongTaek>, Pubic spaces <Myungbo Art Hall>, <Shanghai Stock Exchange> and Commercial spaces <De Maris Daichi franchise>, <The H town>(In figure 2).

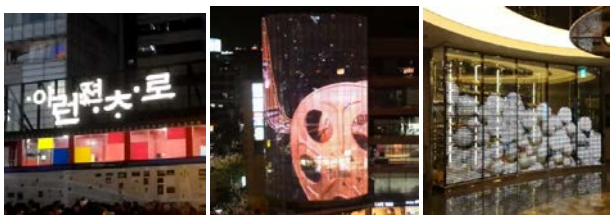
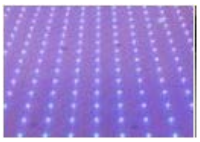


Figure 2: Usability of G-Glass

G Smart Global Company has core, patented independent technologies. One of them is a mount manufacturing process putting special bond on a small sized LED and applies solder to put it on a glass and the other one is a resin injection manufacturing process which fixes LED to prevent LED from being taken off from the glass. Present status of media-façade business product launch is described in (As shown in table 1).[5]

Table 1: Features of LED Outdoor Lighting by Product[10]

Division	*UNIT*	*Whether use constructional materials or not*	*Features*
Smart Glass		o	G smart glass is a laminated glass, therefore, it is appropriate to use it for a constructional material. This means that there is no double charge for installation. Also, unlike other products, it is wireless and it has an over 99.7% of transparency so it is an only product, not damaging the function of 'window', in the world. Furthermore, unlike other products that LED package is unprotected, this product is in the center of glasses so it is perfectly protected from air or humidity and there is less risk for defect and it is easy to clean.
Metal Fabric		X	This product can be produced in various sizes, however, it has a form of applying LED on metal of the building, therefore, when applying it on outdoor of building, the wire structure ruins the beauty of building during day time not lighting media and it has a low transparency. The price is 3 times more expensive than G smart glass.
LED Cluster		X	Since LED module size is big, the light source per LED can have a higher brightness than G smart glass. However, as larger the size of module is, lesser the number of pixel is, therefore, it does not have a high resolution and the large size of module ruins the beauty of building during day time.
Linear Type		X	It is a most common type to use for embodiment of media-façade. There are lots of manufacturing companies producing this type of product and lots of the products are made in China as well. This strongly shows that it does not require high technology for manufacture. Degree of easiness to control resolution is depending on how much close the LED bar is equipped but bar is equipped vertically or horizontally, therefore, when a person is looking at outside from inside of the building, it generates choking feeling. Dust easily lays on LED bar and it is troublesome to clean and maintain it clean.
LED Display		X	Since it has a closer space LED, it has a higher resolution compared to other products but it generates a lot of heat, has an expensive unit price, and it is expensive to maintain because of high energy consumption. Generally, size used for a part of outdoor wall or roof is applied and even though this size has a high resolution, it is not visible from a distant view point, as a result, there is a limitation to deliver message to people.

(1) Features of LED outdoor lighting by Smart Glass

G smart glass is a laminated glass. Therefore, it is appropriate to use it for a constructional material.[6]This means that there is no double charge for installation. Also, unlike other products, it is wireless and it has an over 99.7% of transparency so it is an only product, not damaging the function of 'window', in the world. Furthermore, unlike other products that LED package is unprotected, this product is in the center of glasses so it is perfectly protected from air or humidity and there is less risk for defect and it is easy to clean.

(2) Features of LED outdoor lighting by Metal Fabric

This product can be produced in various sizes, however, it has a form of applying LED on metal of the building, therefore, when applying it on outdoor of building, the wire structure ruins the beauty of building during day time not lighting media and it has a low transparency. The price is 3 times more expensive than G smart glass.

(3) Features of LED outdoor lighting by LED Cluster

Since LED module size is big, the light source per LED can have a higher brightness than G smart glass. However, as larger the size of module is, lesser the number of pixel is, therefore, it does not have a high resolution and the large size of module ruins the beauty of building during day time.

(4) Features of LED outdoor lighting by Linear Type

It is a most common type to use for embodiment of media-façade. There are lots of manufacturing companies producing this type of product and lots of the products are made in China as well. This strongly shows that it does not require high technology for manufacture. Degree of easiness to control resolution is depending on how much close the LED bar is equipped but bar is equipped vertically or horizontally, therefore, when a person is looking at outside from inside of the building, it generates choking feeling. Dust easily lay on LED bar and it is troublesome to clean and maintain it clean.

(5) Features of LED outdoor lighting by LED Display

Since it has a closer space LED, it has a higher resolution compared to other products but it generates a lot of heat, has an expensive unit price, and it is expensive to maintain because of high energy consumption. Generally, size used for a part of outdoor wall or roof is applied and even though this size has a high resolution, it is not visible from a distant view point, as a result, there is a limitation to deliver message to people.

II. PROPOSED WORK

(1) Smart glass and media-façade

Smart glass looks like an outdoor glass but it is capable to retain dynamic images on the transparent glass and it is a transparent LED display glass.[7] Compared to existing media-façade materials, there are some advantages described as follows.

Firstly, G-glass which is a transparent electronic lighting glass is more transparent than an electronic board obstructing obstructing existing buildings, Therefore, it has an excellent aesthetics.

Secondly, its electric charge costs an only 1/50 of electric board and it has no heating problem (http://www.fnnews.com/news/201512171450360640).[5] Because of this peculiarity of the material, it has a better durability which leads to a relative decrease in maintenance and management expenses so it has a high economical efficiency.

Thirdly, expense to construct a building with a unique design is more expensive than making better external appearance of building by using a smart glass.[8]

(http://cn.moneta.co.kr/Service/stock/ShellView.asp?ModuleID=894&LinkID=263&ArticleID=20150402 17383903953&stockcode=114570&wlog_InfoBox2013=JOngmokNews1)

(2) Smart glass Usability

Media characteristics of media-façade which can be actualized on smart glass are as follows.[9]

Firstly, media-façade plays a role of signage of public event space. The exterior decorating by using light can freely express image design based on them of publicity and event and it is capable of capturing detailed graphics, therefore, it has a high utilization rate (As shown in table 2).

Table 2: Public Event Space

Division	**Image**	
Media-façade plays a role of signage of public event space.		Pyeongtaek-City Open space in a square of light water
		Seoul Station Bus stop

Secondly, media-façade is able to decorate landmark exterior appearance of building. If contents of image design corresponding with the size and reputation of landmarks of global major cities such as Hong Kong, rapidly growing China, and America where an outdoor advertising is very popular is produced on buildings, it will generate a hot place as a leader for international trend and this also can create tourism revenue based on location of media-façade after development of contents (As shown in table 3).

Table 3: Landmark Exterior

Division	Image	
Media-façade is able to decorate landmark exterior appearance of building		The Myungbo Art Hall
		Shanghai stock exchange

Thirdly, media-façade enhances value added of space with commercialized contents. In the aspect of spatial art, production of advertising contents based on a concept by using media wall and using it for distinguished advertising media can improve a level of commercialized image art (As shown in table 4).

Table 4: Commercialized Contents

Division	Image	
Media-façade enhances value added of space with commercialized contents		The H town
		DeMaris, Daechi

III. CONCLUSION

G-Glass producing images with emotional artistic message on the smart glass material which has been expanded in the market by material innovation has improved the commercial, artistic, and social communication capabilities and developed the influential power as the media in the image era.

Therefore, Smart G-Glass is expected to improve national and international expandability through development of image design contents in terms of publicity, architecture, and advertising. There is a barrier to climb over since it requires receiving a permission because of light pollution in urban areas but creating wonderful image designs based on certain cities with potential to create tourism revenue can result in high added value and this is considered as an opportunity for media innovation opening new media era.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN 0975-6299

Smart Band Using IC Chip through the User Needs Analysis Focus on the Employee ID Card

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Abstract---

Background/Objectives: Today, while major banks, large corporations, schools and organizations introduce the smart cards, the functions of that has been widely expanded employee ID card, access pass, personal identification, employee time and attendance, cafeteria, etc. In addition to these functions are used in full-scale explosion-bonded wearable device market began to spread in daily life in the form of a watch band accessories.

Methods/Statistical analysis: To develop employee ID card replacement for Smart Band that IC Chip is inserted, we investigate their employee ID card to identify usage patterns and internal business environment, activities. The purpose of this study was to identify user needs and in the Smart ID Card banded lead of discomfort and improvement of ID Card via the user-depth analysis. In addition, the characteristics and behavioral patterns of the real user through the collection and synthesis by in-depth interviews were fabricated sonar total of three personas.

Findings: Goals and needs of the Representative persona are to move easily in and out quick, easy to use, simple design and billing functions. But Smart band should be satisfied with not only the needs of Kim, Ji – Young but also the needs of the user groups because of the needs of the majority of the needs and seeks. Vote results on the key features of a smart band are payment function, commuting to check functions, and interworking functions personal information behind. Design direction of Smart band was determined to result of a user research. It was conducted for the development of smart band to replace an identity card has been inserted the IC Chip, it should be designed to leverage the Company's unique color to maintain a sense of belonging through employee ID card. Also it should be waterproof to meet the needs to be to prevent deterioration due to sweat in the bathroom. Full and thickness should be made thin to minimize hamper flicker when using the keyboard to allow length adjustment will be.

Improvements/Applications: This study was conducted to vote and in-depth interviews with users who will use the actual product. This research was identifying the needs for the product before the value as empirical research to commercialization, especially its significance.

Keywords--- Component, Formatting, Smart Card, ID Card, Smart Band, UX Design.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Today, major banks, large corporations, schools and many institutions, each organization introducing smart cards such as employee ID, has expanded widely throughout the region. It is used to access paths, personal identification during employee time and attendance and cafeteria. It also expected to be used extensively throughout our living environment. Therefore, the demand for smart cards is expected to continue to increase. In addition to such a smart card is to develop into a wearable device coupled with a number of different functions by the explosive growth in the market began to spread in daily life in the form of a watch band, accessories and the like. Wearable device applications have gained incredible popularity in many areas of daily life, such as health[1],entertainment[2], communication[3], rehabilitation[4]and education[5].The rapid adoption and evolution of mobile devices is affecting the entire business landscape. This includes the secure deployment and management of access control credentials for buildings and other applications. The convenience of mobile access is transforming the daily experience of employees and issuers. Wearable's are making this process even faster and easier with the unique capacity to offer a truly synchronous user experience[6].

However, empirical research on the smart card is very rare in design research area. Therefore this study is intended to proceed with the demonstration about conventional developing smart band utilizing IC Chip which is convenient than the existing smart card.

II. CONTRIBUTIONS OF CURRENT STUDY

A. Understanding and Applications of Smart Cards

A smart card is a device that includes an embedded integrated circuit chip (ICC) that can be either a secure microcontroller or equivalent intelligence with internal memory or a memory chip alone[7]. Definition of Smart Card is a plastic card which is built the microprocessor and memorycard and also is possible to save and manage the information. Smart cards are the electronic cards which attached its own arithmetic functions on the surface, such as microprocessor unit (MPU), the card operating system (COS), and IC chip. They look like the typical credit card in terms of the same material and size[8]. The advantages of the smart cards can be the difficulty of the fake/modulation, multi-application possible, the large capacity of storage, flexibility, and portability, etc. The types are classified contact, non-contact, hybrid, combination, etc. depending on how the data is read. Each characteristic is as follows.

- Contact smart cards operate because of the physical contact between the contacts of the IC card reader and IC card contact area. The risk of electric shocks and damage due to frequent contact, but is suitable for applications such as transaction authentication, digital signatures, which focuses on the security handle relatively large amounts of data.
- Non-Contact: this physical contact is not required as the IC card to communicate with the card terminal to the antenna by the radio frequency signal to the means between the card and the reader. Restricted to the processing time traffic, it is suitable for distribution.
- Hybrid: combines the advantages of the contact and non-contact cards. A type of contact and non-contact card is present separately in a single card. In the utilization of hardware and software support structure is inefficient and high manufacturing costs[9].

Thus a high level of confidentiality that utilize smart card IC chips are used advantageously as possible for various identification and billing, electronic signature. In application fields such as smart cards have an ID card, membership cards, transportation cards, electronic money, prepaid internet card[10].

III. EMPIRICAL RESEARCH FOR THE DEVELOPMENT OF SMART BAND

A. User Test

To develop employee ID card replacement for Smart Bandthat IC Chip is inserted,we investigatetheir employee ID card to identify usage patterns and internal business environment, activities. And we find out when thein convenient of usage was occurred at any point and what new needs are saw. Through this report we seek solutions to solve the "inconvenience" they feel, and want to find new ways to meet the needs.First, respondents were selected as target employees who use an employee ID card in YTN building. And also they were consisting of office workers, field workers, and escort staffs. Survey was conducted during the period of ten days from May 4 to May 13, 2015.

Observation

As shown in figure 1, we observed the target employees who use an employee ID card in the YTN building at the first floor lobby, office entrance and all employee ID card point of use. We wrote the observation diary during the observation period was conducted for one week from May 4, 2015.

Figure 1: Observations on the Use of Employee ID Card

The results are in table 1. We found that users stopped and took long times to find the ID card in the bagin front of the lobby points tagging. And also some users blocked the pathway for a long time because of strap earphones and cosmetics, etc. In addition, because the sound of heavy hitting at the desk, some users put off their employee ID card and some users purchase accessories such as card wallets to put the employee ID card and other cards at a time.

Table 1: Observation Diary

Day	Location	Contents
2015. 05. 04.	the first floor lobby, office	A long time looking for employee ID in the bag. Hanging things in the bag can not be ejected fine. This place ticks careless strap wrapped around the employee ID card. Put off because of heavy feeling in one place. The re-use at the time, such as lunch time access is required.
2015. 05. 06.	the first floor lobby, office	The users who have the difficult tagging their employee ID card in both hands holding the heavy equipment. Find the equipment used to put down the employee ID card. Plug in your back pocket to put your employee ID card.
2015. 05. 07.	the first floor lobby, office	The growing inconvenience to users who purchased the employee ID card accessories separately. Place the food stamps paper plugged into the back of employee ID card. After use the employee ID card from inside pocket, it was kept in inside pocket again.
2015. 05. 08.	the first floor lobby,office, Emergency stairs	When you visit the other departments not to bring your employee ID card, comes back. It can not have access to emergency stairs at the entry without using the employee ID card. Carry the locker key in the employee ID card.

In-Depth Interview

Based on the results obtained by the user observing, the user depth interview was conducted. The purpose of the interview is up to see precisely determine the behavior of the employee using employee ID card in accordance with recognized research and usage patterns of workers for the employee ID card. The Interviewees were selected for five people to use the employee ID card in the office YTN, during the investigation period was conducted in May 6 to May 8, 2015.As shown in figure 2, the actual use of the interviewees' state of employee ID card.

Figure 2: The Actual Use of the Interviewees' State of Employee ID Card

In summary, the key questions and answers are as follows.

"In my company, employee ID card seems essential however the wear of outside is dependent on."

Q. When we saw the staff using the company's employee ID card from outside the company, I feel a sense of belonging?

A. Yes. But in the distant look of employees using the employee ID card is dependent on the company looks awkward.

Q. Is there a desire to replace an employee ID card case?

A. I want to replace because of dirty. But it does not bother taking the time to replace.

Q. What about using the employee ID card several times a day?

A. Use approximately 5-6 times for access, except that, there is no need employee ID card. But the goods are always attended to the problem of holding out.

Q. How come when holding the employee ID card work?

A. Almost neglected state. I am holding that comes encased in a bag, because there is no need outside of the company.

Q. Have you ever used due to employee ID card feel uncomfortable in the company's internal life?

A. Sometimes It is taking a desk or the clothes, I feel uncomfortable. And also when I went anywhere else, if I didn't bring it, I couldn't enter the gate.

Q. Do you have a wallet necklace usual?

A. The small wallet card separately for traffic and only attend on average, holding 7-8 cards but not all always required.

"Work out other departments often as nature. Outside of company we don't need employee ID card. "

Q. Do you think that you use the employee ID card is more conducive to the formation of a sense of belonging company?

A. Inside and outside of the company, parents or acquaintances that I also feel a sense of belonging, showing the employee ID card to use.

Q. Why put food stamps on the employee ID card?

A. Because Employee ID card is always used, putting food stampson the employee ID card is possible to use whenever I want to use the food stamps.

Q. Do you use a certain amount of employee ID card in one day?

A. Use at least 10 times a day. There must come back again when I forgot to employee ID card on the move.

Q. How do you carry the employee ID card when you leave?

A. Immediately placed in a bag, because there is no need in the outside.

This result together the interview, the majority of users it can be seen that do not feel the need for the employee ID card outside the company in common. In addition, it was found that in addition to accessories bring another employee ID cards to capture transportation card and food stamps. Through the results, besides the simple use to entrance, we found that they needs for additional features, such as food stamps, transportation card function.

Affinity Diagram

Affinity diagram is one of the methods were presented by KawakitaJiro, Japanese society and culture scholar in 1960. It is also called "affinity Act," to collect Affinity means in UX is commonly used as the collecting the data unit to reveal the relationship. This study found the rules of data extracted from one User Voice obtained via user-depth interviews. With the affinity diagram, we found the current problems and improvement measures required for employee ID card smart alternative bands.

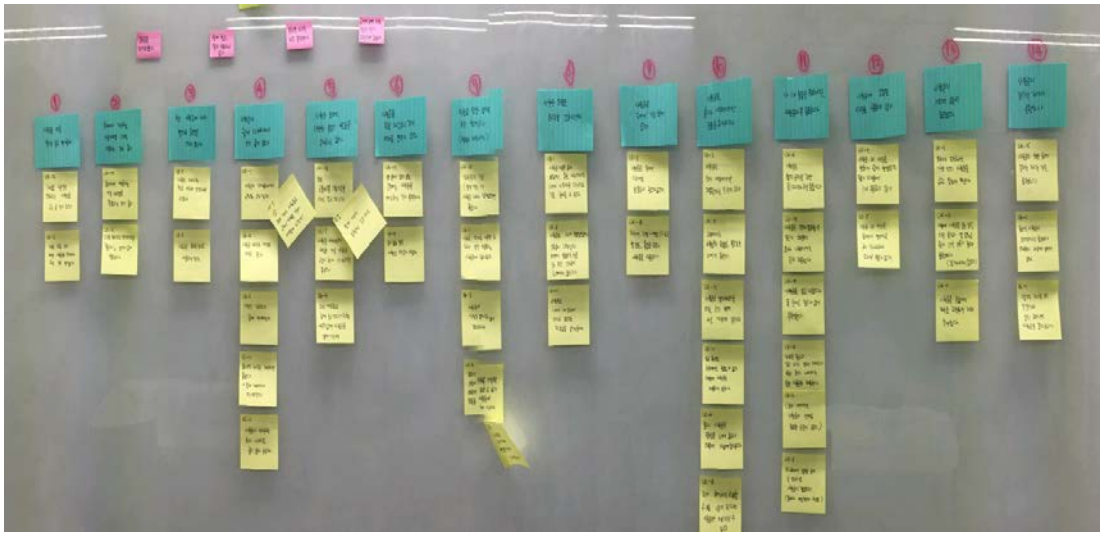

Figure 3: Affinity Classification

As shown in figure 3, through 1st classification, we were able to derive a total of 12 headers.“'It is inconvenient to use the employee ID card due to tackle”, “Employee ID card is easy to get dirty look”, “Using employee ID card enhances the sense of belonging”, “It can be difficult to carry the employee ID card every days”, “Employee ID card directly tagging the trouble”, “In addition to employee ID card, they carry a variety of uses of other card”, “It is only required for access within a company “, “Always carry packed food stamps and business cards are cumbersome”, “Employee ID card is only for door key function”, “Employee ID card is a need exists only inside the company”, ”I do not feel much emphasis on employee ID card”.

Next, a grouping of the detailed sub-items via a secondary classification with twelve headers extracted from the primary classification was classified as lumps having a larger significance. It was obtained a total of four secondary headers. There are as follows. “It is inconvenient to use the employee ID card due to tackle”, '' It is important to feel a sense of belonging”, “easy to find, easy to use”, “I want contains other useful features other than the door key”.

B. User Modeling

User problems through Customer Journey Map

The user scenarios in figure 4,customer journey map are said that they come into work with an employee ID card in the bag at home, and took out an employee ID card after the arrival in the company. The first usage was in the entrance (lobby) and was found to use frequently to access the office and other department. Through journey map, we found the time of the three main types of problems derived. The time information and the problem itself are as follows.

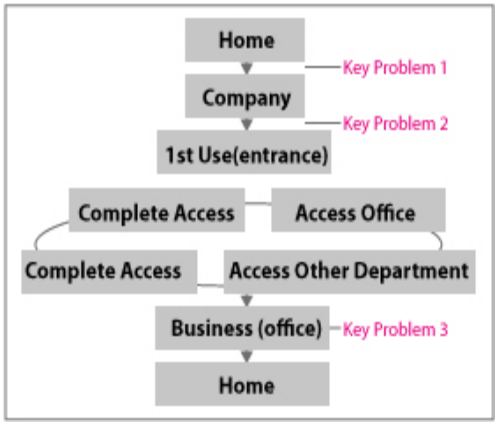

Figure 4: User Problems through Customer Journey Map

- Key problem 1: When there is no need to move from your home they put into the bag.
- It does not require from outside of company and it can be the cumbersome stuff.
- Key problem 2: When using the primary (exit) from the company, they stopped and looked for employee ID card.
- After arriving at the company, stop and take time to find employee ID card and will require a more difficult time finding etc. in the bag.
- Key problem 3: When they work in the office, employee ID card hit upon a desk often.

The employee ID card which is the type of necklace same as the height of the desk keep interfering to take forward work on a desk.

Personas

Personas are the fictional characters designed to represent the different user types within the population a usable product or service. It has been widely used as the service planning, product development and materials for the establishment of user research and marketing strategies in various fields such as interaction design development. Persona is the hand-on methodology introduced by the interaction designer and software development expert Alan Cooper's book 'The Inmates Are Running the Asylum'[12].

The purpose of this study was to collect and synthesize the actual characteristics and behavior patterns of users through in-depth interviews. This classified by the type of users were prepared to focus on putting a total of three personas. The contents are as follows. In table 2, person A is about Shin, Eun-jung. In table 3, persona B is about Park, Seong-gyu. In table 4, persona C is about Kim,Ji Young.

Table 2: Persona A

Name: ShinEun-jung Age: 33 years old Title: Marketing team manager "It's so hard tokeep finding mixing employee ID card from the bag each day!"	
Contents	
· the kind of work Active ——○—— inactive · frequency of use employee ID card 1 ——○—— 10 · sense of belonging Low ——○—— High	
Goal	
· even a small part in the company's business concern, if there is no hope except one. · want a convenient and fast access through increasing efficiency even more. · I want you to pay employee ID card is also available.	
User Needs	
· product that comes with a payment function · put in a bag with products that do not mix well with other things · feature can also be used outside the company · that can be conveniently and quickly accessible services · also goes well with any outfit product	

Table 3: Persona B

Name: Park Seong-gyu Age: 45 years Title: Marketing Team Leader "Using the employee ID card is always required. It can be representative of the image of the company. "	
Contents	
· the kind of work Active—○———Inactive · frequency of use employee ID card 1———○———10 · sense of belonging Low ———○——— High	
Goal	
· maintain a sense of belonging and unity employee ID card. · maintain good image from the outside with clean employee ID card. · easily identify personal information of employees.	
User Needs	
· design and services that can reinforce a sense of belonging · immediately informing feature the personal information of employees · be astute design and functionality that raises the image of the company	

Table 4: Persona C

Name: Kim Ji Young Age: 29 years Title: Technical general staff "Employee ID card to use even dozens of times a day, could be more easily and quickly accessible?"	
Contents	
· the kind of work Active,—○———Inactive · frequency of use employee ID card 1———○—10 · sense of belonging Low ———○——— High	
Goal	
· to conveniently move to quick and easy access · employee ID card should not be cumbersome task during the work. · easy to find employee ID card at the time of preparation work	
User Needs	
· product that comes with a payment function · that can be easily and quickly accessible design and product · Function to recognize me move opens the door. · cumbersome form of products that are unacceptable	

We can classify as the users of all three types after synthesis the actual characteristics and finding the behavior patterns of users. With the vote by the YTN DMB staffs, we finally set the Primary Persona and Secondary Persona.

Persona Analysis and Improvement

Vote for the major personas selection was doing by the 25 people who work at YTN DMB. The method of voting is setting by summing of score which got the most important 3 point, so so 2 points, and not important 1 point.

Table 5: Persona Vote Results

	Persona A Shin Eun-jung	Persona B Park Seong-Gyu	Persona C Kim Ji-Young
Score	59 ((3X9)+(2X16))	25 (1X25)	66 ((3X16)+(2X9))

Persona C, Kim Ji-young was chosen as the main persona through the above voting process. Putting up goals and needs of the this persona have to move fast and easy access to convenient, not to be cumbersome task during the work, and products such as payment functions are combined. However the needs and goals of final goal of Persona C,Kim Ji-young and Persona A, Shin Eun-jung, it was found that most should match. As shown in table 5, the main buffer in the other lines that do not interfere with the needs of Persona C, it is preferred to add the needs of the user group to progress to meet the needs of the majority.

The Use Scenario of Main Persona

8:00 a.m., Kim Ji-young went on the way to work. Some busy office workers commute was using the employee ID card, some of them were around their neck with card holder. Kim Ji-young, after tagging a smart employee ID bands worn on his wrist 'ID-BAND' in the card terminal, carried the body to the subway. After arriving at the company, he was an employee payment at the first floor coffee shop with 'ID-BAND'. He remembered that he came up with the food stamps in different clothes always not too long ago. He did not bend his body at the ground floor entrance, and his hand was stretched out easily for tagging withholding a cup of coffee.

2:00 pm, Kim Ji-young leaved the office and took the equipment needed to work on both hands. Unlike the employee ID card have been loaded to keep in your back pocket hit or hamper ticks equipment, he think the more convenient while using the employee ID card worn on the wrist. 7:00 pm, all employees who are laid off work and went out of hand exit after tagging lightly. He thought that it declined the people who fell off the employee ID card quickly to put in the bag after using smart Band instead of ID card.

IV. SMART BAND DESIGN PROPOSALS

A. Design Direction

Result of a user research conducted for the development of smart band to replace an identity card has been inserted the IC Chip, it should be designed to leverage the Company's unique color to maintain a sense of belonging through employee ID card. Also it should be waterproof to meet the needs to be to prevent deterioration due to sweat in the bathroom. Full and thickness should be made thin to minimize hamper flicker when using the keyboard to allow length adjustment will be. As shown in figure 5, weproposed Smart Band design solution.

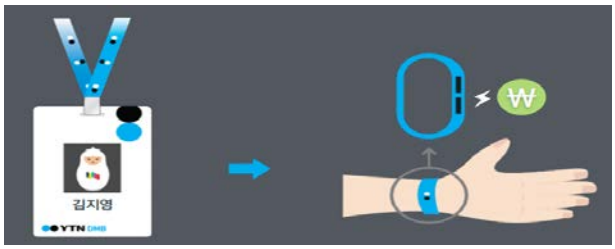

Figure 5: Smart Band Design Solution

B. Function Definition

Vote for the selection of major function was doing by the 25 people who work at YTN DMB. The methods of selection are inserted the function through total sum calculated by multiplying the score extra points after cattle required score (-3 to +3) in each persona.

Table 6: Results of Voting for Key Fuction

	Persona A(X3)	Persona B (X2)	Persona C(X5)	Total Sum
Payment functions	36(12X3)	2(1X2)	60(12X5)	98
Personal information Interworking function	18 (6X3)	32 (16X2)	20 (4X5)	70
Momentum Check Function	6 (2X3)	2 (1X2)	25 (5X5)	33
Commute Check Function	18 (6X3)	40 (20X2)	30 (6X5)	88
Smartphone alerts linked	12(4X3)	16(8X2)	25(5X5)	53

In table 6, key features of the above representatives' vote through main persona; we were able to derive the opinion that the payment feature is most needed. The next important feature was followed by commuting checking, and human resource information and interworking functions are third feature. For efficient use of the product, not too many features can bother or interfere with one or elements, so they were added to only two features. Depending on the voting results, payment functionality (meal tickets and transportation card functions) to commute functional check insert was selected as first insertion. Singularity as "personal information interworking function, it is necessary to see a small number of users are determined to the desired function to consider insertion.

V. CONCLUSION

In this study, we conducted a demonstration study for evolution than traditional smart card with IC Chip and take advantage of the convenient smart wearable band development. User-depth analysis carried out for this purpose which derives the inconvenience and improvement of the ID Card, which was to identify the users' needs in a smart banded ID Card. Through in-depth interviews it was collected for behavioral patterns and characteristics of actual users, which was produced by a total of three personas mainly focusing on the user type classification after selection by voting for one representative of the persona. Objectives and needs of the representatives persona was a convenient, easy to move out fast, unacceptable to use cumbersome, products such as payment functions are combined.

Although it doesn't interfere with the needs of the main persona Kim, Ji young, we need to create a design that reinforces the sense of belonging of company which was the needs of other user groups. In addition to adding features and services, such as what to wear to look good and stylish exterior design should be designed to meet the majority of needs.

Vote results on the key features, billing functions was first, commute check function was second, and personal information interworking function was third. This study has the significance of particular value because it was conducted by the vote and in-depth interviews with actual users that will be using the product. And also it has the value as the former empirical research to commercialization.

ACKNOWLEDGMENT

We wish to express great appreciation to YTN for their help in share this results and findings. And also many YTN members provided informative data during the IC Band user tests. "This paper was supported by Konkuk University in 2016"

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

The Study on Self-Expression Behaviors of Users in their 20s at Android Based Smart Phones

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Abstract---

Background/Objectives: This research is willing to analyze the self-expression behavior of young generation through smart phone and investigate the differences from the attempt of self-expression in the existing cyber space.

Methods/Statistical analysis: To understand how people are using smart phones as a means of self-expression, a qualitative research method through in-depth interview was conducted. The sample of in-depth interview was consisted of 6 female and 4 male universities students in their 20s who were active in self-expression.

Findings: Young users are losing interest in decorating wallpapers of smart phones except when they buy new phones. The reason is that they use shortcut through lockscreen, which is the initial screen of smart phones, rather than choosing icons on the wallpaper. The frequency of using wallpapers relatively decreased, and users do not feel new in decoration functions through themes and app. Besides, wallpapers are hardly shown to other people, so users do not feel necessity of self-expression through wall papers. On the other hand, they were using Kakaotalk profile photos, especially, to show own position, taste, emotional change, recent status or share experience as a venue for communication.

Improvements/Applications: Today, users' desires for their own special experiences through differentiated services are getting intense, so it is necessary for the related industry to establish proper measures for this.

Keywords--- Smart Phone, Self-expression, Personalization, In-depth Interview, Launcher, Kakaotalk.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

As smart devices become generalized and popularized, the necessity of personalized services is raised. Personalized services improve users' satisfaction by providing users' differentiated experiences and value, which couldn't be provided at the beginning stage of smart devices.

Especially, the smart phone is a very suitable medium to express thoughts and emotions because users can participate in designs with their creativeness according to their life patterns and styles. At Android operating system, separate personalized interface is provided, so personalization is most actively done in this system. Through functional contents including applications and widget used, screen can be assigned freely, and interface can be decorated according to what users want with reorganization of background screen, texts and icons. Through Launcher App, which gathers public attention as a next generation service platform in ICT(Information and Communications Technologies) market, users who are fed up with interface mounted on the smart phone can have personalized screens by directly designing their screen with forms they want.

In addition smart phones support people to take photographs anywhere anytime; and touch up and edit through diverse applications to share their days and memories. As such, photographs are involved in users' self-expression as a means to explore and establish own identity.

The purpose of this study is to examine how the smart phones which have deeply penetrated into our lives are utilized as a means of individual self-expression instead of the functional device to call on the move.

Existing studies on self-expression based on media focused on self-expression in the cyber world with different new nature from the real world.

However, since smart phones are more intimate media to individuals, different patterns are expected from the self-expression in cyber space.

In this regard, the present study seeks to probe into how people are using smart phones as a tool of self-expression and how it is different from self-expression attempts in the existing cyber space.

II. MATERIALS AND METHODS

To understand how people are using smart phones as a means of self-expression, a qualitative research method through in-depth interview was conducted. The sample of in-depth interview was consisted of 6 female and 4 male universities students in their 20s who were active in self-expression as shown in the table1, the interviewees answered questions on self-expression through smart phone interface and profile photo of Kakaotalk, the main smart phone messenger platform of South Korea, in comfort for about 1 hour.

The friend list of Kakaotalk is optimized in looking at others' profiles registered with users' phones to expose oneself to many viewers, functioning as a public medium.

Anyone who registers my phone number with his or her phone can look at my profile photo. Therefore, this profile photo works as my face or gate in the virtual world, serving as a good means of identity expression. For this reason, such profile photos were investigated in this study.

Table 1: Interviewee Information

Name	Gender	Age	Smartphone model	Name	Gender	Age	Smartphone model
○○Choi	M	25	Samsung Galaxy S6	○○Kim	F	21	LGG3
○○Goo	F	21	Samsung Galaxy S4	○○Lee	M	23	LGG3
○○Hwang	M	24	Samsung Galaxy Note4	○○Lee	F	26	Samsung Galaxy S7
○○Jeong	F	21	Samsung Galaxy Note5	○○Lim	F	21	Pantech VEGA Secret Note
○○Jung	F	24	Samsung Galaxy Note5	○○Lim	M	24	LGG2

III. LITERATURE REVIEW

Self-expression

Goffman defined conveying a person's own impression that he or she intends to convey to other people as self-expression. He highlighted sociologic aspects, and he claimed that in self-expression, social activity by personal relations is an important element, and that self-expression is an essential element for smooth interaction with other people. In addition, he viewed self-expression as the process of constant information management, or the process of controlling and managing information to convey their impression to others. He argued this is done through a behavior called 'impression management' [1] [2].

Therefore, instead of showing one fixed feature continuously, people express what they want to show by selecting one among various features in self-expression[3].

Today's young generations try various methods for their personality expression or self-expression. These attempts sometimes create new culture or fashion. In the past, people made those attempts by decorating their appearances, but nowadays, various devices including internet, smart phone and SNS are used, and the influence of those devices is getting bigger and bigger.

Regarding the devices that they can expose themselves in cyber space, SNS has become expanded to mobile devices have become expanded with popularization of smart phones following personal website, blog, mini-homepage and so on. The content shared through the social networks platforms expresses the emotion of an individual sharing the content[4].

Self-expression at cyber space depends on the elements that media provides. At cyber space, people can express their ideal features by hiding their uncomfortable emotions, so that they can be provided with opportunities to form high ego and to recover their self-esteem with availability of positive self-evaluation[5].

Rather than continuously showing their fixed images among their appearances, people express the features that they want to show to other people. That's because they want positive impression management by showing the features that can induce positive judgement about themselves. Accordingly, self-expression that is conveyed by intentional manipulation has to be selective. Selective self-expression can be used more at cyber space where visible verification is limited than at face to face situations. At face to face situations, it is not easy to control impression directly through verbal/non-verbal elements. However, at cyber space, where physical proximity is unavailable, social-contextual words such as social presence and non-verbal elements are excluded, so selective self-exposure is easier. Therefore, self-expression suggested at cyber space might be features that are selectively designated expression rather than actual features. Thus, many studies on self-expression at cyber space regard media that convey self-expression as important elements and try to comprehend expressive characteristics of the media [2] [6] [7] [8].

Smart phone is very personal medium compared to other media. Especially, user interface that has important meanings for establishment of various functions of smart phone is mostly used or decorated for users' own usability rather than for others. For this reason, self-expression on smart phone is expected to have a distinctive feature from self-expression at cyber space. On the other hand, Kakao Talk, a popular SNS based on mobile, might not be very different basically from the aspect of cyber space. Nevertheless, it is expected that differentiated elements from expressions at other cyber space could appear while it is combined with mobile, which highlights instantaneity and mobility.

Therefore, based on precedent studies about self-expression at cyber space, this study intends to discover how college students use the media of smart phones for self-expression tools and what differences their attempts have from other existing self-expression trials at cyber space.

Self-expression through Personalization

Personalization can be defined as providing services, contents or products customized to individuals based on knowledge about their preferences and behaviors[9] [10].

Kang defined personalization as a system that supports users to find, acquire and customize what they want by interaction with information, functions and interface for their preferences and tastes as a strategic tool that supports interaction of corporation and individual users [11].

Personalization role of smart phone users' interface can be categorized into two types. The first is it can improve usability and accessibility by resetting user environment according to their behavior patterns and interest areas among numerous menus. The second is it can enhance emotional satisfaction, because it can differentiate by using their own images and fonts. By satisfying users' desires to choose and decorate their space the way they want, it can make them feel satisfied with feedback. Due to the satisfaction, not only do users gain information they want easily and conveniently, but also they can satisfy their desires for active participation.

All the people want to be acknowledged as members of society that they belong to, and this basic desire can be expressed as a symbolic meaning through products they own. In addition, people often recognise their smartphone as “another self,” leading to a role reversal of “user” and “tool”[12].The examples are mobile phone users use ring tones or wallpapers reflecting trend to imply their ages, and they make customized phone cases to feel the products are not normal but unique.

Recently, due to personal media generalization, users stay with machines all the time, so personalization is considered important. Especially, as the experience of using smart phones is extended, desires for environment setting increase. In this situation, users who are tired of interface basically installed to smart phones started to have interest in personalized applications, and the amount of use tends to increase gradually. Among various personalized applications, it is 'Launcher App' that provides the environment where users reflect their identities as active main agents and reorganize them.

Launcher of smart phone is a start manager app that enables users to decorate their smart phone screens such as changing app icon designs as shown in the figure1. Formerly, manufactures of android smart phones of open OS installed unique interface and launchers of designs basically to establish differentiation of terminal. Recently, as technological restrictions were solved due to high market shares of android with excellent openness and increase of CPU capacity of smart phones, and users highly desire unique screens, various independent types of launchers are appearing. As these independent types of launchers gain popularity, portals and SNS also release launcher apps, leading to arrival of serious smart phone home screen competition era[13].

<Nova launcher><Go launcher><Dodol launcher>

Figure 1: Example of Launcher

Meanwhile, in Kakao Talk, a type of information to expose individuals in personalized space, SNS, which is a 'text centered' communication type, is mixed with 'photo centered' contents including profile pictures and background pictures. Via status messages, people expose their thoughts in a single sentence, so it is a stage of expressing self-identity that connects time and locations easily. Especially, 'the profile picture', which is an element that can show their identities visually the most in the online network space, is used as a tool for their own reflection, and self-presentation and self-design to show other people.

Kim reported that the use of profile photos is for 'change of emotion and mind', 'identification', 'expression of taste', 'showing experience and recent conditions' and 'conveyance of social and personal messages'. [13]

In this study, users' interviews were performed to find out more intensively how profile pictures are used as a tool for self-expression.

IV. RESULTS AND DISCUSSION

Self-expression Methods through Smart Phones

In technology and exterior designs of smart phones, there isn't a big difference among brands, so more people try expression of individuality through accessories such as cases. Besides, rather than wallpapers, they decorate lock screen more frequently.

This result is because cases or lock screens are revealed to other people, and they stay on wallpapers less since they use functions such as checking messages directly through short cut.

『What I concern the most about my smart phone is its case. It is most noticeable. However, I have a limit allowance, so I can't change often. Instead, I change background themes or use the launcher, but I am losing interest nowadays. At first, it was new and curious, and it was fun to decorate as my style, but nobody sees it, nothing is new, and it seems like the speed of smart phone is getting slow. It will be nice if there are themes that I can edit or revise. It might be fun if I can make my own pattern using an app』 ○○ Lee(female,23)

『I feel like I decorate a lot when I switch a smart phone. I am making my own unique phone. Wallpapers are only for me, so I decorate them with what I like without caring about other people. However, I don't do it that often. I don't see the wallpaper often, and there is nobody who sees it… I change lock screen sometimes when I feel like it.』 ○○ Goo(female,21)

『I put Audrey Hepburn, my favorite actress, on the lock screen, but I do not change that often. Because I can use short cut through status display or multi-tasking, I do not use wallpaper that often. It seems that there is no image that I like... Instead, I change Kakao Talk profile photos or themes sometimes. Because I often use them.』 ○○ Choi(male,25)

『When I used feature phones, I changed ring tones or caller rings to songs that I like or depending on my mood, but I rarely use them. Recently I go to places where I have to my phone with mute or vibration, that's why… But I change wallpaper from time to time. I also use the launcher. Since I like girlish images, I mostly use those kinds. I also want others to view me like that.』 ○○ Lim(female,21)

Self-expression through Smart Phone Interface and its Intention

Users were found to use smart-phone lock screen or home screen to realistically reproduce or restrict the degree of their present emotion by emphasizing natural background images or more abstract aspect. Or they were found to use these screens to refresh their mental attitude towards an ideal or expectation every time they turn on the phones.

Changing themes through launcher app is on stagnation due to infrequency of its use, and desires for new technology appeared.

『I downloaded a photograph of a model of a brand l like from the internet and installed it in my background screen. I like the brand and I also want to be like the model』 ○○ Lee (female,23)

『It's the photo I took last week, I took a picture of my feet in autumn leaves. It's my background wallpaper. The photo feels good so I want to see it every time I turn on my phone. I change my phone background often wherever I get a good photo. It's my phone so my personality is well expressed. 』 ○○Jeong (female,21)

『I use my phone background as a note. For example, what I want to buy, eat, not to forget or good phrases to memory or photos I empathize with each time, cute illustrations, selfies, etc. to show my feelings… 』 ○○Goo(female,21)

『My phone background is my new girlfriend. I want to see her every time I turn on my phone and whenever I want to see her. 』 ○○ Hwang (male,24)

『I changed themes using GO Launcher before, but nowadays there are some useless functions, and designs are limited. So I don't use often.』 ○○ Lim(female,21)

『At first I used the launcher app several times because it was new and curious, but there are so many useless functions... I like the ones that images can be changed easily and conveniently like Kakao Talk profile photos. If there are themes with extraordinary designs, I would use it again. They only change fonts, images and icons... It will be nice if the whole interface is changed like Card UI, which is popular these days.』 ○○ Lee(male,23)

Self-expression through Kakaotalk Profile Photo and its Intention

It was found that users not only expressed their position by showing their images in the Kakaotalk profile but also their emotion actively by displaying images expressing own mental status or feelings. By making public oneself to others, users were found to communicate with others or update their recent status.

『I uploaded the selfi I took when I went to a restaurant with my friends. The photo was good and I had a great fun on that day too. 』 ○○ Goo (female,21)

『I was so depressed a few days ago then I found a photo similar to my feeling in the internet. So I posted it. I wanted that my friends would see it and recognize it』 ○○ Lim(female,21)

『Selfi. Photo with friends and images showing my current feelings and so forth. I just change it often. I tend to change the images whenever I think somebody may be curious about what I'm doing now. If I really feel bad, I just don't put anything and leave it empty. 』 ○○ Kim(female,21)

『Some people change the profile images several times a day. They seem to like to show something to others or express themselves. Some others do not change it for so long. Then such people seem lazy. I think those who have nothing in the profile tend to be a little unfriendly. I had one friend who was very quiet and looked like to study all the time but he put a very geeky picture for himself. I was very surprised and felt like I came to understand him a little more. Then he looked different. 』 ○○ Hwang(male,24)

『I change photos when I want to express my mood, or when I have something that I want to show other people. However, because my parents could see them, I am reluctant to express my bad mood. So I just upload my pet cat.』 ○○ Lee(female,26)

Difference in Self-expression between Kakaotalk Profile Management and Computer-mediated One-man communication

The existing computer-mediated communication(ex: CyworldMinihomepage, Blog) is more meaningful in terms or record or storage. They required a lot of time and efforts to manage. Whereas, Kakaotalk profile is easy to change frequently thanks to the simplicity, mobility and connectivity of smart phones. It was found more consumable rather than recordable and storable.

Thus, communication was the main purpose while personal impression management behaviors were found lower in Kakaotalk profile activities than the computer-mediated communication.

『I take care a lot of Mini homepage because the images are shown to other people.. and the number of views... It seems like I care more about others than my own satisfaction. I usually used PC at night when I feel sentimental, so there are a lot of written contents. 』 ○○ Hwang(male,24)

『Computer-mediated communication was cumbersome as they needed a lot of time to decorate. But smart phones are easy to upload images. So I can decorate anytime. It's good. 』 ○○ Lee (female,23)

『Minihomepages are more taken care of because others will look at it. Number of visitors and others. They seem to make people more self-conscious rather than own satisfaction. 』 ○○ Jung (female,24)

『Well, it seems like Minihomepages untangle and stretch a story. They are like, we look at a specific person closely. But Kakaotalk shows brief pieces. So viewers also just pass by at a glance without putting much significance. 』 ○○ Lim (male 24)

『Minihomepages were hard to access so I didn't' use it more often. Now, there is no one around me who uses the page. Kakaotalk profile is how I talk with my friends to I use it everyday and decorate it more often. 』 ○○ Lee(male,23)

『For blogs, I upload funny photos, videos, and articles for others to read but for Kakaotalk, I have more of my own pictures and what I like. 』 ○○ Kim(female,21)

What Kind of Photos are Put in Kakaotalk and Have you Ever Edited a Photo?

People came to take photographs easier with high-definition smart phone cameras and touch up photos with just simple operation of smart phones. Now the act of taking a picture had become no longer that of experts exclusively but easily accessible activity for anyone. In this aspect, it was found that the act of expressing oneself visually had become part of important daily routine.

『Because Kakao Talk is more exposed to people than other SNS, I choose photos to upload more carefully. I also hope many people will see them. I always use filter app for photos. I like photos whose colors look warm. 』 ○○ Kim(female,21)

『I often take photos of scenery or natural moments of my friends, I use Photoshop to correct colors or brightness to post the photo. 』 ○○ Lee (female, 23)

『I often use selfi, photos on dogs or others' faces then correct the colors or shape a little by the app. Sometimes I use filtering too. 』 ○○Jeong(female, 21)

『When I'm alone, I upload photos of selfi, good memory with friends or other funny ones. So I sometimes touch up for a better photo and edit a lot. 』 ○○ Lee (female, 26)

『I think I mostly put pictures expressing emotion. I installed a photo editing app to adjust the color tones, remove unnecessary parts from the background, or correct the faces.』 ○○ Lim (female, 21)

『I sometimes upload photos that are edited in funny ways using app. It's fun to share those photos with friends.』 ○○ Choi(male,25)

V. CONCLUSION

Young generation users are very active in expressing themselves through smart phones, form networks in this cyber space and express their identities freely. Especially, smart phones with android basis are basically equipped theme functions, so they support to easily change basic UI environment that can show at smart phone display. In addition, by allowing users to download various themes and wallpapers through app, they try to satisfy users' desires for expression.

Nevertheless, young users are losing interest in decorating wallpapers of smart phones except when they buy new phones. The reason is that they use shortcut through lockscreen, which is the initial screen of smart phones, rather than choosing icons on the wallpaper. The frequency of using wallpapers relatively decreased, and users do not feel new in decoration functions through themes and app. Besides, wallpapers are hardly shown to other people, so users do not feel necessity of self-expression through wallpapaers.

On the other hand, they were using Kakaotalk profile photos, especially, to show own position, taste, emotional change, recent status or share experience as a venue for communication.

This study found that while self-expression in the existing cyber space was more about recording or storing and impression management in consideration of others, self-expression through smart phones was instant and freer. Nevertheless, the small profile size and limited and stalled image not only restrict expression but also disturb message communication. In this sense, further expansion into freer space of identity expression is expected by using diverse multimedia functions.

While there were smart phones that had distinction, and each brand presented their own unique technologies in the past, nowadays a technology that a company releases can be easily applied to products of other companies making it hard to find technical difference. Thus, users' desires for their own special experiences through differentiated services are getting intense, so it is necessary for the related industry to establish proper measures for this.

ACKNOWLEDGEMENT

Funding for this paper was provided by Namseoul university.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Hybrid PCM Memory as a Main Memory for a Next Generation Smart Device

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Abstract---

Background/Objectives: Our main objective is to design a hybrid PCM memory for the substitution of a DRAM.PCM (Phase Change Memory) is a promising candidate to replace DRAM due to its non-volatile, byte-addressable access, in addition to its ability to store data without refreshing.

Methods/Statistical analysis: However, PCM is unsuitable as the main memory because it has limitations: high read/write latency and low endurance. In this paper, we propose an effective memory management technique for a hybrid PCM with a DRAM buffer. We can reduce both access and write operations of PCM by using effective page replacement. For performance evaluation of the proposed algorithm we used a SPEC CPU 2006, and implement a trace driven simulation. The trace is acquired using a modified version of the Cachegrind tool from the Valgrind 3.6.3 toolset.

Findings: For the performance evaluation, we determined the access ratio of PCM and the access time of the hybrid memory, and compared them with the CLOCK-DWF algorithm because it utilizes DRAM based on the write operation, just like the proposed hybrid memory. According to our simulation, the hybrid PCM can reduce the access count by approximately 66% and the access time by 22%, compared with the CLOCK-DWF algorithm.

Improvements/Applications: we proposed an effective and simple page management policy for the next-generation hybrid memory architecture.

Keywords--- PCM(Phase Change Memory), DRAM, Paging Management, Hybrid Memory, LRU Algorithm.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Until today, DRAM is using a main memory due to low memory latency, a byte-addressable access and a low cost. Still the main memory has been made a study for low power consumption and fast access time [1,2]. However main memory capacity is becoming a critical issue for many systems. This is because that working-set is becoming to increase by using multi-core, large application and concurrent thread. Because of this reason, it is the capacity of memory must be increased. However density of DRAM has already reached the limit. For this reason, these main memory requirements using DRAM will not be ideal.

Today, PCM(Phase change memory) is promising candidate for replacement of DRAM. PCM is byte-addressable access similar to dram but it is nonvolatile and consumes less an idle power than dram. Furthermore PCM have high density that can store more information in the same area than DRAM density [3]. And PCM is advantageous in terms of facility investment and development costs, because it can produce substantially similar to the DRAM process compared to other non-volatile memory.

However, PCM has a critical darkness that prevents to utilize main memory. First, PCM has lower write endurance that is known to be about 10^7-10^8. If the number of write operations to a cell exceeds the limit, the PCM cell cannot be used any longer [3,4].

Second darkness is that write access time of PCM is expected to be about 6~10 times slower than that of DRMA. Last, PCM has higher active power to access cell than DRAM, although PCM has ideally the idle power [3].

In order to overcome this disadvantage, PCM is to use a DRAM along with PCM (it call Hybrid structure). Using a DRAM, it can to hide the slow write latency and an energy consumption of PCM. By the use of DRAM, the hybrid memory can be divided in tow structures, as shown in Figure 1.

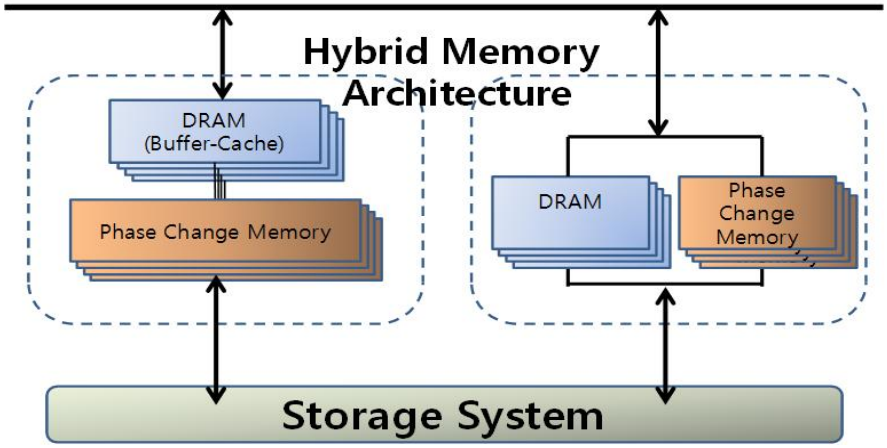

Figure 1: PCM&DRAM Hybrid Main Memory Structure

One uses DRAM as an upper level buffer-cache memory of PCM, and main memory consist of PCM only(as figure 1(a)) [6,7,8]. In other to access the page, access to the DRAM and the PCM takes place sequentially. Thus fully associative placement is difficult to be used in this architecture. Hence, collision may degrade the efficiency of the DRAM buffer-cache. The other memory architecture is to provide both DRAM and PCM at the same main memory(as figure 1(b)) [5,9,10]. In this architecture, address translation is performed via the page table for both DRAM and PCM, So, fully associative placement is possible. However, the operating system manages page replacement based on the limited information provided by the paging unit hardware and cannot be used complex algorithms as the full LRU algorithm. Furthermore, a hybrid memory has to be further considered for the page replacement policy because of the different characteristics of DARM and PCM. Thus, it is necessary to an effective page management policy for DRAM and PCM hybrid memory.

This paper is aimed at effective DRAM management of a hybrid memory consisting of PCM and DRAM. We propose a new page-caching algorithm for the effective management of DRAM. The algorithm is designed to overcome the long latency, endurance problem, and frequency access of DRAM. To reduce the access number of PCM, this paper proposes a simple LRU algorithm, called the Sifter_LRU replacement policy. This algorithm

is applied to both PCM and DRAM. However, it works differently based on the LRU operation. The remainder of the paper is organized as follows. In Section 2, we briefly summarize the characteristics of DRAM and PCM and related work for hybrid memory systems. In Section 3, we present the design of our algorithm. The performance evaluation results are presented in Section 4. Finally, Section 5 concludes this paper.

II. BACK GROUND

A. DRAM vs PCM

DRAM is organized as a grid of rows and columns, where each bit is stored in the form of a charge in a small capacitor. Thus, DRAM, with its small capacitor, has a fast access time and the same operation time for read and write functions. However, DRAM requires a consistent refresh operation to sustain its data due to leakage and frequent accesses. DRAM consumes power setting up its rows and columns for a physical address access, and also closing a row if some other row needs to be accessed. Additionally, it consumes power for the actual read/write accesses, and consistent standby power due to leakage and clock supply.

Unlike DRAM, PCM is a non-volatile memory that retains its data even when the power is turned off. The phase-change material used for PCM is called GeSbTe (GST), and it stores information permanently in the form of different states, amorphous (a RESET operation) or crystalline (a SET operation), using a small heater. To write to a PCM cell, the GST state needs to be altered by injecting a large but fast current pulse to heat up the GST active region. To read a PCM cell, the power consumption is much lower, since no heating is involved. Thus, PCM has a different access time for read/write operations. As shown in Table 1[2], although PCM has attractive features such as high density (x4 DRAM), non-volatility, low idle power, and good scalability, the access latency and write power of PCM are still not comparable to DRAM latency. Furthermore, PCM has a worn-out problem caused by limited write endurance.

Table 1: DARM and PCM Characteristics

Attribute	DRAM	PCM
Non-volatile	*X*	*O*
Read latency	*50(ns)*	*50~100*(ns)
Write latencty	*50(ns)*	*350*(ns)
Read Energy	*0.1(nJ/p)*	*<<1.0(nJ/p)*
Write Energy	*0.1(nJ/p)*	*<<1.0(nJ/p)*
Endurance	*X*	*10^8 for write*
Idle Power	*~1.3W/GB*	*~0.05W*
Density	*Low*	*High(4XDRAM)*

B. The Related Work for Hybrid Memory

The studies of [6, 7, 8] were utilized in the DRAM buffer cache for high-performance PCM. Although this structure hides the access of PCM, it does not use the existing page table for DRAM. Therefore, DRAM requires an additional controller.

As previously mentioned, the operating system manages page replacement based on the limited information provided by the paging unit hardware, relatively complex algorithms such as the full LRU policy, due to the large capacity. CLOCK can reduce the LRU algorithm overhead, which is the overhead of moving a page to the LRU position on every page hit[11]. CLOCK-Pro[12] is based on CLOCK, which is a simple approximation of the LRU replacement algorithm. The objectives of CLCOK-Pro are to obtain a low computational requirement and remove the disadvantages, which are the same disadvantages as those of LRU, with the workload of weak locality. CLOCK-DWF is also based on CLOCK, which is an approximation of the LRU algorithm. CLOCK-DWF works by dividing the write operation and read operation in the DRAM and PCM. By using a write operation count for the DRAM, it reduces the write operation of the PCM.

Even though the CLOCK algorithm is an approximation of the LRU algorithm, it can be effectively used in operating systems by using additional algorithms such as CLOCK-Pro and CLOCK-DWF.

III. THE PROPOSED ALGORITHM OPERATION

A. Motivation

A proper page management policy can have a significant effect on improving the performance of I/O by hiding the long latency of disks. Many studies have been undertaken to create an efficient page replacement policy for a DRAM-PCM hybrid memory. For effective page management of hybrid memory, a page that can be referenced in the near future must have existed for a long time in the DRAM.

Employing the LRU (Least Recently Used) replacement policy is one of the best ways to improve cache memory performance. When the cache is full and a miss occurs, this algorithm selects the page where it is in the LRU position as the victim page. The advantage of LRU is that it is very simple to implement and is the most effective performance improvement method. However, LRU cannot operate well with an access pattern with weak locality, such as sequential scans, a cyclic pattern that is slightly larger than the cache size. Thus, the operating system manages page replacement based on the limited information provided by the page table, and relatively complex algorithms such as the LRU algorithm cannot be used as replacement policies. As a result, approximate algorithms such as CLOCK-Pro [11] or CLOCK-DWF [10] become practical choices. However, in the case of CLCOK-Pro, it must define a hot page or cold page by its thresh value. To find the victim page, CLOCK-DWF spends more time than the conventional LRU using its state bits.

Thus, there is a need for a simple and effective page replacement algorithm for a hybrid memory. In this paper, we propose a simple method called shift-LRU. It is an approximate algorithm like CLOCK-Pro and CLOCK-DWF. However, our LRU policy is very simple and effective. In addition, our LRU policy operates at a different reference value from DRAM and PCM. The LRU policy of DRAM is based on the write operation that will write in the PCM. The LRU policy of PCM is based on the read operation in the PCM.

B. The Proposed Hybrid Memory Structure

In the proposed hybrid memory, DRAM and PCM operate as the main memory of the same layer. For effective page management for hybrid memory, we propose a simple and new LRU policy called Shift_LRU. In our LRU algorithm, only DRAM updates state bits of LRU, when a write hit occurs. When a read hit occurs on PCM, the LRU state bits of PCM are updated.

Our LRU algorithm for DRAM has four state bits: a Shift_LRU0 (D_L0) bit, a Shift_LRU1 (D_L1) bit, a NP (new page) bit, and a Reference (R) bit. The D_L0 bit indicates that a write operation has occurred previously in the same page. The D_L1 bit means that the current write access hit has occurred. The NP bit means that a new page has been stored to DRAM from the hard disk or PCM. The Reference bit indicates an access hit by a read operation or write operation.

Our LRU algorithm for PCM has two state bits: a Shift_LRU0 (P_L0) bit and a Shift_LRU1 (P_L1) bit. The P_L0 bit indicates a previous access hit, and P_L1 indicates a current access hit or an update from DRAM.

Through a miss of the hybrid memory or a write operation hit to PCM, if the page is stored to DRAM, the NP bit is set to '1'. Because we don't know if the page is useful or not, the page needs the least interval time for usefulness. When a page in DRAM results in a write operation hit, the D_L1 bit that indicated the current write operation hit is set to '1', and the Reference bit is also set to '1'. If a read operation hit occurs in DRAM, only the Reference bit is set to '1'.

When the DRAM is full and a new page is stored, our LRU algorithm selects the victim page. To select the victim page, we check the D_L0, D_L1, and NP state bits. If the state bits are all '0', the page is selected as the victim page, and is stored to PCM. If the Reference bit of the victim page is '1', the Reference bit is updated to a P_L1 bit of PCM. If some state bits for the selected victim page are a '1', the value of the state bit moves to another state bit. In other words, the D_L1 bit is moved to D_L0, the NP bit is set to '0', and the state bits of the next page are checked. This action takes place until the state bits of some page are all '0'.

When the page results in a write operation hit to PCM, the page is exchanged with the victim page of DRAM. At that time, the NP bit of the page that will be stored to DRAM is set to '1', and the P_L1 of PCM is also set to '1'. If a read operation happens to PCM, only the P_L1 of PCM is set to '1'.

If PCM is full, and the new page is stored to PCM from DRAM, the victim page is selected using our LRU algorithm. To select the victim page to PCM, the LRU algorithm checks P_L0 and P_L1. If the two state bits of the page are all '0', the page is selected as the victim page. However, if LRU bits of PCM are not all '0', the P_L1

is moved to P_L0, and P_L1 is set to '0'. Then, the state bits of the next page are checked using the LRU algorithm. This action takes place until the state bits of some page are all '0', as for DRAM.

Figure 2 shows the current status of the hybrid memory. Here, a clock pointer (C.P.) indicates the most recently stored page. Figure 2(a), page 'E' is the most recently stored page because the NP bit is '1'. After storing the page, the page did not result in any operation because the R bit is '0'. Page 'A' and page 'C' request a write operation because D_L1 is '1'. Page 'B' only requests a read operation because the state bits of page 'B' are all '0', except for the R bit. In the PCM, the clock pointer indicates page 'F'. Page 'I' indicates a recent request by a read operation. Detailed operation of our proposed LRU algorithm is shown below.

a. DRAM Hit Operation

Figure 2(a) shows, if page 'E' is hit by a read operation, it results in a DRAM hit. Page 'E' is only an update with an R bit that is set to '1'. If there is a write operation request for page 'E', the D_L0 bit and R bit are set to '1'.

b. Statistical Analysis

In the PCM of Figure 2(a), if the page is hit by a read operation, the P_L1 is set to '1'. In our LRU algorithm, the read operation hit is only updated to P_L1. If a write operation hit occurs on page 'I', page 'I' is exchanged for the victim page of DRAM. To select the victim page of DRAM, the state bits of page 'C', which is the next page of the clock pointer, is checked. As the D_L1 bit of page 'C' is '1', page 'C' is excluded from the victim page candidates. The D_L1 of page 'C' is updated to D_L0, and D_L1 is set to '0'. The clock pointer indicates the next page of page 'C'. The state bits of page 'D' are not all '0' so page D is also excluded from the victim page candidates. The D_L0 of page 'D' is set to '0' due to D_L1. Page 'B' is selected as the victim page because the state bits are all '0'. Therefore, page 'B' and page 'I' swap with each other. When page 'I' is stored to DRAM, only the NP bit is set to '1', and the other state bits are set to '0'. The clock pointer of DRAM indicates page 'I'. When page 'B' is stored to PCM, the P_L1 bit is set to '1', and the P_L0 bit is set to '0'. The clock pointer indicates page 'B'. The result of the write operation is shown in Figure 2(b).

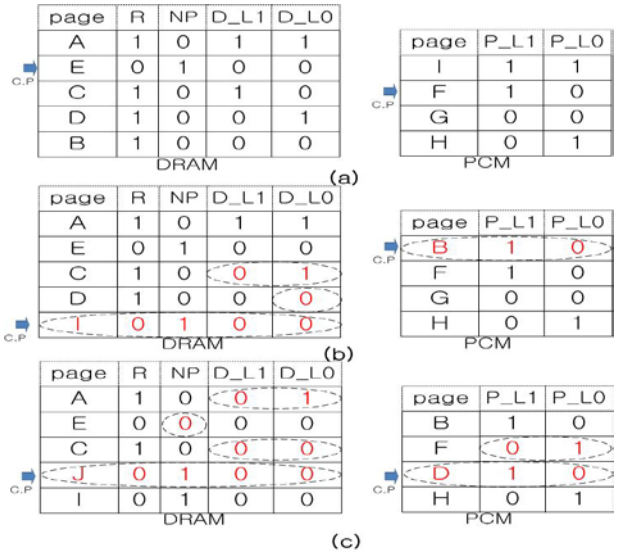

Figure 2: The Proposed Algorithm Operation

c. Miss Operation

Figure 2(b) shows, page 'J' is requested by the CPU, and the hybrid memory is a miss. To select the victim page, our algorithm checks the state bits in page A, which indicates the next page of the clock pointer. The D_L1 bit and D_L0 bit are '1', so it is excluded from the victim page candidates. The D_L0 bit of page 'A' is set to '1' due to D_L1, and D_L1 is set to '0'. Even though the state bits (D_L1, D_0) of page 'E' are all '0', page 'E' is not the victim page because the NP bit is '1'. The NP bit is then updated to '0', and the next page is checked. Page 'C' is also not the victim page due to D_L0. Finally, page 'D' is selected as the victim page because the NP bit, D_L1, and D_L0 are all '0'. Page 'J' is inserted into page 'D', and only the NP bit of page 'J' is set to '1'.

Page 'D' is stored in the PCM. However, the PCM is full. For the victim page selection, it checks the state bits from page 'F'. Page 'F' is not the victim page because P_L1 is '1'. The state bit is updated so that P_L1 is set to '0' and P_L0 is set to '1'. Page 'G' is the victim page because P_L1 and P_L0 are all '0'. Therefore, page 'D' is inserted into page 'G', and the P_L1 bit of page 'D' is set to '1' by the R bit of page 'D'. The result of the write operation is shown in Figure 2(c).

IV. THE PROPOSED ALGORITHM OPERATION

For performance evaluation of the proposed algorithm we use a SPEC CPU 2006 [13], and implement a trace driven simulation. The trace is acquired using a modified version of the Cachegrind tool from the Valgrind 3.6.3 toolset [14]. We filter out memory references that are accessed directly from only the memory references observed at the main memory system. After approaching from the L1 cache and L2 cache, a miss trace was used for the 100 million addresses of data accessed in memory.

For the performance evaluation, we determined the access ratio of PCM and the access time of the hybrid memory, and compared them with the CLOCK-DWF algorithm[5] because it utilizes DRAM based on the write operation, just like the proposed hybrid memory. However, we don't consider the miss delay time because it takes a very long time compared to a read/write hit operation. For performance evaluation, the DRAM was utilizing 50% of the capacity of the PCM and the CLOCK-DWF shows the best performance. We also utilized the DRAM and PCM characteristics for the simulation, as shown in Table 1.

Figure 3 shows the access ratio of PCM. This paper is aimed at effective DRAM management of a hybrid memory. As shown in Table 1, the read latency of PCM is different as a sequential read operation takes 50ns and a random read operation takes 100ns. Therefore, reducing the access of the PCM is effective in improving the performance of a hybrid memory.

Our proposed hybrid memory reduces the PCM access count by approximately 66%, compared to the CLOCK-DWF. Figure 3 shows, the proposed hybrid memory shows a good effect on 'libquantum', 'mcf', 'bwaves', milc', and 'emsFDTD', because the CLOCK-DWF was simply divided into DRAM and PCM for read and write operations, and is unable to consider application characteristics. As a result they request more read operations than write operations. On the other hand, 'bzip2' is similar to CLOCK-DWF. DRAM access of 'bzip2' is similar as 'bzip2' requests more write operations than read operations.

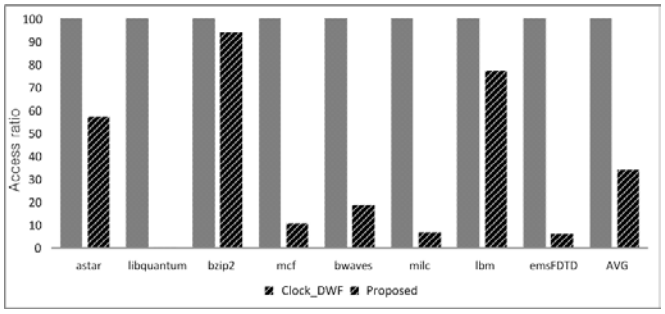

Figure 3: The Access Ration of the PCM Access(%)

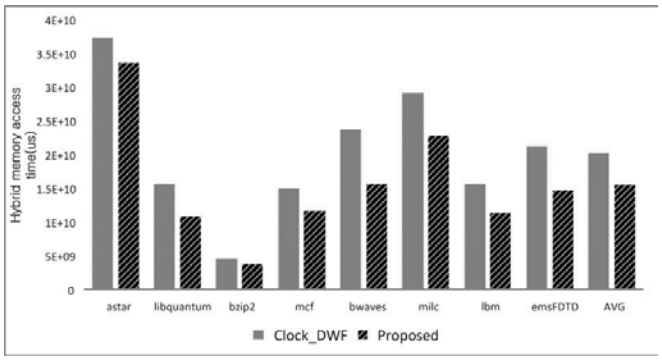

Figure 4: Hybrid Memory Access Time

In order to evaluate the hybrid memory performance, we used memory access time. This is a basic method for evaluating performance. According to the simulation, we can reduce the memory access time by approximately 22%, compared to CLOCK_DWF. The write count of PCM can be similarly reduced. Figure 4 shows the average memory access time. Figure 3 shows, 'libquantum', 'mcf', 'bwaves', milc', and 'emsFDTD' showed good performance. However, AMAT did not because the write operation has a longer latency than the read operation.

V. CONCLUSION

In this paper, we propose an effective and simple page management policy for the next-generation hybrid memory architecture. The proposed page management method is executed in the same way (shift operation) to DRAM and PCM. However, the reference value for operation is different for each as DRAM is based on write operations and PCM is based on read operations. We can achieve performance improvement in the hybrid memory using a simple algorithm.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the ministry of Education, Science and Technology(NRF-2014R1A1A4A01008504).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Workflow Evaluation for Optimized Image-Based 3D Model Reconstruction

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Abstract---

Background/Objectives: In recent years, image-based 3D modeling techniques and systems have been improving rapidly. They are cost effective, portable and largely used for creating accurate 3D models.

Methods/Statistical analysis: Structure-from-motion (SfM) is one of the most applied methods that have been implemented in many applications. In present study we evaluate a complete workflow through the recent and open source tools for 3D modeling using image-based technique to obtain a 3D model from real objects.

Findings: We further identify and evaluate the factors that have an important impact on the quality of result.

Keywords--- Image-based Modeling, Structure-from-Motion, Point Cloud Reconstruction, Surface Reconstruction, Surface Texturing.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Generating three-dimensional (3D) models of natural and man-made objects or scenes is an active research field in Photogrammetry and computer vision. In recent years, 3D modeling has been rapidly improved in diverse applications including medical diagnosis, entertainment industry, 3D printing and virtual reality, preservations of cultural heritage and museum objects[1].

Three-dimensional model reconstruction of objects and scenes can be performed by using both range based and image-based methods. However, range based techniques and methods are not the subject of current research. System based on image-based methods can create 3D models of given objects or scenes from 2D overlapped images acquired by a digital camera. This method uses complex algorithms to determine 3D coordinates of objects from a sequence of overlapped images obtained at arbitrary viewpoints. In this field, Structure-from-motion (SfM) is one of the most familiar, among a variety of algorithms. This method promises the safeness and does not harm the subject matter because of the use of natural illumination. One of the advantages of image-based methods is the low cost capture setup that does not demand any special hardware.

In present study, we evaluate a work flow for 3D model reconstruction of real objects from multiple images captured from different perspectives. To reconstruct the 3D model, we implement the Structure-from-motion to recover the camera parameters (intrinsic: focal length and radial distortion, extrinsic: position and orientation) and determine the 3D coordinates of the object. A sparse point-based 3D model is generated that is further processed to acquire dense point cloud of the object.

The obtained point cloud needs processing for surface reconstruction and surface texturing. Further we evaluate the factors that impact the quality of final 3D model. Hence, this report would demonstrate the best operating method and limitations of the tested tools for 3D modeling of real objects.

II. WORKFLOW

To reconstruct 3D model from multiple images, performance of various software is tested. Bearing the proficiency and accuracy in mind, two software among the freely available ones were chosen; Visual SfM and OpenMVS. Visual SfM[2,3] is an academic tool which bundles its SfM techniques with multi-view-stereo[4] techniques into a powerful tool. It is able to generate point cloud from multiple images. For surface reconstruction from point clouds and surface texturing, we used OpenMVS[5] that provides among the best algorithms available. It takes the camera poses and a point cloud as input and output is a textured mesh. Figure 1 presents our workflow, and a stepwise breakdown of which is discussed in the following:

A. Feature Detection and Feature Matching

The first step is to locate the features in each input image. Visual SfM provides a variety of different algorithms for feature detection including SIFT by Lowe (Scale Invariant Feature Transform) point detector[6] and SiftGPU (a GPU implementation of SIFT)[7].

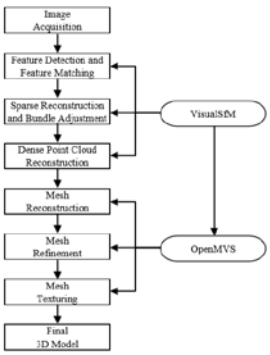
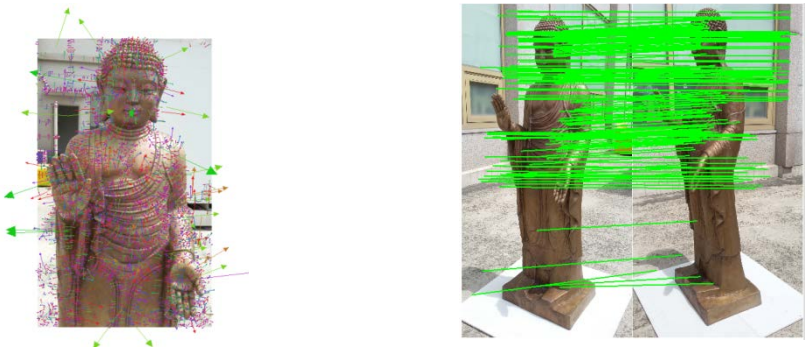


Figure 1: Workflow Steps for Image-based 3D Model Reconstruction



(a) (b)

Figure 2: (a) Feature detection and (b) Feature Matching between two views

Every Feature is Marked and Matched by Lines

SIFT algorithm first searches for the distinct feature points in the images which is prerequisite for the image matching step while SiftGPU accelerates the feature detection using the GPU. Features detected by SIFT are shown as marked in Figure 2(a). These feature points are saved within a feature descriptor. The detected features describe the variations in the images with respect to certain changes, such as noise, rotation, image scale, contrast and exposure.

For feature matching Visual SfM implements preemptive feature matching[2] to accelerate the matching process. First it arranges the features of images into decreasing scale order and then lists all the pairs to be matched, either using the pairs or a subset as shown in Figure 2(b).

B. Bundle Adjustment

The purpose of Bundle Adjustment is to calculate the camera parameters and 3D positions of points in the linear run time to restore the scene. Visual SfM implements the incremental structure-from-motion with Bundle Adjustment and provides a 3D point cloud as shown in Figure 3.

C. Dense Point Cloud Reconstruction

The goal of this step is to provide a complete and accurate and dense point cloud. In our workflow it can be done by using either VisualSfM which implements CMVS[4] or OpenMVS using path-match algorithm[8].

Figure 3: Structure-from-motion Reconstruction Showing the 3D Point Cloud and All of the 121 Camera Poses

D. Mesh Reconstruction

This step aims to estimate the mesh surface that explains the best input point cloud, and to robust the outliers. The algorithm used by OpenMVS performs well with both sparse and dense point clouds and the algorithm currently implemented is based on the system of [9].

E. Mesh Refinement

Mesh refinement recovers all the fine details from the mesh obtained by previous step. Mesh reconstruction was performed with fast algorithms that were able to recover the true surface and then in this step reconstructed surface is improved based on the algorithm given by[10].

F. Mesh Texturing

This step is to compute a sharp and accurate texture to color the mesh. The algorithm used for this purpose is able to handle with slight errors and variations between the mesh and camera poses[11].

III. EXPERIMENTS AND RESULTS

To evaluate the performance of workflow, we considered two objects for 3D model reconstruction performed on two different operating systems; Microsoft Window and Linux. The system with Windows OS has Intel Core i7 CPU with 8 x 4 GHz per CPU and 16 GB of main memory. It also has a smart GPU NVIDA GTX 970. Our second system is an Intel Xeon Dual CPU system with 8 x 3.20 GHz per CPU, 16 GB of main memory and works under Linux OS. In the following we show our experiments and their reconstruction results.

1. *Buddha Statue:* The first dataset, called Buddha Statue, was captured in an outdoor environment and contain 121 images. Statue is made of metal with rough surface and height of about 1m. A smart-phone (Samsung SM-G530H) with 8 megapixels camera was used to capture images. This is a compact dataset as the resolution of all images is same i.e. 1836 x 3264. We capture the images in three rings form different range distances from the statue. These photos were imported to VisualSfM for point cloud reconstruction shown in Figure 3. We tested our workflow with and without GPU for the point clouds reconstruction of Buddha statue and found a reasonable time difference shown in Table 1. Further these point clouds were imported to OpenMVS and mesh reconstruction, mesh refinement and mesh texturing is performed and an accurate and complete 3D model is reconstructed.
2. *Kwangwoon statue:* We also tested our workflow on a 3 m tall object, called Kwangwoon Statue. For 3D modeling of Kwangwoon statue, we used less number of photos to show the efficiency of tools we used in our workflow. We used 98 images captured with camera of smart phone (SM-G530H). Figure 5(a) shows the highly accurate and smooth mesh while Figure 5(b) is the final textured 3D model.

(a) (b) (c)

Figure 4: Reconstruction Results (A) Surface Reconstructed (B) Zoom of Statue Hand (C) Final Textured 3D Model

(a) (b)

Figure 5: Reconstruction results of Kwangwoon Statue(a) Surface Reconstructed (b) Textured Mesh

IV. LIMITATIONS AND PRACTICAL ASPECTS

In our experiments we evaluated that the 3D reconstruction of real objects with small and medium datasets can be done with high accuracy. However, OpenMVS failed to refine the model from the surface reconstructed when datasets of more than 150 images of same resolution are processed. It terminates the process with failure after some computations on both systems. In addition, we performed texturing on unrefined models and it was successful but the final 3D model was not smooth enough. In the following we also discuss some practical aspects of our method that should be considered.

A. Image Acquisition

Acquiring images is a crucial part for surface reconstruction of objects and it can affect the final result. While shooting a subject, these guidelines can give the better quality 3D model.

a. *Visual Overlap:* For surface reconstruction of a scene or an object, multiple images are required. These images are captured at arbitrary viewpoints in order to estimate the 3D position of the points. Although in theory, surface reconstruction with fewer images is possible, however it may reduce the quality of final 3D model and lead to more noisy results. On the other hand, more overlaps in the images lead to a very dense and accurate surface reconstruction.
b. *Camera Parallax:*Along with large overlaps in the images, camera parallax is also needed for accurate estimation of 3D points. Therefore, each image should be captured at different positions in both vertical and horizonatal direction.
c. *Light and Color:* While large overlaps in the images and camera parallax are important in order to evaluate the surface of the scene, camera settings and lighting conditions also effect the final result. Changes in the camera white balance and exposure reduce the quality of surface reconstruction as well as the final textured 3D model. Thus the camera settings should not change throughout the capture process.
d. *Camera lens and focus:* It is another important factor that influences the final result. When an object is captured with a camera having long focal length, more pictures are required because of the small field of view. When one get closer to the object, cause in small focus and reduces the amount of feature points.

Table 1: Run Time Performance for Buddha Statue and Kwangwoon Statue Datasets. The SfM Timings are Combined

Dataset	**Images** ***(number)***	**SfM** ***(time)***	**MVS** ***(time)***	**Texturing** ***(time)***	**Total** ***(time)***
Buddha statue*	121	0hr, 40m	5hr, 46m	4hr, 05m	10hr, 51m
Buddha statue	121	0hr, 29m	5hr, 39m	3hr, 53m	10hr, 01m
Kwangwoon statue	099	0hr, 34m	4hr, 29m	2hr, 05m	07hr, 18m

* shows the timing without GPU acceleration.

V. FUTURE WORK

The feature matching process in SfM is designed to match features between pairs of images. It faces difficulties when the surface of the object does not have distinct features or unrecognizable texture. Our proposed workflow also faces difficulties when the surface of object is poorly textured. In future, we aim to enhance our study so that we can construct 3D model of feature-less objects.

VI. CONCLUSION

In this paper we evaluate a complete workflow for 3D modeling of real objects, from multi-view images of two statues using open source tools; VisualSfM and OpenMVS. This method can give an accurate and complete 3D model, which is also important in the process of creating contents for virtual reality (VR) and 3D printing, using small and medium data sets (121 images tested). However, refinement module terminates the process and systems ran out of memory when large datasets (>150 images) are processed. Interestingly, the texturing of unrefined models is possible but the final 3D model appears bumpy, noisy and unsmooth. Hence, this report would demonstrate the best operating method and limitations of the tested tools for 3D modeling.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Branch-and-Bound Algorithm for Concave Minimization Problem with Upper Bounded Variables

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Abstract---

Background/Objectives: This paper presents a branch-and-bound algorithm for solving the concave minimization problems with upper bounded variables. In <30 words.

Methods/Statistical analysis: The algorithm uses simplex to construct the branching and the bounding procedure. The linear convex envelope (the objective function of the subproblem) is uniquely determined on the candidate simplex which contains the subset of the local minimal points. The optimal solution of the subproblem is a local optimum of the original concave problem and used in reducing the list of active subproblems. It should be <70 words. Include the method adapted to study the objectives/sampling details or simulation or statistical analysis of data; technique employed; mention unique/important points of modification of methodology in the current study. Mention about test samples the control employed or approach used for comparing the test sample.

Findings: The branching process splits the candidate simplex into two subsimplices by fixing the selected branching variable at value 0 or upper bound. Then the subsimplices are one less dimensional than the candidate. It means that the size of the subproblems gradually decreases. It should be <170 words. Mention your findings in the form of statements along with the conclusive data of statistical importance; Mention different how your findings are unique and novel; how your findings are in consensus with the existing values/ reports or how are they from the already reported findings. Highlight how your results are helpful in adding more value to the existing reports.

Application/Improvements: Further research needs to be focused on the efficient determination method of the simplex. The algorithm of this paper can be applied to solving the concave minimization problems under knapsack type constraints. In <30 words.

Keywords--- Branch-and Bound Algorithm, Concave Minimization, Convex Envelope, Simplex5-6 Words, Drawn From Title, Word Representing the Work.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The global minimization of a linearly constrained concave function has attracted the attention of a number of researchers since Tui's fundamental work[1]. Since many practical applications can be formulated as concave minimization problems. The zero-one integer linear programming problem[2,3,4,5], the linear fixed-charge problem[6],economies of scale and strategic weapons planning[7], the facility location problem with concave costs[8] are included among them.

The local optimum for the convex function minimization problem must be the global one. But this property is not true for the concave function. The concave function problem may have many local solutions. Thus any special methods are required for solving the concave minimization problem. Since most of them repeatedly use any appropriate local optimization techniques, their computations are expensive. From the complexity point of view, the concave minimization problem is NP-hard. It is seen by the fact that the zero-one linear programming is a special case of the concave minimization problem[9]. This is the reason that it is difficult to develop the encouraging algorithm.

The most general approach to the concave minimization problems is the branch and bound type search[10]. Many authors have incorporated some useful schemes into branching and bounding strategies to design the efficient algorithms. These strategies are based on the exploitation of the underlying structure of the problem. The most important bounding strategy is the use of underestimating function. The cut which Tui[1]suggested to exclude the part of feasible domain may be seen as its first form. Since then, it has developed into various types of the underestimating functions. A piecewise linear underestimating function has appeared, in the algorithm developed by Falk and Hoffman[7]. Rosen[4]developed the function which underestimates a smooth concave function over a polyhedron, and Kalantari and Rosen[11] considered the under estimator for the global minimization of a quadratic function over a polytope. Benson[12] showed that the underestimating function of the concave function over a simplex is linear and uniquely determined by solving linear equations.

The other strategy combined with the bounding is the branching. During the algorithm, the branching procedure partitions the set of feasible solutions into many subsets. Then these partitioned subsets may be the same form or be relaxed to be the same. Because the partition element of the same form makes it possible to consistently define the subproblem for bounding operation. Tui[1] partitioned the feasible domain by cone in his algorithm. Kalantari and Rosen[11]considered the parallel piped containing the feasible region as partition elements. Benson[12], Benson and Erenguc[13], Falk and Hoffman[14] and Horst[15] developed algorithms in which the partition element is simplex.

The algorithm of this paper uses the simplex as the partition element like the above author's algorithm. In order to initialize our algorithm, we introduce the simplex containing the feasible region. In fact, many researchers have suffered from the expensive computation for generating the simplices. Since most of the partition method endures the addition of the many constraints. But, in this paper the simplex is divided by being projected onto two half spaces. This operation is easily implemented by imposing two equality constraints on the candidate simplex. It means that two hyperplanes intersect the simplex respectively. Hence the dimension of two sub simplices is one less than the candidate simplex. Consequently, the subproblem size decreases one by one while iteration proceeds. This is the main advantage of our algorithm. After solving the linear equations to determine the underestimating function on the candidate simplex, the subproblem is defined to be the linear programming problem. The optimum value of the linear function serves as the lower bound for the candidate problem. Since the optimal solution of the subproblem is locally optimal, the concave objective value at this point updates the incumbent value.

Section 2 shows the validity and embodiment of the bounding strategy in the algorithm. In section 3, we present the branching procedure. And Section 4 explains branching variable selection rule and describes the formal of the algorithm and gives a numerical example to illustrate the algorithm.

Finally, we present some concluding remarks.

II. BOUNDING STRATEGY

A. Convex Envelope

The following concave minimization problem is dealt with in this paper.

$$(P) \qquad \min_{x \in \Omega} f(x)$$

where $f(x)$ is any concave function and $\Omega = \{x \in R^n \mid 0 \le x_i \le u_i, i = 1,2, \ldots n\}$

The algorithm for solving the problem (P) performs the binary branching and the bounding operations.At each stage, the subproblem, whose objective function underestimates the concave function over feasible region, is defined for bounding operation and two subsimplices are generated from the candidate simplex. After performing the bounding operation, our algorithm selects the branching variable and fixes that at 0 and the upper bound. The fixation of the branching variable results in two subsimplices. The motivation of our algorithm is based on the fact that the objective function of the subproblem underestimates the original concave function over feasible region and is uniquely determined over simplex. The important part of the bounding procedure is to determine the underestimating function. Thus the efficiency of the algorithm depends on what kind of the function is adopted. The following underestimating function is considered in this paper.

Definition1[7]. The convex envelope of a function f over a polytope Ω is a function $\Gamma(x)$ defined over Ω such that:

(i) $\Gamma(x)$is convex over Ω.
(ii) $\Gamma(x) \le f(x), \forall x \in \Omega$.
(iii) If is g(x) any function satisfying (i) and (ii), then g$(x) \le \Gamma(x), \forall x \in \Omega$.

The above function$\Gamma(x)$ is the supremum of all underestimating functions of$f$ over a polytope Ω. If Ω is a general form of polytope, it is difficult to determine $\Gamma(x)$. Horst[15] has shown that if $\Omega$is a simplex, $\Gamma(x)$ is linear and agrees with f for each vertex of Ω.The following Figure 1.illustrates the convex envelope of the concave function over 1-dimensional simplex.

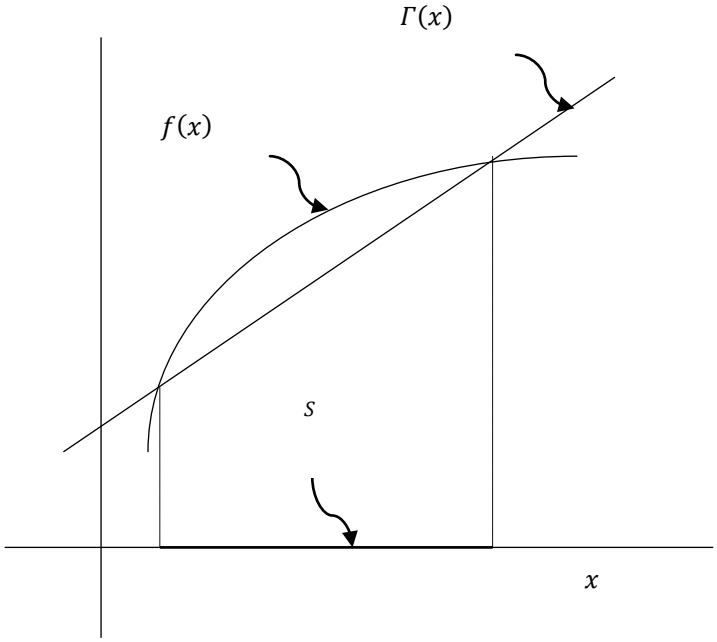

Figure 1: The Convex Envelope Γ of f on S

Let us introduce the following convenient notations and the definitions to explain the algorithm.

Notation

S_φ : the candidate simplex

$(C.P_\varphi)$: the subproblem generated from S_φ

$\Omega_\varphi (= \Omega \cap S_\varphi)$: the feasible region of $(C.P_\varphi)$

v_{φ}^{j} , j = 0,1, … n_{φ}: vertices of S_{φ}

n_{φ}: dimension of S_{φ}

i_{φ}: index of the branching variable selected at $(C.P_{\varphi})$

$(v_{\varphi}^{j})_{i}$: i th component of vertex $v_{\varphi}^{j} \in R^{n}$

$L.B_{\varphi}$: lower bound of $(C.P_{\varphi})$

$\overline{x}^{\varphi}$: the optimal solution of$(C.P_{\varphi})$

Ψ_{φ}: the index set of unfixed variables in $(C.P_{\varphi})$

$U.B_{\varphi}$: the current incumbent value after bounding operation over S_{φ}

Definition2[12]: Let $v^{0}, v^{1}, \dots, v^{n}$ be (n+1) affinely independent points in R^{n}. The convex hull of $\{v^{0}, v^{1}, \dots, v^{n}\}$denoted conv($\{v^{0}, v^{1}, \dots, v^{n}\}$) is called a n-dimensional simplex, and the points $v^{0}, v^{1}, \dots, v^{n}$ are called vertices of the simplex.

The convex envelope on the given simplex is uniquely determined by solving the following (n+1) linear equations[12].

$$< \alpha, v^{i} > +\gamma = f(v^{i}), i = 0,1,2, \dots n \text{for the unknowns } \alpha \in R^{n},\ \gamma \in R.$$

Let

$$\Gamma(x) =< \alpha, x > +\gamma$$

Then the above linear convex envelope underestimates the concave function over the given simplex.

In order to initiate the algorithm, it is necessary to take an simplexS_0as tightly as possible that contains the feasible region Ω. Without loss of generality, a vertex $v^{0} = (0,0, \dots,0)$ of Ωi.e., the origin of $R^{n}$is chosen. The n nonnegative variable constraints binding at the origin form a cone. Let us consider the hyperplane whose normal vector is $(\frac{1}{u_1}, \frac{1}{u_2}, \dots, \frac{1}{u_n})$and which contains the feasible point$(u_1, u_2, \dots, u_n)$. This hyperplane intersects the n coordinate axes at $(0,0, \dots,0, \text{n} \cdot u_i ,0, \dots,0), i = 1,2, \dots n$and the intersecting points are naffinely independent. Let us take a simplex S_0as follows:

$$S_0 = \{x \in R^{n} | \sum_{i=1}^{n} \frac{x_i}{u_i} \le n, \qquad x_i \ge 0, i = 1,2, \dots n\}$$

The simplex S_0 can be identified by its set of vertices as follows:

$$\upsilon_0^0 = (0,0, \dots,0),$$
$$\upsilon_0^{\text{i}} = (0,0, \dots,0, \xi_{\text{i}} ,0, \dots,0) \text{ , fori = 2, … , n}$$
$$\text{where} \xi_i = \text{n} \cdot u_i, \text{i} \neq 1$$

Then $v_0^0,\ v_0^1, \dots,\ v_0^n$are the vertices of an n-dimensional simplex S_0.

B. Subproblem Generation and Bounding Operation

If the convex envelope is determined on S_0, the first subproblem$(C.P_0)$is defined as follows for bounding operation.

$$(\text{C.P}_0) \qquad \min_{\text{x}\in\Omega_0} \Gamma(\text{x})$$
$$\Omega_0 = \{x \in R^{n} | 0 \le x_i \le u_i, i = 1,2, \dots n\} \cap S_0$$

The optimal value of $(C.P_0)$ serves as a lower bound of all children subproblems generated from it by the following theorem.

Theorem 1. $\Gamma(x)$underestimates$f(x)$ on Ω_0.

Proof.

$f(x) \ge \Gamma(x)\ \ for\ x \in S_0$

Since $S_0 \supseteq \Omega_0$,
$f(x) \ge \Gamma(x)\ \ for\ x \in \Omega_0$

When any one is selected among the candidate simplices, the bounding operation performs the following procedure.

Bounding-Algorithm

1. Select the simplex S_φ in the list.
2. Identify the vertices of the selected simplex.
3. Determine the convex envelope by solving equation (1).
4. Set up the subproblem $(C.P_\varphi)$ as follows:
5. $(C.P_\varphi)$ $\min_{x\in\Omega_\varphi} \Gamma_\varphi(x)$

$$\Omega_\varphi = \{x \in R^n \mid 0 \le x_i \le u_i, \text{for } i \in \Psi_\varphi\} \cap S_\varphi$$

6. Seek the optimal solution $\overline{x}^\varphi$ of $(C.P_\varphi)$
7. Calculate $L.B_\varphi = \Gamma_\varphi(\overline{x}^\varphi)$, update the incumbent $U.B_\varphi$

Since $\overline{x}^\varphi$ is the local optimum, $f(\overline{x}^\varphi)$ updates the incumbent. If $L.B_\varphi = f(\overline{x}^\varphi)$, the simplex S_φ need not be considered any further. It is fathomed. And any candidate problems whose lower bounds are greater than the current incumbent are removed.

III. BRANCHING OF SIMPLEX

The branching begins by selecting a branching variable after bounding operation. The candidate simplex is divided into two subsimplices of similar figure by fixing a branching variable x_{i_φ} at 0 and u_{i_φ}. At this time, feasible vertices contained in the simplex are exclusively and exhaustively partitioned into two groups. Consequently, two new simplices which contain two groups of feasible vertices respectively may be registered in the candidate simplex list. The following theorem guarantees the validity of our approach.

Theorem 1

Assume that the n-dimensional simplex $S_0 (\subset R^n)$ contain Ω.

Let us consider two hyperplanes $H^0 = \{x \in R^n | x_i = 0\}$, $H^1 = \{x \in R^n | x_i = u_i\}$ for some i. Then

$S_{01} = H^0 \cap S_0$ and $S_{02} = H^1 \cap S_0$ are the (n-1)-dimensional simplices that partitions the vertices set of Ω into two subsets.

Proof.

S_{01} is a facet of S_0. Hence it is a (n-1)-dimensional simplex. The vertices of S_{02} are the points on the segments between the vertex $(0,0,\dots,0, n \cdot u_i, 0, \dots, 0)$ of S_0 and the vertices of S_{01}. These n points are n affinely independent in R^n. S_{02} is a (n-1)-dimensional simplex . The vertices of S_0 are placed on S_{01} or S_{02}.

Hence S_{01} and S_{02} partition vertices set of Ω into two subsets.

S_{01} and S_{02} are one less dimensional than S_0. It means that whenever the branching occurs, the size of the subproblem decreases. Assume x_1 be the branching variable. Then by making the hyperplane $\{x \in R^n | x_1 = 0\}$ intersect S_0, a (n-1)-dimensional simplex is obtained as follows:

S_{01}=conv($\{ \upsilon_{01}^0, \upsilon_{01}^2, \dots, \upsilon_{01}^n \}$),

$\upsilon_{01}^0 = (0,0,\dots,0)$,

$\upsilon_{01}^i = (0,0,\dots,0,\xi_i,0,\dots,0)$, for i = 2, … , n

where $\xi_i = n \cdot u_i$, $i \neq 1$

The above simplex S_{01} is a facet of S_0. And conv($\{ \upsilon_{01}^2, \upsilon_{01}^3, \dots, \upsilon_{01}^n \}$) is a facet of S_{01}. Even if it is translated to the point $(0, u_2, u_3, u_4, \dots, u_n)$, the compressed S_{01} still contains all vertices of $S_{01} \cap \Omega$. Hence it guarantees tighter underestimating function. Thus S_{01} may be redefined as follows:

S_{01}=conv($\{ \upsilon_{01}^0, \upsilon_{01}^2, \dots, \upsilon_{01}^n \}$),

$\upsilon_{01}^0 = (0,0,\dots,0)$,

$\upsilon_{01}^i = (0,0,\dots,0,\xi_i,0,\dots,0)$, for i = 2, … , n

where$\xi_i = (n-1)\cdot u_i, i \neq 1$

The other simplex is generated by translating$S_0$to the vertex $(u_1, 0,0,0, \dots ,0)$as follows:

S_{02}=conv({ $\upsilon_{02}^0, \upsilon_{02}^2, \dots , \upsilon_{02}^n$ }),

$\upsilon_{02}^0 = (u_1, 0, \dots ,0)$,

$\upsilon_{02}^i = (u_1, 0, \dots ,0, \xi_i ,0, \dots ,0)$, for i = 2, … , n

where$\xi_i = (n-1)\cdot u_i, i \neq 1$

Generally, at the kth iteration, assume S_φ besplitted and x_{i_φ}be selected by branching variable selection rule. Then S_φ= conv({ $\upsilon_\varphi^0, \upsilon_\varphi^j$, j ∈ Ψ_φ }). Consequently

$S_{\varphi 1}$=conv({ $\upsilon_{\varphi 1}^0, \upsilon_{\varphi 1}^j$, j ∈ $\Psi_\varphi \backslash i_\varphi$ }),

where $\upsilon_{\varphi 1}^0 = \upsilon_\varphi^0$,

$(\upsilon_{\varphi 1}^j)_i = (n_\varphi - 1)\cdot u_i$forj ∈ $\Psi_\varphi \backslash i_\varphi$

At the *k*th iteration, subsimplices generation procedure is as follows:

Simplex Splitting Algorithm

1. Choose the branching variable $x_{i_\varphi}$by selection rule.
2. Identify the vertices of S_φ s.t. S_φ= conv({ $\upsilon_\varphi^0, \upsilon_\varphi^j$, j ∈ Ψ_φ }).
3. Generate the vertices of $S_{\varphi 1}$

   Delete $\upsilon_\varphi^{i_\varphi}$

   $$(\upsilon_{\varphi 1}^0) \leftarrow (\upsilon_\varphi^0)$$

   Forj ∈ $\Psi_\varphi \backslash i_\varphi$

   If(i ∈ $\Psi_\varphi \backslash i_\varphi$)

   $$(\upsilon_{\varphi 1}^j)_i = (n_\varphi - 1)\cdot u_i$$

   Else If

   $(\upsilon_{\varphi 1}^j)_i = (\upsilon_\varphi^j)_i$

   End If

   End For

   $$\Psi_{\varphi 1} \leftarrow \Psi_\varphi - i_\varphi$$

   Generate the vertices of $S_{\varphi 2}$

   $$(\upsilon_{\varphi 2}^0) \leftarrow (\upsilon_\varphi^0)$$

   For j ∈ {0, $\Psi_{\varphi 1}$}

   If (i=i_φ)

   $$(\upsilon_{\varphi 2}^j)_i = (\upsilon_{\varphi 1}^j)_i + u_i$$

   Else If $(\upsilon_{\varphi 2}^j)_i = (\upsilon_{\varphi 1}^j)_i$

   End If

   End For

   $$\Psi_{\varphi 2} \leftarrow \Psi_\varphi - i_\varphi$$

4. Set $S_{\varphi 1}$ = conv({ $\upsilon_{\varphi 1}^j$, j ∈ $\Psi_{\varphi 1}$ })

   $$S_{\varphi 2} = \text{conv}(\{ \upsilon_{\varphi 2}^j, \text{j} \in \Psi_{\varphi 2} \})$$

IV. ALGORITHM AND NUMERICAL EXAMPLE

A. Branching Variable Selection and Candidate Simplex Selection Rule

The branching variable selection can be carried out arbitrarily. The first variable among the unfixed variables may be selected as the branching variable. In this paper, a heuristic rule for selecting the branching variable is suggested such as:

Selecting the variable x_{i_φ} such that

$$\left|\frac{\partial f}{\partial x_{i_\varphi}}(\bar{x}^{\varphi})\right| = \max_{j\in\Psi_\varphi}\left|\frac{\partial f}{\partial x_j}(\bar{x}^{\varphi})\right|$$

This rule is based on the fact that the direction of x_{i_φ}-axis is the steepest ascent or descent direction of the concave function value at $\bar{x}^{\varphi}$.

Over new simplices $S_{\varphi 1}$,$S_{\varphi 2}$, $(C.P_{\varphi 1})$,$(C.P_{\varphi 2})$ are define respectively as follows and two bounding operations are performed:

$$(C.P_{\varphi 1}) \qquad \min_{x\in\Omega_{\varphi 1}} f(x)$$

where $\Omega_{\varphi 1} = \{x \in R^{|\Psi_{\varphi 1}|} \mid 0 \le x_i \le u_i,\ i \in \Psi_{\varphi 1}\} \cap S_{\varphi 1}$

$$(C.P_{\varphi 2}) \qquad \min_{x\in\Omega_{\varphi 2}} f(x)$$

where $\Omega_{\varphi 2} = \{x \in R^{|\Psi_{\varphi 2}|} \mid 0 \le x_i \le u_i,\ i \in \Psi_{\varphi 2}\} \cap S_{\varphi 2}$

Next candidate simplex selection rule is as follow:

Selecting the simplex that is associated with the least lower bound among all terminal nodes

If the tie occurs, it is broken arbitrarily.

B. Branch and Bound Algorithm Description

Branch & Bound Algorithm

Iteration 0: Initialization

0-1:Determine the initial simplex S_0

0-2:Perform *the bounding-Algorithm*

0-3:Calculate $L.B_0$, the incumbent

0-4:Call branching-algorithm and Register generated subsimplices in the list

Iteration k: Repeat until registered subsimplices in the list do not exist

k-1:Select the candidate simplex S_φ of the subproblem $(C.P_\varphi)$ whose $L.B_\varphi$ is the least

k-2: Call *the simplex splitting algorithm* and Register generated two subsimplices in the list

k-3:Perform *the bounding-algorithm* and Calculate $L.B_{\varphi 1}, L.B_{\varphi 2}$ respectively for two children

k-4:Update the incumbent

Delete the simplices in the candidate list whose lower bound is greater than the incumbent

C. Numerical Example and Branch &Bound Tree

Consider the problem below

$$\text{Min } f(x) = -2x_1^2 - 2x_2^2 - 3x_3^2 - 4x_4^2 - 2x_1x_2 - 2x_1x_3 - 2x_1x_4 - 2x_2x_3 - 2x_2x_4 - 2x_3x_4 + 30x_1 + 28x_2 + 30x_3 + 34x_4$$

$$\text{s.t. } 0 \le x_1 \le 9,\quad 0 \le x_2 \le 7,\quad 0 \le x_3 \le 5,\quad 0 \le x_4 \le 3$$

In Figure 2, the search tree is drawn to illustrate how the search is processing.

V. CONCLUSION

The branch and bound method for solving the concave minimization problem was investigated. The algorithm in this paper was based on the followings:

a) The bounding procedure uses the convex envelope to underestimate the concave function.
b) The convex envelope is uniquely determined on the given simplex.
c) It splits the candidate simplex by restricting the branching variable to be 0andthe upper bound.
d) The local points i.e., the vertices of the feasible region are partitioned when subsimplices are generated.
e) The simplex is identified by the vertices to obtain linear equations for calculating the convex envelope.
f) It solves the simple linear programming problem for bounding operation.
g) Gradually the size of the subproblem decreases at every stage.

The problem size of the candidate subproblem gradually decreases. It means that the computational effort also diminishes. The more the feasible region which does not contain the local solutions is excluded from consideration, the tighter convex under estimators for the bounding operation is. Thus further research needs to be focused on the efficient determination method of the simplex and the introduction of the strong valid cut. The algorithm of this paper can be applied to solving the concave minimization problems under knapsack type constraints and the box-type constrained concave minimization problem.

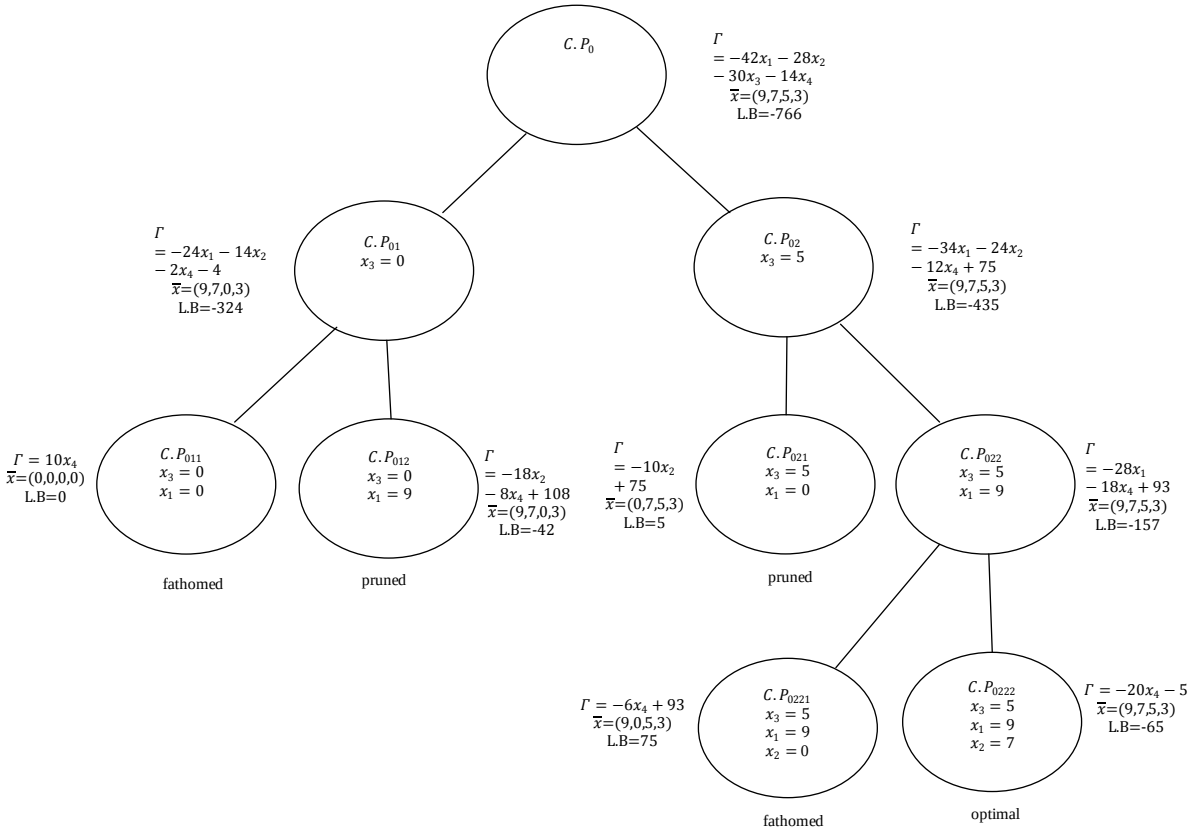

Figure 2: The branching tree of the example

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Study of Bio-feedback Signal Analysis Algorithm Associated with the Development of the Low-frequency Face Muscle Motion System

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Abstract---

Background/Objectives: In this study, the bio-feedback to prevent the overuse of the low fre quency stimulation was studied in the method of using the parameters of the EMG

Methods/Statistical analysis: First of all, before you start the low-frequency stimulation, at th e position of the face of the electrode, to measure the EMG signal during muscle contraction. O bserve the measured EMG signals and records the extracted parameter values. After stimulation o f the face of the subject in low-frequency stimulation that lasts a certain period of time (up to 30 seconds), by observing the EMG signal to extract the parameter values.

Findings: In the present study, the EMG before adding the low frequency stimulation to the mask face, measured normal contraction, EMGs when facial muscles are paralyzed, can't be actual ly measured, and only thought tends to shrink the appropriate facial muscles based on the virtu al paralysis muscles protocol presented in this study, actually without shrinkage was measured E MG. Result of comparison of parameters used for the feedback to the subject 17 men and wom en subjects is as follows.

1. Parameter RMS EMG measured under the assumption of a virtual paralysis muscles, decre ased than normal systolic RMS average to less than 50%, there was a statistically signific ant difference.
2. Virtual paralysis muscle EMG parameters were measured under the assumption of ZCR has been increased by more than the normal shrinkage ZCR, a portion was reduced. Also, the re was a statistically significant difference.

Improvements/Applications: Paralyzed muscles, because it does not actually contracted, the pr otocol of the virtual paralysis muscle is effective for selection of parameters for biofeedback to prevent excessive least low frequency stimulation, practical things considered.

Keywords--- EMG, Parameter, Low Frequency Stimulation, RMS, Facial Mask.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Functional electrical stimulation in the treatment method using electrical stimulation, functional neuromuscular stimulation, therapeutic electrical stimulation, and a number of methods, such as low frequency stimulation is used, muscle strengthening, pain relief, rehabilitation, therapy, etc. electrode stimulation is used in various fields. Low frequency transcutaneous electrical nerves stimulation therapy helps to relief, recovery and run through a weak low-frequency massage on the human body directly stimulate the muscles that promotes blood circulation and soothe the nerves to the muscles. Physiological activity of muscles, promotion of blood circulation, lipolysis effect, to induce reduction of the near spasms, enhances the functionality of the cells, an effect of relieving muscle pain. Expansion of personal medical devices using low frequency is increasing. This market is expanding by giving a significant impact on the market cosmetic products is released suddenly. Pain was improved by using a low frequency, as well as the clinical validation of the anti-wrinkle effect, using the equipment of the anti-wrinkle cosmetic devices is a reality that relies on expensive imported products.[1,2]

In particular, the use of low-frequency stimulation in order to eliminate the stress and pain but is universal, there is no product to bio-feedback system has been applied. Therefore, in this Study, wrinkle improvement of, to study the bio-feedback signal analysis algorithms necessary for the development of the mask system of the low-frequency face for application to the beauty of the skin.

II. MATERIALS AND EXPERIMENTAL METHODS

A. System Configurations

A control system composed of a target subject for this study is illustrated in Figure 1 below. Subject, is intended for people who want to transdermal low-frequency stimulation there is a function of improvement and pain suppression of the blood circulation of the face. The control system uses the parameters of the EMG measured from the subject for biofeedback to be able to prevent the excessive use of the low-frequency stimu lation of facial transdermal Position of the electrodes for EMG measurements grounded as shown in Figure 1 below is a clavicle, muscle forehead, the right and left sides of the cheek muscle, a jaw muscles.[3]

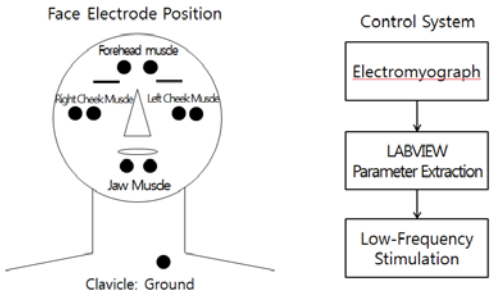

Fig. 1: Face Electrode Position Feedback Control and Control System Configuration

B. Experimental Method

Process for preventing excessive use of low-frequency stimulation of facial transdermal is as follows. First of all, before you start the low-frequency stimulation, at the position of the face of the electrode, to measure the EMG signal during muscle contraction. Observe the measured EMG signals and records the extracted parameter values After stimulation of the face of the subject in low-frequency stimulation that lasts a certain period of time (up to 30 seconds), by observing the EMG signal to extract the parameter values.[4]

C. Parameter Extraction

Surface electromyogram measured at the site of muscle, through some politics analysis, since it can be clinically useful utilized, In this Study, we want to use the parameters extracted from the EMG of the subject for biofeedback that can prevent excessive use of low frequency stimulation during treatment. In the parameters of the EMG have been classically extraction, iEMG (integrated EMG), RMS (root mean square), ZCR (zero crossing rateR) MDF (median frequency), there is such as MPF (mean power frequency). The formula for each parameter of the above is as follows

1. $iEMG = \frac{1}{N}(x + a)^n = (x + a)^n = \sum_{n=0}^{N-1}|x(n)|$ (1)
2. $RMS = \sqrt{\frac{1}{N}\sum_{n=0}^{N-1} x^2(n)}$ (2)
3. $ZCR_{(q=0\ldots N)} = \begin{cases} ZCR + 1: x(n-1) \times x(n) \leq 0 \\ ZCR + 0: x(n-1) \times x(n) > 0 \end{cases}$ (3)
4. $\frac{\sum_{f=0}^{MDF} P(f)}{\sum_{f=0}^{Fs/2} P(f)} = \frac{1}{2}$ (4)
5. $MPF = \frac{\sum_{f=0}^{Fs/2} fP(f)}{\sum_{f=0}^{Fs/2} P(f)}$ (5)

P(f) is the power spectrum of the EMG signal x(n) at the frequency f, Fs is the sampling frequency.

EMG, RMS and ZCR the above parameters can be extracted directly from the electromyogram signal x(n). However, MDF and MPF may be after the calculation of the power spectrum P(f) of the electromyogram signal x(n), is extracted. In addition, iEMG and RMS, reflecting the degree of muscle contraction and muscle tone, ZCR, MDF and MPF reflects the degree of fatigue information of muscle. The power spectrum of the EMG signal reflects the muscle fatigue because it represents the conduction velocity of the muscle fibers.[5]

D. Statistical Comparison of the Parameter

Excess facial muscles when the muscles paralysis occurs shrinkage transdermal low frequency stimulation of the face, because impossible, direct parameter that may indicate a characteristic of EMG during shrinkage and non-contractile in trying to use the RMS and ZCR.

Further, since it is impossible to actually measure the EMG when the amount muscle can occur when an excess of the low-frequency stimulation of the facial transdermal, left cheek muscle, right cheek muscle and Jaw muscles were paralyzed, in this study, using the virtual paralysis muscle protocol as follows.[6]

1. It is only thought to try to shrink the corresponding facial muscles.
2. In fact it does not shrink.

The parameters and time parameters contraction of the plurality of measured with the appropriate muscles in accordance with the virtual paralysis muscles protocol electromyogram signals, used for biofeedback compared with each other if there is no statistically significant difference can do. Therefore, we compared the parameters of the subject in the match set t-test in the comparison method of statistics (paired t-test). The reference of significance was set at $p < 0.01$.[7,8]

III. RESULTS AND DISCUSSION

A. Experiment Subjects and Parameter Extraction

Subjects who participated in the experiment, was to target a total of 17 people with 12 people and women 5 men of 21-43 years of age is not a disease of the muscles. And, in the case where the muscles of the corresponding face from each subject to contract normally, if you have not contracted on the basis of the virtual paralysis muscle protocol is to measure each EMG signal, from the EMG signal It was extracted parameters.

Figure 2 and 3 show the parameters extracted from the muscle contraction state and the non-systolic EMG signal of the face.

(A) of Figure 2 is a facial muscle contraction during the electromyography signal (EMG), is between the minimum -451.1 maximum 361.9, the RMS of (c), the EMG signal (a) , mean (standard deviation) is 104.0 (12.1), (d-) is a ZCR, mean (standard deviation) is 101.7 (24.0). On the contrary, (a) in Figure 3, during the non-contraction of facial muscles, that is, electromyography signal of a virtual paralysis muscle (EMG), is between the minimum -89.3 up 78.7, (c) the average of the RMS EMG signal (a) (standard deviation) is 34.5 (0.6), (d) is a ZCR, mean (standard deviation) is 156.5 (7.2).

Therefore, the parameter RMS of muscle contraction during the EMG signal of the face is large but contrary parameters ZCR than during the non-contraction of the virtual paralysis muscle, it is smaller than the non-contraction of the virtual paralysis muscle, an excess of low-frequency stimulation You can know the possibility of a feedback parameter to prevent.

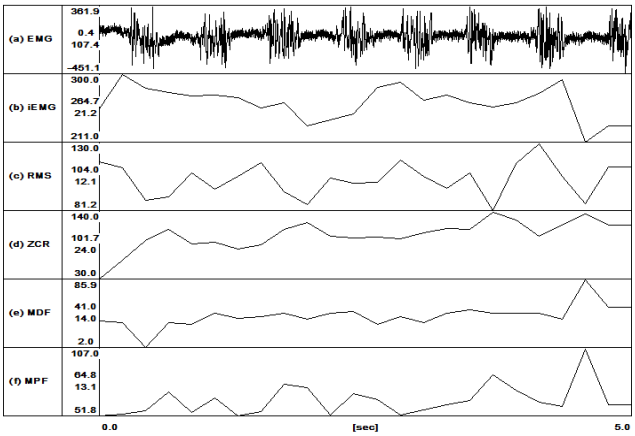

Fig. 2: The Extracted Parameters from the Repeated Contraction of the Right EMG Signal Cheek Muscle

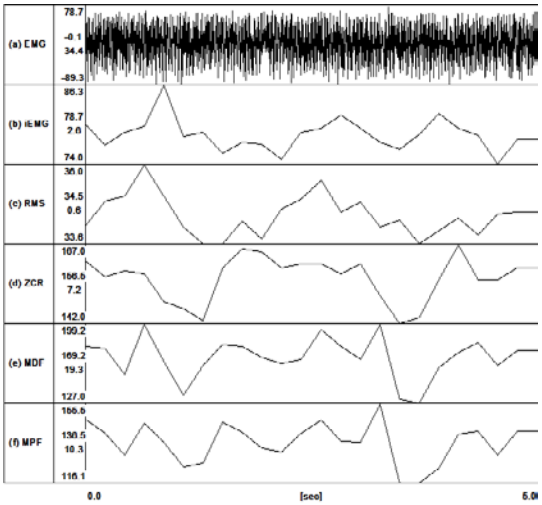

Fig. 3: The Extracted Parameters from the Non-contraction of the Right EMG Signal Cheek Muscle

B. Parameter Comparison

Figure 4 to 7 is forehead muscles of the facial muscles, respectively, left cheek muscle, and when the subject all the right cheek muscle and Jaw muscles was successfully shrink, the parameters RMS when not contracted on the basis of the virtual paralysis muscle protocol a comparison.

In Figure 4, each subject as a percentage of non-systolic RMS virtual paralysis muscle on the forehead near systolic RMS was reduced by an average 38.2% up to 20.6-68.0%. As a result of the matching sets t- test between them, there was a significant difference ($p < 0.01$).

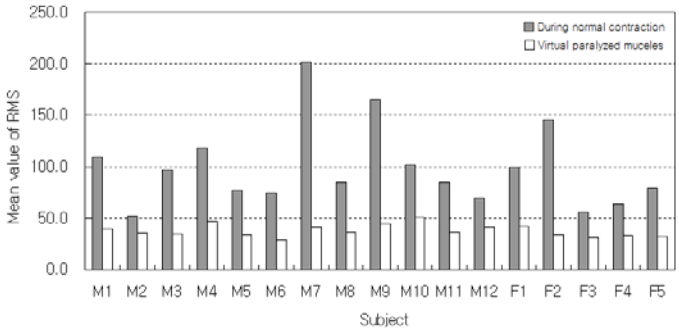

Fig. 4: Comparison of the RMS Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Forehead Muscle

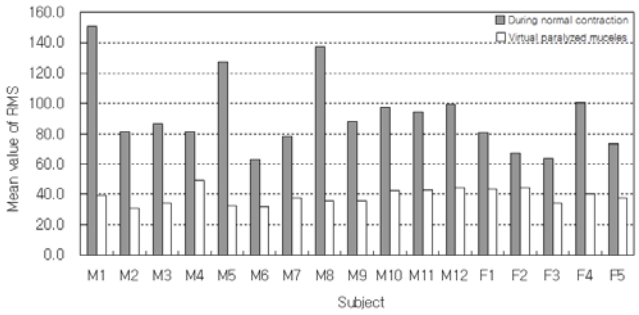

Fig. 5: Comparison of the RMS Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Right Cheek Muscle

In Figure 6, each subject as a percentage of non-systolic RMS virtual paralysis muscle of normal systolic RMS of left cheek muscle was reduced by an average 43.0% up to 24.4-62.7%.As a result of the matching sets t- test between them, there was a significant difference ($p < 0.01$).

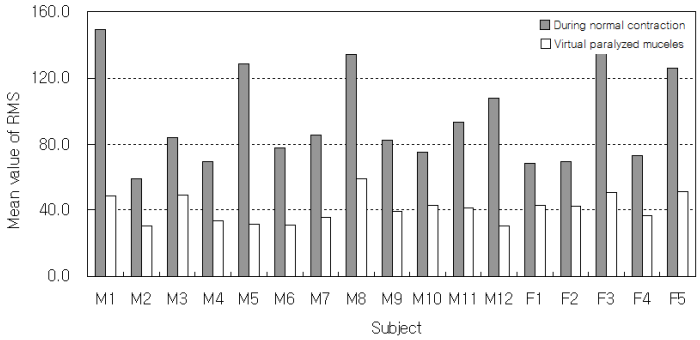

Fig. 6: Comparison of the RMS Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Left Cheek Muscle

In Figure 7, each subject is a non-shrink when the ratio of the RMS as a virtual paralysis muscle of normal systolic RMS of jaw muscle was reduced by an average 22.1 percent up to 5.8-47.7%. As a result of the matching sets t- test between them, there was a significant difference ($p < 0.01$).

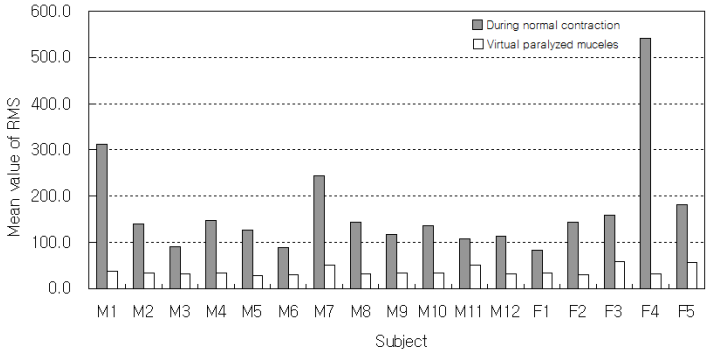

Fig. 7: Comparison of the RMS Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of Jaw Muscle

Figure 8 to 11 is forehead muscles of the muscle of each face, left cheek muscle, and when the subject all the right cheek muscle and jaw muscle was successfully shrink, parameters when you do not have contracted on the basis of the virtual paralysis muscle protocol ZCR a comparison of the.

In Figure 8, each subject as a percentage of non-systolic ZCR virtual paralysis muscle on the forehead near systolic ZCR up 115.9-1015.8%, it was increased by an average of 215.2%. As a result of the matching sets t-test between them, there was a significant difference ($p < 0.01$).

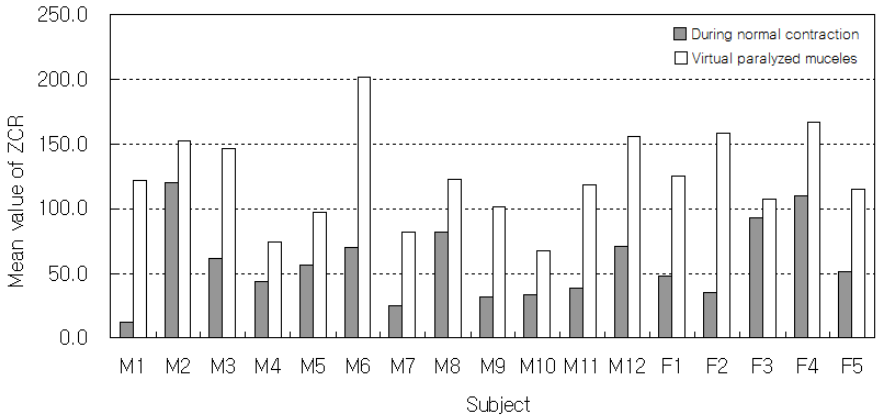

Fig. 8: Comparison of ZCR Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Forehead muscle

In Figure 9, each subject as a percentage of non-systolic ZCR virtual paralysis muscle of normal systolic ZCR of right cheek muscle up to 84.6-628.2%, it has changed an average 176.5%.As a result of the matching sets t- test between them, there was a significant difference ($p < 0.01$).

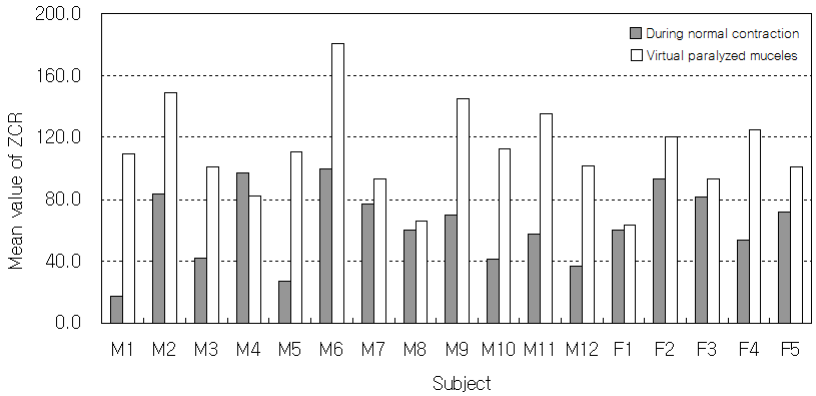

Fig. 9: Comparison of ZCR Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Right Cheek Muscle

In Figure 10, each subject as a percentage of non-systolic ZCR virtual paralysis muscle of normal systolic ZCR left cheek muscle up to 96.9-346.9%, has changed an average 167.5%. As a result of the matching sets t-test between them, there was a significant difference ($p < 0.01$).

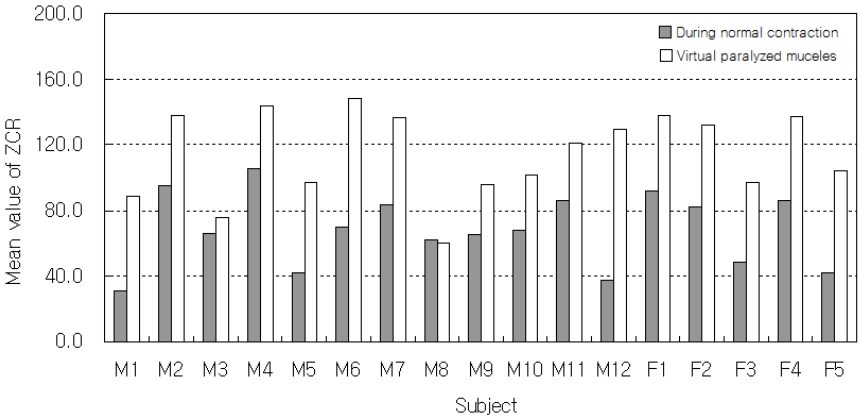

Fig. 10: Comparison of ZCR Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of the Left Cheek Muscle

In Figure 11, each subject is the proportion of non-systolic ZCR as a virtual paralysis muscle on systolic ZCR of jaw muscle varied average 2,123.3% up to 91.3-47.7%. As a result of the matching sets t- test between them, there was a significant difference ($p < 0.01$).

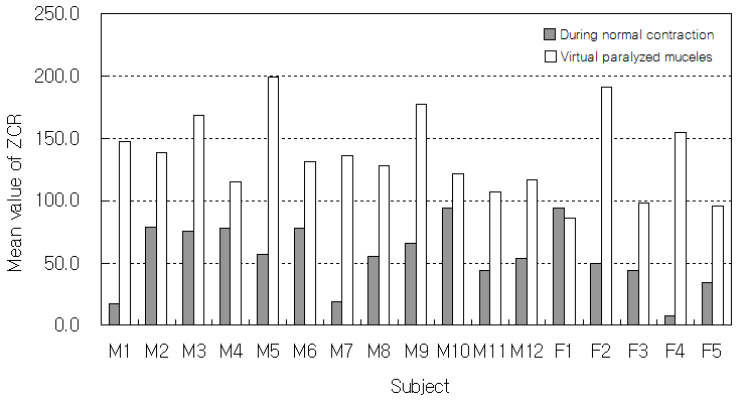

Fig. 11: Comparison of ZCR Non-shrink to Normal Muscle Contraction and the Virtual Paralysis of Jaw Muscle

Perverted Figure 4 to 7 the results of comparison of the RMS of facial muscles to the non-shrinkage during RMS decreases as the virtual paralysis muscle than in RMS normal contraction, it was confirmed that statistically there is a significant difference. Moreover, 8-11 results of a comparison of muscle ZCR facial, uncontracted during ZCR is varied as a virtual paralysis muscle than the normal shrinkage ZCR, but it was confirmed that statistically there is a significant difference, the RMS to reduce all as, the parameters used for feedback since no ZCR also increased all scheduled, it was possible to know that is inappropriate. Therefore, appropriate parameters for the low-frequency stimulation biofeedback was confirmed to be RMS.

IV. CONCLUSION

In this study, before applying a low-frequency stimulation of the facial mask EMG it was measured during normal contraction. Since the electromyogram when the facial muscle paralysis in this study can actually be measured, only the idea of contraction of the facial muscles according to the protocol of the virtual muscle paralysis and electromyogram were measured without actually shrink.Result of comparison of parameters used for the feedback to the subject 17 men and women subjects is as follows.

1. Parameter RMS EMG measured under the assumption of a virtual paralysis muscles, decreased than normal systolic RMS average to less than 50%, there was a statistically significant difference.
2. Virtual paralysis muscle EMG parameters were measured under the assumption of ZCR has been increased by more than the normal shrinkage ZCR, a portion was reduced. Also, there was a statistically significant difference.

In conclusion, in order to prevent an excess of low-frequency stimulation, the parameters of the EMG to be used in bio-feedback, it was confirmed that the RMS. In other words, under the assumption of a virtual paralysis muscle, it showed a tendency to decrease specific EMG parameters Gun moths, consistently than normal contraction. In contrast, the parameter ZCR is there was a statistically significant difference, and the parameters ZCR of EMG was measured under the assumption of a virtual paralysis muscle or increased, some of the, in order to decrease, It did not show a tendency consistent as RMS.

In this study, instead of actually measuring the EMG of paralyzed muscles, with the protocol set of virtual paralysis muscle, it was compared with the EMG parameters of the normal contraction. Therefore, it is necessary to experiment targeted a subject facial muscles are paralyzed., However, paralyzed muscles, because it does not actually contracted, the protocol of the virtual paralysis muscle is effective for selection of parameters for biofeedback to prevent excessive least low frequency stimulation, practical things considered.

ACKNOWLEDGEMENT

This work was supported by CatholicKwandong University and the Human Resource Training Program for Regional Innovation and Creativity through the Ministry of Education and National Research Foundation of Korea(NRF-2015H1C1A1035925)

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Bioinformatic Information Management Method based on Map Reduce in Cloud Computing Environment

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Abstract---

Background/Objectives: Recently, various medical services utilizing bioinformatics information to the central institutions is increasing. However, bioinformatics and related services that are used by the medical situation insufficient to satisfy the user.

Methods/Statistical analysis: In this paper, we propose a technique for users to manage MapReduce-based bioinformatics appropriate information in the cloud so you can easily process the information requested in bioinformatics. The proposed method can be easily linked to process large amounts of bioinformatics information represented by the data value of the correlation matrix of MapReduce in 64-bit units in order to efficiently manage the bioinformatics information.

Findings: Performance evaluation, the proposed scheme Search time according to the conventional technique can increase the data was lower than 18.8%. Furthermore, while the proposed scheme increases the number of data processing times it has been reduced on average by 3.7% compared to traditional techniques. Finally, the increasing number of data communication between the server and the user latency showed improved average 21.8% more than the original proposed approach technique.

Improvements/Applications: In the future research, the performance evaluation of systems will be conducted by applying the results of this research to actual systems.

Keywords--- Bioinformatic, MapReduce, Data process, Information Management, Cloud Computing.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Bioinformatics is a field of science in which biological issues are collected, managed, and analyzed on a molecular level by using a computer so that they may be applied to a variety of fields[1]. It is an applied field of information science in which information technology (IT) is converged into biotechnology (BT), including sequence alignment, gene search, gene combination, protein structure alignment, protein structure prediction, gene expression prediction, mutual interaction between proteins, and evolution models[2,3].

Bioinformatics is the system to investigate the protein structure or function of genes by fusing genome data with such various sciences and technologies as basic biology, applied biology, medicine, pharmacy, mathematics, statistics, physics, chemistry, and engineering. Currently, a variety of research based on biological data in any fields has been increasing explosively[4-6].

In bioinformatics, have various methods been used to obtain biological data, First, available is the method to create a lot of data by using high-capacity high-speed analyzers[7-10]. The high-speed analyzers to create a lot of data are Automatic DNA sequencer, DNA microarray, image analyser, and mass spectroscopy. Second, available is the method to create a large quantity of biological data by developing high-throughput screening technology and instruments. In this method, obtained are such various types of data as images, signals or patterns.

However, due to lack of fast-speed production technology and management/analysis technology, the created bioinformatic data have not been utilized efficiently. In addition, since the bioinformatic information has not been updated on a timely basis in the bioinformatic research conducted so far, it has a problem that it lacks the innovativeness of information[11].

Depending on various kinds of bioinformatic information, it is necessary to classify it in the aspects of not only application fields but also information itself. In addition, in order to establish the map of large-scale bioinformatic information, it is necessary for database establishment, information service field, software field, and information infrastructure field to help one another. This should be realized through a new and creative method[12].

In this paper, proposed is the management method to easily process bioinformatic information by using MapReduce operated in the cloud environment. In the proposed method, used is the correlation matrix in order to express high-capacity data as block data with a size of 64 bits by expanding the existing MapReduce. The purpose of the correlation matrix used in the proposed method is to minimize the processing time of bioinformatic information between the server and the user. In the proposed method, used are consistent indices so that the bioinformatic information of MapReduce may be easily linked/.

The configuration of this paper is as follows: In Chapter 2, described are MapReduce and bioinformatics. In Chapter 3, proposed is MapReduce-based bioinformatic management model in cloud environment. In Chapter 4, analyzed is the evaluation on the proposed model. Finally, in Chapter 5, summarized are the results of this paper and proposed is the research direction in the future.

II. RELATED WORKS

A. MapReduce

MapReduce is the method to conduct the distributed parallel processing of high-capacity data in order to efficiently search them in accordance with their purpose. Its processing process is divided for operation into the step of Map and the step of Reduce. Each step has key-value pairs for inputs and outputs. The type of key-value pairs used in MapReduce cab be arbitrarily selected by programmers, and the function of Map and Reduce can be also prepared directly by programmers[2]. Map of MapReduce performs the work of classifying and tying scattered data into relevant data in the form of Key and Value, and Reduce of MapReduce performs the work of removing the overlapped data and extracting the desired data out of the mapped work. Representatively, MapReudce is applied as open source software in Apache Hadoop. The operating process performed by Map and Reduce is shown in Table 1.

Table 1: Operation of Map and Reduce

Map: (key1, value 1) → (Key2, value2) Reduce: (key2, List_of_value2) → (key3, value3)

The operation of Map is similar to performing group-by-aggregation after calculating solutions in the existing SQL DMBS. In MapReduce, Job is performed in the unit of work performed by clients. Job of MapReduce is composed of input data, MapReduce program, and established information as the unit of work performed by clients. Hadoop is executed by dividing the work of Job into Map Task and Reduce Task.

Fig. 1 shows the processing flow of MapReduce. In. Fig. 1, Job Tracker plays a role of controlling the task scheduling and the entire system tasks performed by Task Tracker. Task Tracker performs tasks and plays a role of reporting the entire progress to Job Tracker. The size of Job Tracker is basically 64MB and divided into various data chunks.

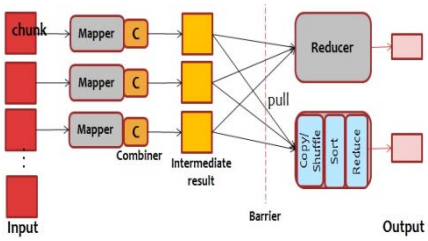

Figure 1: Process Flow of MapReduce

In Figure 1, it is possible to designate the number of Reduce tasks independently regardless of the size of inputs. Setting the task number a little lower than the number of Reduce slots within the cluster is the best for the performance. In MapReduce, it is possible to embody more complicated algorithms by connecting more than or equal to 2 MapReduce tasks. The status of Map tasks is classified into Data-local, Rac-local, and Off-rack. Data-local executes Map tasks on the node with input data within HDFS. It operates best since the network bandwidth is not used for optimization of data locality. Rack-local is executed on a different node out of the same racks. When all of the three nodes where HDFS block replicas are stored execute other Map tasks, Job Tracker brings in available Map slots on a different node out of the same racks where block replicas are stored. Off-rack is searched for execution from the node of other external racks and uses the network bandwidth since it should be transmitted from the network between racks.

B. Bioinformatics

Bioinformatics, as a field of science in which biological issues are collected, managed, and analyzed on a molecular level by using a computer so that they may be applied to diverse fields, has been efficiently used in various fields of information utilization. Especially, it has been actively used in sequence alignment, gene search, gene combination, protein structure alignment, protein structure prediction, gene expression prediction, mutual interaction between proteins, and evolution models[4,5,6,9].

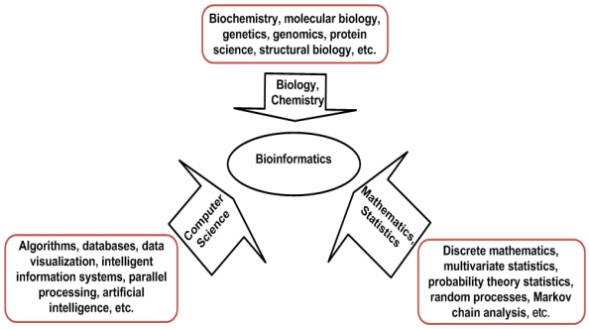

Figure 2: Definition of Bioinformatic

As shown in Figure 2, bioinformatics collects, manages, stores, and evaluates biological data in order to acquire the answers for biological issues. It has been converged in diverse field, and its application targets include the entire areas of life science[7,8].

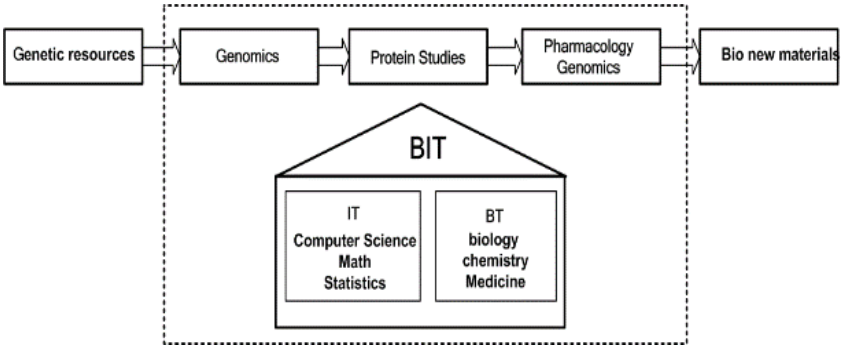

Figure 3: Components of Bioinformatics

Figure 3 shows the components of bioinformatics. As shown in Figure 3, the data from data collection are arranged, processed, and mutually linked to compose databases. Especially, it is difficult to compose databases by mutually linking data, and no proper solutions have been available so far. Thus, there are so many problems to be solved[9].

III. MAP REDUCE-BASED HIERARCHICAL BIOINFORMATIC MANAGEMENT METHOD

A. Information Creation Process of Bioinformatics

The proposed method shows high-capacity bioinformatics by using MapReduce in order to create bioinformatic information.

The key1 used in Map: (key1, value 1) creates value 1 as shown in equation (1) by dividing data into blocks in the unit of 64 bits.

$$V_n = \{v_i \in Z | V_n,\ v_1, \dots, v_i\},\ \ 1 \le i \le n\ mod\ 64 \quad (1)$$

Where $v_i$means the minimum data of block units to create bioinformatic information. In addition, $V_n$means key 1 for the bioinformatic information blocks composed of nunits.

In Map: (key1, value 1), value 1 is expressed as a correlation matrix as shown in equation (2). The large-capacity bioinformatic information expressed as equation (2) is input for parallel processing as value 1 used in Map: (key1, value 1).

$$value1 = \begin{bmatrix} \mathbf{0} & \cdots & \boldsymbol{a_{1k}} \\ \vdots & \ddots & \vdots \\ \boldsymbol{a_{k1}} & \cdots & \mathbf{0} \end{bmatrix} \quad (2)$$

Where a_{ij}means the correlation between pieces of bioinformatic information, and $a_{ij}$and a_{ji}have conditions that i is greater than or equal to 0 and j is less than 1 (0≤i , j≤1). If $a_{ij}$is equal to 0, it means that there exists no correlation of bioinformatic information.

The bioinformatic information classifies the information collected from diverse fields into Type, Property, and Priority, and the classified information may vary depending on the purpose and environment for extraction of bioinformatic information.

In the proposed method, depending on the relative importance of key1 and value1 displayed as the results of equations (1) and (2), created is the evaluation factor for weighted values as expressed by equation (3).

$$w = (w_1, w_2, \dots, w_n) \quad (3)$$

Where nmeans the number of bioinformatic input values, and $w_n$means the evaluation factor of bioinformatic information.

Since vector wis not known exactly in equation (3), it is impossible to evaluate exact weighted values through relative comparison. Thus, vector$w'$is obtained by estimation with the unique root decomposition as expressed by equation (4).

$$w' = \tau_{max} \mathrm{w} \quad (4)$$

Where τ_{max}means the maximum eigenvalue.

Since $\tau_{max}$is always equal to or greater than $n$in equation (4), it is confirmed from equations (5) and (6) that as τ_{max}gets closer ton, value1 for relative comparison is consistent with no errors in the proposed method.

$$I_C = \frac{(\tau_{max} - n)}{n-1} \quad (5)$$

$$I_{CR} = \frac{I_C}{I_R} \times 100 \quad (6)$$

Where $I_C$means the index of consistency, I_{CR}means the ratio of consistency, and $I_R$means the ratio of correlated information between factors.

B. Bioinformatic Information Processing

In the proposed method, prior to receiving the solutions of bioinformatic information, the solutions are requested to LSS(Location Service Server) by using the weighted value information of bioinformatic information. In order to process bionformatic information, the bioinformatic information block created through Map: (key1, value 1) groups the values output through Map function on the reference of key2, a new key, like equation (7), and then outputs the results created by performing the aggregation.

$$\text{Reduce: (key2, List_of_value2)} \rightarrow \text{(key3, value3)} \quad (7)$$

Here, Redice function has the feature of processing in parallel the data targeting various nodes. The proposed method composed of data blocks applies$listofvalue2$, the data information set created of data groups, to the hash finction.

$$H_i: \{0,1\} \rightarrow Z_N \quad (8)$$

$$HI_i = \text{H(key2, } listofvalue2\text{)}, \ 1 \le i \le n \quad (9)$$

$$DII_i = \text{H}(HI_i) \in L_{w_i}, \ 1 \le i \le n \quad (10)$$

WhereH_i: $\{0,1\} \rightarrow Z_N$means a safe hash function. Here, $w_i$means the key word for data search and L_{w_i} is used in data extraction together with the data index information,DII_i, by setting w_i, the key word, and then registering it to the management server.

LSS creates key2 of Reduce function, which corresponds toDII_i, the data index information created by equation (10), by using a random key, r, just like equation (11).

$$\text{Generate key2} = (DII_i, \text{r}) \in Z^* \quad (11)$$

LSS uses, as the bioinformatic information, key2, the key created by equation (11). LSS renews the bioinformatic information in a cycle of a certain time. At this time, the renewal state of bioinformatic information, State, judges whether or not the information is renewed, depending on the value of 0 or 1.

IV. EVALUATION

The proposed method is evaluated by the information retrieval time due to the number of data, the processing time due to the number of data, and the delay time of communication between the server and the user.

A. Environment Setting

For evaluation of the proposed method, set to 1 is the server threshold to process bioinformatic information. In case the user request bioinformatic information, LSS sets to 0.01ms the time of creating bioinformatic information.

Table 2 shows the parameter and experimental environment used in the simulation.

Table 2: Operation of Map and Reduce

Parameter	Setting
Number of bioinformatic	nd = {500, 1,000, 2,500, 5000, 10,000}
Threshold	th = {1}
Data Generation Interval	0.01 ms
Initial self data set time	1 Hours

B. Performance Analysis

Information Retrieval Time Due to Increase in Number of Data

Fig. 4 shows the information retrieval time of the server due to the number of data, the experimental results of Fig. 4 show that the information retrieval time of the server increased proportionally to the increase in the number of data for both the proposed method and the existing method. However, the information retrieval time due to the increase in the number of data was 18.8% lower for the proposed method than that for the existing method. These results were achieved since the proposed method improved the data collection method of MapReduce used in the existing method.

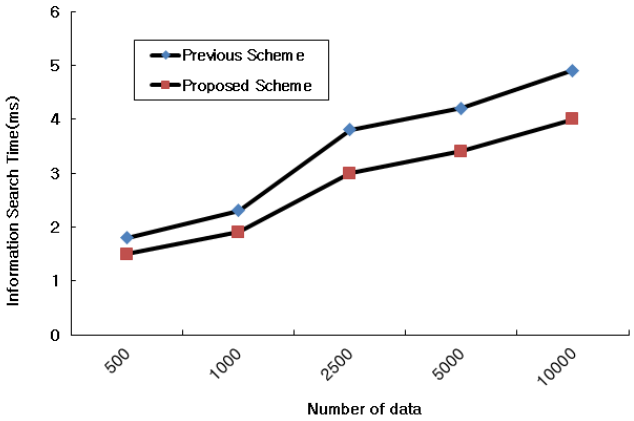

Figure 4: Information Search Time through Number of Data

Data Processing Time of Server due to Increase in Number of Data

Fig. 5 shows the data processing time of the server due to the increase in the number of data. The experimental results of Fig. 5 show that the information retrieval time due to the increase in the number of data decreased proportionally for both the proposed method and the existing method. However, as the number of data increased, the processing time was 3.7% shorter for the proposed method than for the existing method. These results were achieved since the values of value 1 used in Map function were expressed as the correlation matrix to collect and process large-capacity data.

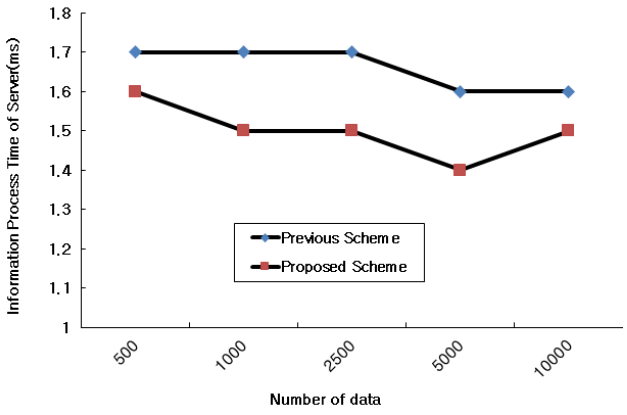

Figure 5: Data Process Time of Server through Number of Data

Communication Delay Time between Server and User

Fig. 6 shows the communication delay time between the server and the user due to the increase in the number of data. The experimental results of Fig. 6 show that as the number of data increased, the communication delay time between the server and the user for the proposed method was improved by 21.8% on the average over that for the existing method. These results were achieved since the proposed method managed data hierachically to make the data processing time constant.

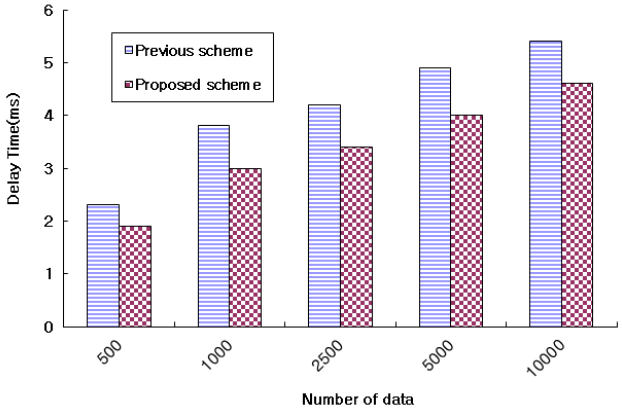

Figure 6: Delay Time through Number of Data

V. CONCLUSION

Lately, the use of bioinformatics has increased mainly due to medical institutes. In this paper, proposed is the method of managing MapReduce-based bioinformatic information to improve the processing time of bioinformatic information used in medical institutes under cloud environment. In order to manage efficiently bioinformatic information, the proposed method expresses the data values of MapReduce as the correlation matrix in the unit of 64 bits. This expression method can process in linkage a large amount of bioinformatic information easily while minimizing the processing time between the server and the user. The results of performance evaluation show that the information retrieval time due to the increase in the number of data was 18.8% lower for the proposed method than that for the existing method. In addition, as the number of data increased, the processing time of the proposed method was shorter by 3.7% on the average than that of the existing method. Finally, as the number of data increased, the communication delay time between the server and the user for the proposed method was improved by 21.8% on the average over that for the existing method. In the future research, the performance evaluation of systems will be conducted by applying the results of this research to actual systems.

ACKNOWLEDGMENT

This work was supported by the Security Engineering Research Center, granted by the Ministry of Trade, Industry & Energy. This paper has been supported by 2017 Hannam University Research Fund.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

The Development of Molding Structure for Ultra-compact LED Package

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Abstract---

Background/Objectives: This paper introduces the ultra-compact molding techniques to deal with less than 1.0mm. In general, in the field of ultra-compact molding, it has been known that there is a problem to be solved as the release problem. This paper presents the technology for solutions to these problems.

Methods/Statistical analysis: This technique was conceived in terms of which the main causes of increasing the defect rate is the roughness of EDM(Electric Discharge Machining) in the existing one-piece method. The core of this method is that it changes the monolithic (one-piece) structure with prefabricated structures. The implementation of the proposed method can increase the releasing property due to decrease the surface roughness. In addition, there is an effect to reduce the production costs in the process of producing products in large quantities.

Findings: The advantage to making a removable the core portion is that it is possible to finely machine the surface by the grinding process of molding. Therefore the proposed structure, with a favorable structure to the release, enables the compact mold of 1mm or less. When designing with the proposed assembly type structure, it was found a new problem to be solved in L/F (Lead Frame). This problem is roughly divided into left/right dimensional misalignment, EMC leak, stroke, and burr. And this paper point out these problems and suggest solutions for them.

According to the experimental results, the proposed method can reduce a lot of defect caused by surface roughness. The molding material is used as a white EMC (Epoxy Molding Compound) known to be advantageous to high temperatures and discoloration.

Improvements/Applications: The research will be needed on whether to increase production by increasing the number of units in L/F. This research refers to changes the structure so that the 540 unit is arranged in the L/F of the same size, the products currently under development are arranged with a 432 unit. As a result of this study, by putting the same time, the same material, and the same labor can improve the productivity compared to conventional products as 125%.

Keywords--- LED Package, Molding, EMC, Prefabricated Structure, Releasability.

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I. INTRODUCTION

The application of LED has been used in various fields in wide-industry on the display such as TV and smart phones, lighting, automobile, and IT, etc[1]. Among these areas, the lighting market in US has become the first year of growth, with sales ban incandescent by 2014[2]. And in the Asian region including China and Japan, LED market is growing rapidly according to various support policies of the government.

The growth background of LED lighting market is due to the fall in production costs by a decline in the price of components/materials and the development of related technologies. And government policy, such as a sales ban incandescent bulbs, played a major role to support in many countries. Finally, there may be mentioned the impact of standardization.

LED lighting is in the spotlight as an alternative lighting because it has the following advantages[1] :

1. Due to the excellent efficiency to convert the light, there is an effect to the energy savings and the reducing of generated CO_2.
2. It can be implemented a product with excellent durability, long life, high brightness and glare reduction
3. It does not use toxic substances such as mercury and does not generate the harmful ultraviolet rays on the human body.
4. It is easy to lighting control, such as dimming and color adjustment. And it has the miniaturization of light source and the higher degree of freedom in design.

The development of molding must be assumed in order to technically improve the product of the LED. The core of the mold technique is to reduce the size and the mass production of a product with improved performance. The LED material, which is becoming the material forming the outer wall of the molding product, is converted from PCT, PPA to White EMC. And the other materials have also been reviewed. For the thermoplastic resin, PCT and PCA is difficult to secure reliability of the product caused by heating with a heat resistance problem. The thermosetting resin, a White EMC is required in order to solve this problem. But there is a limit in the case of a tiny mold products, so the product is still being produced in the PCT, PPA materials. As a result, it does not take advantage of the strengths of the White EMC, favorable to high temperatures and fading. If it improves the development productivity in order to improve the mold, it is expected to improve the quality and to achieve the efficiency mass production of competitive products

It is well known that the packaging parts of LED lighting manufacturing costs accounted for more than 50% and accounted for the highest proportion. In the case of the LED package uses a PPA, PCT, EMC, Silicone as the housing material of the package body. As a key element for the production of ultra-compact LED, changes in raw material of package molding from PPA to white EMC, so that it can be used in various fields. Since the development of the product using the white compound accelerated for the purpose of the recent light source, it is imperative to develop a compact package.

Conventional methods have made an internal reflection angle portion and POD(Package Outline Dimension) of the LED package to a one-piece[4].

However, when the package manufactured with the white EMC of less than 1.0mm, the followings have been pointed out[3]: 1) It has been difficult to produce EDM since the package has small width. So it will need a lot of volume electrodes. 2) The machining time is three or four times more consuming than conventional products. 3) Because of the EDM roughness, the molded product can't be released from the mold after completion of EDM operations. The molded product was the cause of quality defects such as package crack[1,5].

On the other hand, the shape of the LED package is processed to separate a package internal reflection angle(CUP) and a POD. This paper proposes a new method to solve a difficult problem which can't be implemented with a conventional one-piece processing. This proposed method ensures a release force after molding by improving the roughness of the EDM.

II. UNDERSTANDING OF THE LED INDUSTRY

Global LED market is expected to grow rapidly in size to $ 122.8 billion in 2017, whereas it was about US $ 82.1 billion in 2014. And BLU market for display and mobile devices are entering the maturity stage. The LED lighting is expected to lead to LED demand, as a new growth engine in the future[2,6].

Power consumption of the lighting accounts for 19% of total power. Therefore, the interest in the LED light spread is concentrated, because it has the advantages at the same time economically large energy savings and environment-friendly. If you replace 66 billion global lighting installed in the United States with LED lighting, it expected to result in annual energy savings of 37 billion dollars (3731 billion kWh).

Global LED lighting market has grown in earnest after 2012, and the market is booming with about $ 27 billion in 2014, $ 42.4 billion in 2016. The growth of these lighting market is due to the cause as follows[2] : The first is the reduction of manufacturing cost due to development in lighting technology and decline of the parts/materials price. The second is a policy support around the world, such as an incandescent light bulb exit. In order to succeed in the LED lighting market, it is necessary business strategy tailored to the characteristics of the individual lighting market. In the world lighting market, market power of global corporations is low, the influence of their brands is a big market, because the world's third market share of the leading lighting manufacturers, Philips, Osram, and GE, not only to 11%, 5%, and 4%.

The development of these lighting markets is because there is a particular advantage of the LED lighting as compared with conventional illumination.

Table 1 is a comparison table for explaining this.

Table 1: Comparison of Conventional Lighting and LED Lighting

Classification	Conventional lighting	LED lighting	Remarks
Control	On/Off	A multi-color and the brightness of the multi-level	Intelligence sensibility lighting
Response speed	1~3second(Fluorescent lamp)	~10 nanoseconds	
Light conversion efficiency	Incandescent lamp 5% Fluorescent lamp 40%	The potential efficiency of up to 90%	High-efficiency light sources, CO_2 reduction
Mercury	Use (gas light source)	Free (solid-state light source)	Eco
Emission band	Can not concentrate	Centralized	The use of special lighting
Lifespan	3-7 thousand hours	50 ~ 100 thousand hours	Easy to maintain management
Heat-resistant	Excellent	Vulnerable to high temperatures	Another heat dissipation design
Price	Cheap	Expensive	Difficulties in supply

This paper is focused on molding problem for ultra-compact LED below 1mm. Here it is important to design a new structure, but should be considered also to mass production in large quantities. In this area, the releasing property and the production unit cost problem has become the most important issue. Table 2 summarizes these issues.

Table 2: Ultra-compact LED Mold Problem

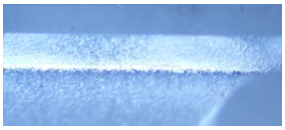
Classification	Releasability	Production costs
Problem	Due to the EMC sticking, continuous operation is difficult in the mass production stage. The mold maintenance costs rise due to frequent cleaning	The yield is lowered due to the limitations of the continuous operation. Therefore, the production cost is raised. By using the improved mold structure, we will be able to mass production of the quality of higher compared to the production unit price, on the characteristics of the market, difficult to secure competitiveness
Solution	If you change a one-piece structure with a prefabricated structure, the releas ability get better by improving the roughness of the product surface. (Ra 0.4 -> Ra 0.2 or less) By reducing the number of cleaning, mold maintenance costs are lower	When you increase the Units number in the same L / F size, because the production per time is increased, production unit price will fall. As a result, the price and quality competitiveness is strengthened.

III. IMPROVED MOLDING STRUCTURE

The conventional molding methods have used a one-piece structure, such as in Figure 1 (a). This structure has not only limitations in reducing the size, but also the disadvantage even during processing. The greatest impact among these is the roughness of the surface[3]. The conventional one-piece method has to produce a molding with EDM, It causes problems due to the release of the surface roughness[7], as shown in Figure 1 (b). So this is a big obstacle to the mass production of ultra-small mold development. In particular, the roughness

of the product side gives a great influence on the mold release. If you use the partitioning scheme for the secured releasability, you can solve the problem of moldreleasability, as well as cost savings even on mold machining process.

(a)

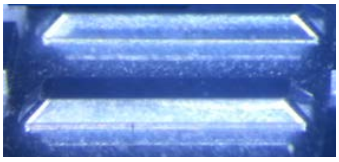


(b) The surface roughness : Ra 0.5~0.4

Figure 1: The One-piece Molding Structure

The newly developed molding structure is a prefabricated one, such as in Figure 2 (a). That is, the newly proposed structure is fabricated by a separate core part. The advantage of this method is that it can produce a mold by finely machining the surface, as shown in Fig 2 (b). Therefore, it is possible to compact LED mold production of less than 1.0mm, with the proposed modular structure so as to facilitate the release process during molding.

(a)



(b) The surface Roughness : Ra 0.2~0.3

Figure 2: The Proposed Prefabricated Molding Structure

Figure 3 shows that the core and the core holder designed/manufactured separately, and assemble them using a method fixing with a pin. The new issue also occurs in the new techniques, it will discuss in the next chapter.

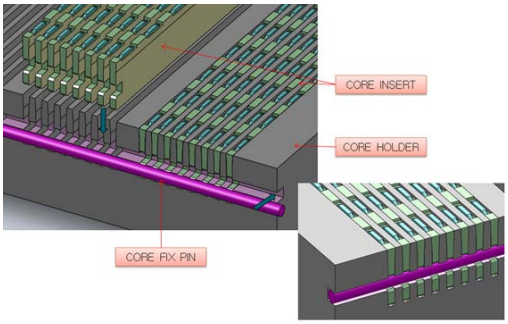


Figure 3: Assembly of the Core and the Core Holder

IV. LED 4.0 x 0.8mm Products Design

LED Package Design diagram shown in Figure 4 are based on a product that is produced with a conventional resin injection. It was designed as sizes and shapes used a corresponding products in applying future production (0.8mm wide product applied).

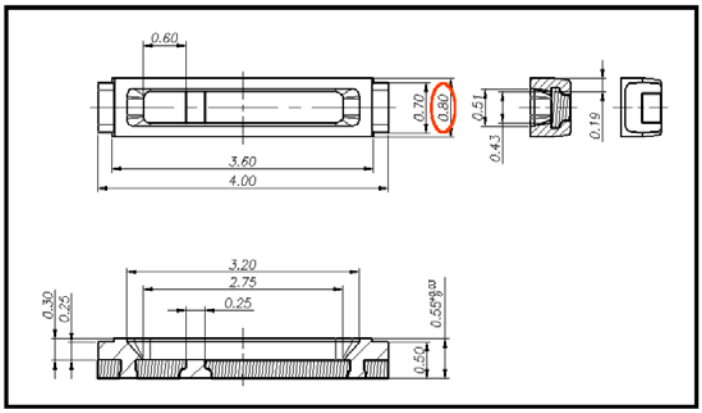
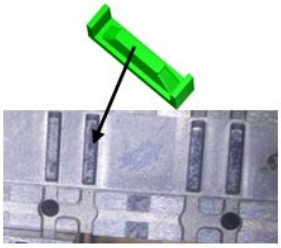
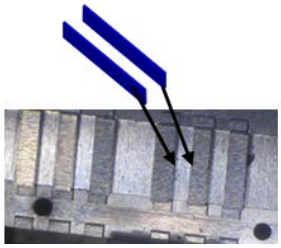


Figure 4: LED Package Design Drawing

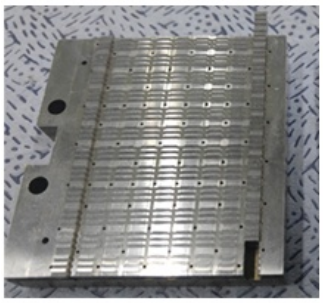
Figure 5 is a shorthand for the process to produce products with the proposed method. First, assemble the top core in (d) and the bottom core in (c) of Figure 5.Then, the injection is carried out in here. (a) is an enlarged view of a portion of the bottom core of (c).And (b) is obtained by displaying the role of an enlarged part of the top core of (d). (e) shows the result of the plated injection molded L/F. Finally, it is shown as (f) when separating the unit from the molded L/F.



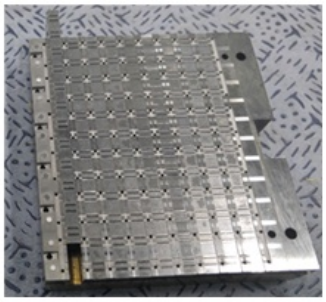
(a) Bottom Core



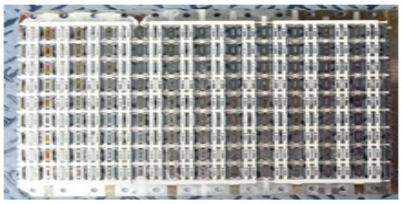
(b) Top Core



(c) Bottom Core



(d) Top Core



(e) Molded L/F

(f) 1 Unit

Figure 5: The Production Process of Schematic Product

The issues raised by the implementation process, the release problem and damage problems in the lead frame, and left and right dimensional misalignment(X/Y Misalignment). The first problem solved by adding the Eject Pin 5 EA with a partial fix. The second one solved by changing the mold dimension tolerance and

product workpieces control dimension to a smaller value. As a result of the injection, the following problems were found. Figure 6 is showing them, and then explain the solution as followings.

a. PKG left/right dimensional misalignment

In the core pitch has occurred misalignment problem, re-processing the core based on center site for size correction. Applying the general management dimensions (SPEC') appears incomplete shape of the product. This problem is caused because of the very small product. It was solved by changing the mold dimension tolerance and product workpieces control dimension to a smaller value.

- Management of mold tolerance associated with the molding portion tolerance change :
  (+/-) 0.01 -> (+/-) 0.005, (+/-) 0.005 -> (+/-) 0.002
- Dimensional control relating to the part which affects the shape dimension SPEC' : 0.03 -> 0.02

The mold was partially modifying with applying a modified tolerance. The part of the additional expansion by the heat and the assembly process of the mold was changed to fit the management SPEC'. The improved molding structure can correct the dimensions using SHIM, after making room for the both ends.

b. EMC LEAK occurs inside hole while injecting the EMC in frame gate site.

In order to ensure that EMC is not entering the hole site, to insert a PIN from the mold.

c. The stroke occurs in lead frame portion of the mold.

It operates the core holder pressed the "R" area of the L/F.

d. Burr occurs in PKG

Burr is generated because EMC is leaked in the gap between the core and core holder. Check the refresh state, it is solved by re-assembling the mold.

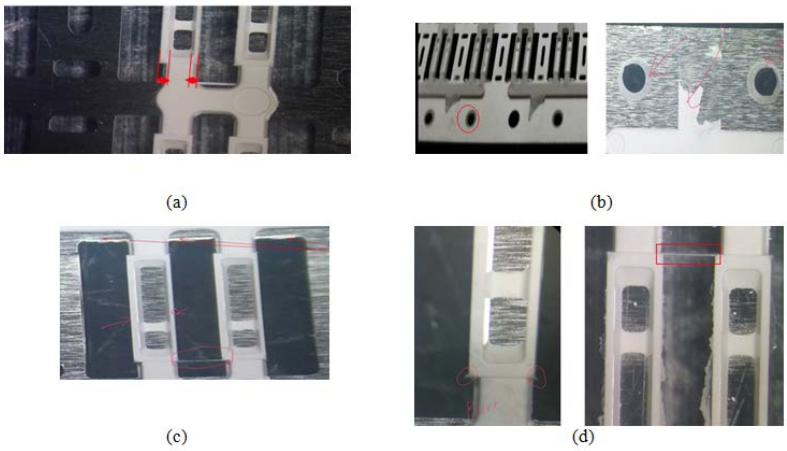


Figure 6: The Type of Problems Found After Injection

V. CONCLUSION

This paper introduced a molding technology to develop ultra-compact LED package using a white EMC, thermosetting resin. The proposed structure is a molding technique that may be utilized in the development of the ultra-compact LED products. This structure was not a conventional one-piece type, but a prefabricated one. The proposed method can reduce the surface roughness (especially the side), it was responsible for reducing the defect rate. Also this paper discussed the issues raised by the implementation process and provided a solution to these.

A subject of future research is interested on mass production with the newly developed a prefabricated structure. This research will be needed on whether to increase production by increasing the number of units in L/F. It refers to changes the structure so that the 540 unit is arranged in the L/F of the same size, the products currently under development are arranged with a 432 unit. As a result of this study, by putting the same time, the same material, and the same labor can improve the productivity compared to conventional products as 125%.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Design and Implementation of Small &Medium IMS Core Controller for IMS Convergence Service

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Abstract---

Background/Objectives: Since 4G LTE has been spread, it became efficient for companies to implement IMS Convergence necessary for multimedia services while maintaining existing communication network environment at a minimum of cost.

Methods/Statistical analysis: SIP-Gateway performance is verified by call completion rate, call processing reliability, MOS which affects voice transmission quality, and Jitter buffer that influences on voice transmission.

Findings: This paper materialized IMS core main system that companies who have less than 1,000 employees can adopt to the level where it is necessary, while maintaining the existing communication network environment. Furthermore, the paper gives functions of IMS terminal by connecting with IMS service of the key telecommunications service provider, and developed SIP Gateway that can interwork existing terminals such as wire telephone or SIP phone.

Improvements/Applications: This solution is in the middle of IMS terminal and CSCF, as it plays a role as CSCF to IMS terminal and vice versa. Terminals in the company can also interwork Gateway.

Keywords--- IMS, Gateway, CSCF, SIP, IP Network, PSTN.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Currently, Next Generation Network (NGN) is being developed for better communication service and advanced network infrastructure is required as Intelligent Mobile terminals and various multimedia streaming service increases. In this respect, IP Multi-Media Subsystem (IMS) is highly regarded as Integration of the wired and wireless control network for the highest result with limited resources[1].IMS structure is defined as a session control layer in NGN as it changes the setting to provide various multimedia services such as voice, audio, video and data using both Internet protocol (IP) based communications network and SIP[2-5]. In the early part, it was suggested in 3rd Generation Partnership Project (3GPP) to provide multimedia service from 3G mobile network. Nowadays, it is broadly used by IPTV and wire telephone service business replacing former soft-switch based internet phone service platform. Especially as 4G LTE, a mobile communication service, has been widespread, related market is growing fast[6-11].

Therefore, this paper developed high-speed main IMS Core processor that can make use of diverse multimedia IMS services and accommodate 1,000 subscriber lines at most by applying to workplaces with less than 1,000 employees. Moreover, SIP Gateway is designed and materialized that can use IMS service without the exchange of terminals by connecting IMS Core and SIP terminal which uses standard SIP protocol.

II. RELATED WORKS

IMS is not communications standards for information exchange, but a service architecture to provide with all multimedia services by one single platform. Exchange of information with systems needs protocols such as Diameter and SIP used to control multimedia communications sessions such as voice or video in Internet Protocol[11]. The reason IMS architecture became widespread is because of structural characteristics of IMS. In unified session control, IMS performs terminal authentication. Therefore, no additional authentication is performed in application server, and there is no need to manage information in application server because IMS also manages terminal information of user ID. It connects to application server in various ways such as URL, E.164 or user profile[3-5]. The structure of providing dynamic service analyzes user's connection request message as a service trigger condition and connects with applicable application servers. In unified session, it can be connected to application server at the same time using multiple trigger or in a terminal, service profile can make use of other various IDs at once.

As shown in figure 1, one terminal processes multiservice simultaneously in IMS structure and supports multiple users ID in IMS. It resulted in the revolution of wired and wireless communications such as personalized service, mobility guarantee, and TPS[6-7]. For example, various next generation network services such as presence, instant messaging and multimedia telephony can be used at home. Also, diverse multimedia services is supported that calling on TV or talking with people who are watching the same TV program became available.

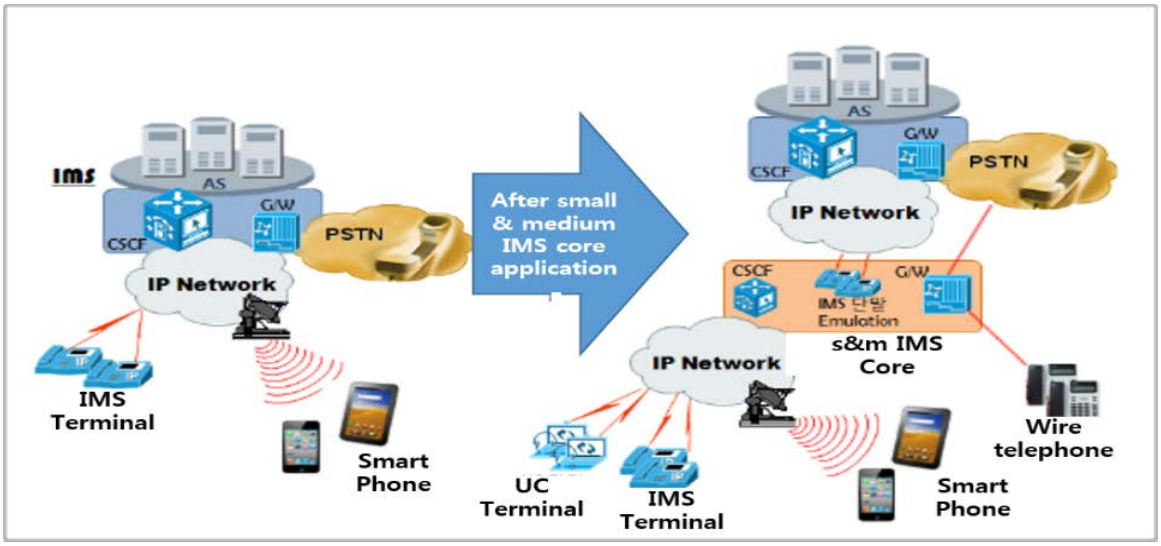

Figure 1: The Overview and Functional Example of Small & Medium IMS Core

III. IMS CORE MAIN SYSTEM DEVELOPMENT

A. IMS Core Solution Development Outline

Embedded based small and medium IMS solution that this paper developed is for small multimedia service providers that have less than 1,000 employees. IMS focuses on personalized service using global numbering and it is different from telephone service in typical enterprises. To fulfill company's expectation to deal with various multimedia service at minimum cost, it is effective to maintain existing communication environment as much as possible and bring only IMS convergent services that are essential.

As shown in figure 1, it is in the middle of IMS terminal and CSCF, as it does a role of CSCF in response to IMS terminal and a role of IMS terminal in response to CSCF. Terminals that companies originally used such as wire telephone or SIP make use of Gateway to connect[4-6]. IMS Core can be used for small businesses and also for countries that does not provide IMS service. Especially, it provides SIP-Gateway function to connect with SIP based Internet phone service that can interwork SIP based Softswitch and standard SIP phone. Also, as standard SIP terminal is available, it provides protocol conversion function between SIP-IMS[12,13]. With Mobile-VoIP, it is made to provide voice roaming service between wireless base stations which make it possible to use Mobile VoIP while users are on the move in 3G/4G network by using FMC Controller function. Figure 2 shows small capacity IMS Core controller. Small capacity IMS Core system consists of Main control part that simply provides functions necessary for group of customers among IMS functions, PSTN processing part that is used to extend physical ports of POTS, SIP-Gateway that converts standard SIP message into IMS message, and FMC controller that makes wireless terminal such as IMS terminal or smart phone available in mobile ambient[14-15].For the connection, small capacity IMS Core system is made involving IP communication based back-plane which exchanges information among each UNIT. These back-plane is comprised of Virtual Ethernet. Each UNIT by back-plane is made to exchange information at 10/100/1000Mbps Ethernet speed, so that stable signal transmission can be done among each UNIT.

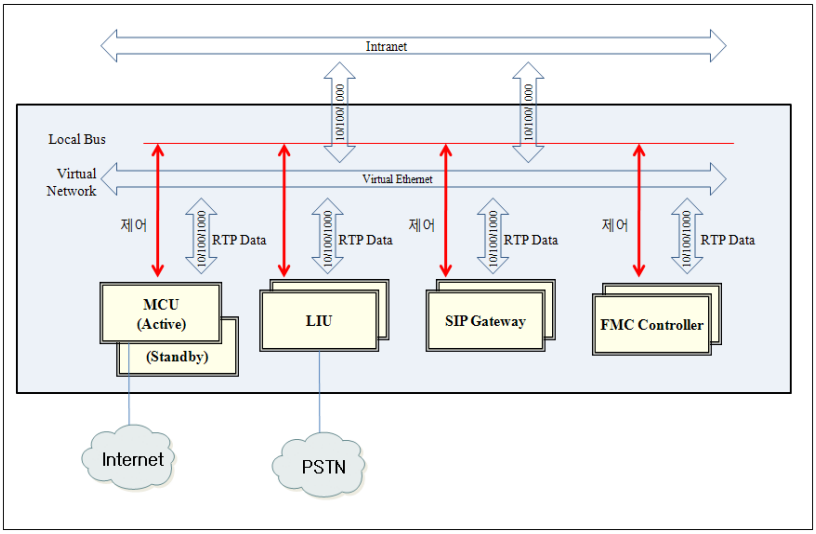

Figure 2: The Inner Structure of Small Capacity IMS Core Controller

The layer structure of Main control part of small capacity IMS Core system that the paper developed is shown in figure 3. Main control part is made with functions used to accept group of customers, and it operates being distributed to multiple CPU Core. Network port of Main control part is divided into WAN port and LAN port. Voice/data packet between each network port and CPU core is exchanged by Multi Layer Bus with IP method. Multi Layer Bus manages security of Main control part and QoS/Congestion in OSI Network Layer or Data Link Layer following upper Application Core. Functions of application S/W that operates in each Core follows the definition of each functions of IMS structure. PSTN ports which are to be connected to Main control part interworks DSP Core through TSI (TDM bus). SLIC is an analog terminal, and SLAQ is an analog office line. T1/E1 Framer is a module used to connect with digital T1/E1 line, and CODEC is a device that converts analog signals into digital PCM.

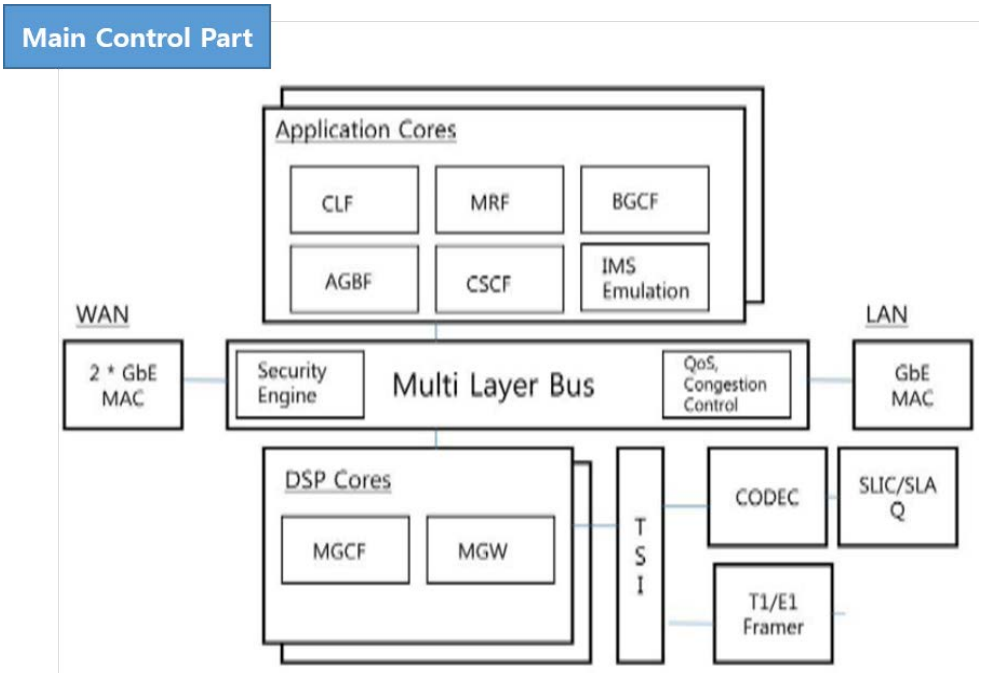

Figure 3: The Hierarchy of Main Control Part of IMS Core System

B. Design and Realization of Small Capacity IMS core Hardware

Figure 4 shows hardware block diagram of small capacity IMS Core system. CPU here uses Freescale P2041 Processor, and each processor provides 4 Ports of Gigabit Ethernet at most and DDR3 memory of 4GB and Nor Flash of 128MB. Ethernet interface made one inner part and 4 outer parts. DDR3 is used in Memory and the size of the memory is to be determined according to performance after S/W porting and Call test.

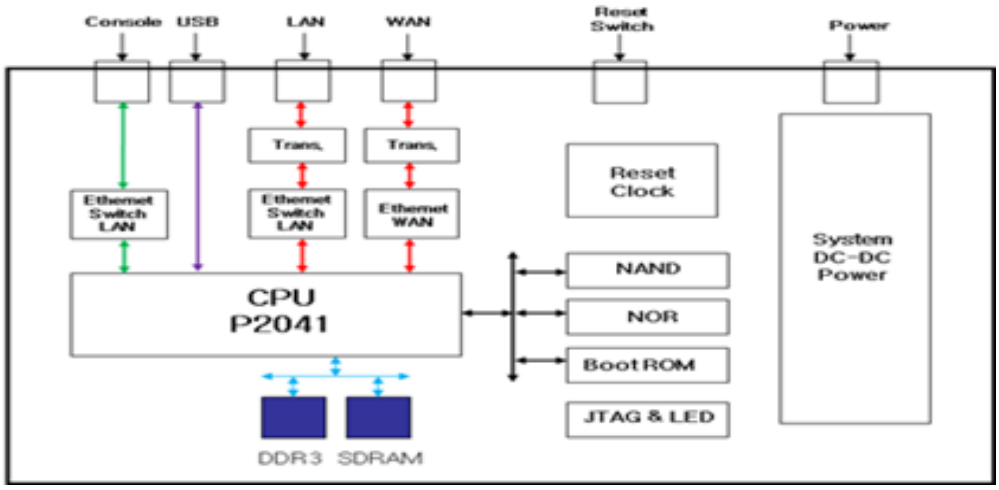

Figure 4: The H/W Block Diagram of Small Capacity IMS Core System

C. The Development of Main System Software for IMS Solution

Main system software block for IMS solution is composed of 9 parts of processor for IMS data as shown in figure 5. There is a web server interlocking handling phase which deals with web server linkage for web server application. In addition, there is IVR/VMS interlocking handling phase for IVR and VMS application. Address interlocking process can be done by Address server. BLF interlocking handling phase and Accounting interlocking handling phase is designed for the application of BLF and Accounting PC. Information of IMS terminal connected to system for IMS solution can be stored by designing SMS message processor, Local sound source processor, SIP message processor, Media data relay processor and Database inside.

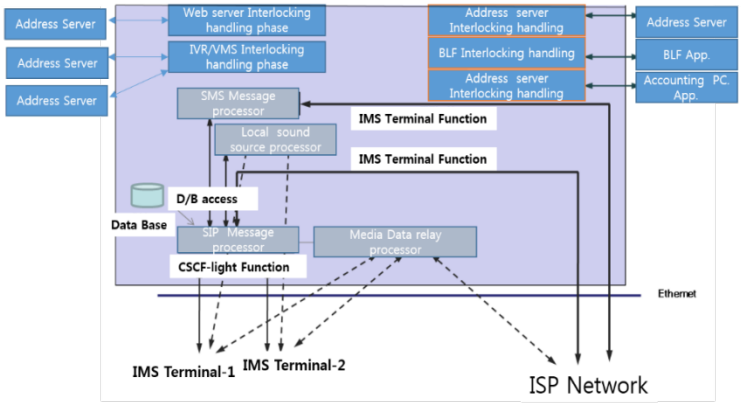

Figure 5: The Block Diagram of MCU Board

D. The Registrar Algorithm

In case of a small capacity IMS system, if the number of users increases, degradation of PBX can be happened as the portion of Registrar in PBX grows. To make up for the weakness and prevent the degradation, the algorithm in the paper is developed to reduce processing time in CPU, extracting Registrar for distribution process. For the outer distribution process, Registrar is divided into PBX function, Registrar1, Registrar2,… Registrar N functions. PBX function only takes part of call connection function and added response function to inquiry if there is an extension number from Registrar. Register message about IVR, VMS, MGR, CONF extension is to be dealt in PBX. Therefore, when booting up, PBX should read /home/config/registrar.ini and get to know the address and port number of Registrar. Registrar function is enrolled after receiving Register from extension and going through authorizing process. After the enrollment, IP and port is to become known to PBX by using the structure, and when in timeout, deletion is requested to PBX. Not assorting which extension to manage in Registrar, it is to be enrolled if PBX responds that the extension number exists after receiving Register message and parsing. In Registrar function, PBX address and port number are set up at /home/config/registrar.ini. Therefore, the algorithm for Registrar's booting up is shown in figure 6. The algorithm for Registrar accepting Register's message is shown in figure 7.

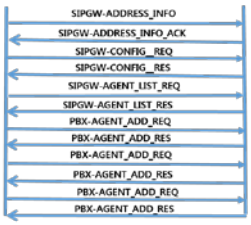

Figure 6: Algorithm When SIP-G/W Booting

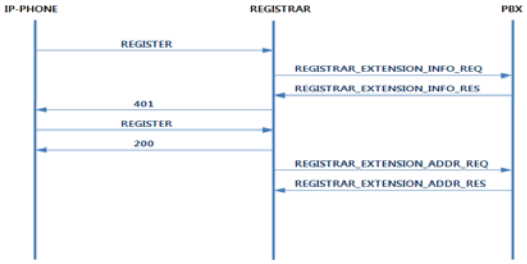

Figure 7: Algorithm When REGISTRA Booting

IV. THE SIP GATEWAY SYSTEM DEVELOPMENT

A. SIP Gateway H/W Development

As shown in figure 8, SIP Gateway is set up as an independent function inside the small capacity IMS Core which is connected to P-CSCF installed in communication service companies.SIP Gateway connected to the device converts wired network (FXO) of ISP and call from FXS into IMS data, then transfers to MCU which operates the function of P-CSCF. It is a two-way transmission. Hardware of SIP Gateway is a central processing unit developed using C1000 processor of ARM. Ethernet switch LAN chip is used for console and LAN. Moreover, Ethernet WAN chip is used for WAN.

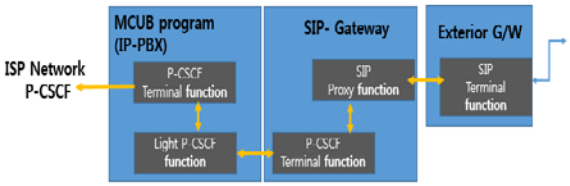

Figure 8: SIP Gateway System Diagram

B. The Software Development of SIP Gateway

SIP Gateway S/W is installed as an independent function of IMS solution inside connected with terminals for enterprise. The device converts FXO of telecommunication service companies and calls from FXS into IMS data, then transfers to MCU that takes a role of P-CSCF. Also, it converts IMS data from MCU into calls and transfers to FXO and FXS. By external analog gateway devices, call signal is converted to SIP message for IMS, then passed to P-CSCF for business through MCU. In case of signals scripted as IP-PBX, it is formed to convert into existing SIP message and then delivered to external devices through IMS-SIP handling phase.

C. Evaluating the Performance of the SIP-Gateway

Performance tests on SIP Gateway which has a key role in IMS Core system are done as shown in figure 9. By connecting ABACUS 5000 (IP Telephony Migration test system) and SIP Gateway, the performance of Jitter buffer that makes voice transmission, call completion rate, call processing reliability, and MOS which determines voice transmission quality are measured. WAN of ABACUS 5000 and LAN 2 port are to be connected to the measurement device, and another LAN port is connected to PC using hub to monitor the test and save the result. The other port is connected to LAN port of SIP Gateway to control ABACUS 5000.

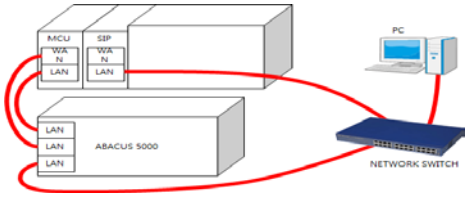

Figure 9: Measurement with ABACUS 5000

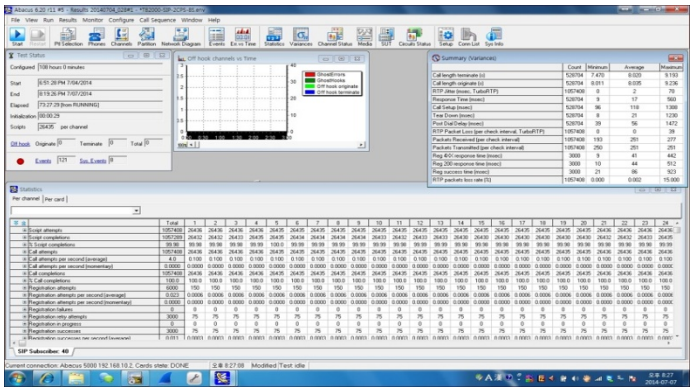

Figure 10: The Measuring Result Screen of ABACUS 5000

The result of ABACU performance of SIP Gateway is shown in figure 10. According to the result, performance goals suggested in table 1 are mostly satisfied as described in Table 2. Call completion rate rated 99.99%, 1057289 times success out of 1057408 trials. Call processing reliability that indicates call trials per second was measured 6PCS. MOS which infers the quality of voice transmission is measured 4.5, which is much above the purpose rate 4.0. The initial goal for Jitter Buffer which reduces voice disconnection was set up at below 120ms, but 100ms was estimated in the performance test. It can effectively reduce the number of buffers. As the device contains the function of LAN and WAN, speed is also an important factor. In regard of network speed of the device, it was measured 2.5Gbps speed which fully satisfies the goal 2Gbps.

Table 1: Target Evaluation Indicator of Development

Main performance indicator	Unit	Final goal of development	Test standard	Objective Measuring method
call completion rate	%	99 or more	G.711	ABACUS
call processing reliability	CPS	5 or more	G.711	ABACUS
MOS	MOS	4 or more	G.711	ABACUS
Jittter	ms	120 or less	G.711	ABACUS
NAT	bps	2Gbps or more	G.711	SmartBit

Table 2: Performance Test of Developed Product

Main performance indicator	Unit	Final goal of development	Test standard	Objective Measuring method
call completion rate	%	99.99	G.711	ABACUS
call processing reliability	CPS	5	G.711	ABACUS
MOS	MOS	4.2	G.711	ABACUS
Jittter	ms	100	G.711	ABACUS
NAT	bps	2Gbps	G.711	SmartBit

V. CONCLUSION

IMS Core the paper developed for small businesses can be implemented in IMS service for enterprises, but also countries that does not provide IMS service, as it is made of IMS structure such as CSCGF and MGW. Furthermore, it is a system for enterprises that have less than 1,000 employees or small scale multimedia service business.

IMS focuses on personalized service using global numbering. It is efficient to maintain existing communication environment as much as possible and only adopt IMS convergent services that are essential. To interwork SIP based internet telephone, it is possible to interwork SIP based Softswitch and standard SIP phone providing SIP gateway functions. The performance test of SIP gateway made it clear that the system works properly as the call completion rate became 99.99% and call processing reliability rated 6PCS. For further research and development, enhancing the performance will be done so that IMS Core can be used for big business.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Development of HMI System by Using Reactive Reserve Power Cooperative Control for Securing Voltage Stability in Power System

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Abstract---

Background/Objectives: A power system has been changing by variety load and increase transmission line capacity. So, it was need to monitoring voltage and reactive power for supply and distribution in power system.

Methods/Statistical analysis: This paper studies to secure reserve power in power system. The developed system algorithm was consisted of two different cooperative control methods. First, sequence control has been secure momentary reactive power by controlling reactive power compensation equipment in steady state in power system. Second, concurrent control has been maintaining the bus voltage by controlling FACTS in transient state in power system.

Findings: This control system was calculated to control necessary reactive power compensation equipment by operating individual bus voltage sensitivity in power system. HMI system has been used the IT power system that was adapted the monitoring and control.

Improvements/Applications: This control has been managed for improving the bus voltage stability and for control fast response speed in the power system.

Keywords---HMI(Human Machine Interface) System, FACTS(Flexible AC Transmission System), RPCE (reactive power compensation equipment), Power System.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

A power system has been changing by variety load and increase transmission line capacity. For reliable power supply, the power system was used to RPCE(reactive power compensation equipment). A reactive power was necessary cooperative control for effective operated power system[1-7]. The RPCE was used to conventional reactive power, shunt reactor (Sh.R.) and shunt capacitor (S.C.), and fast response characteristics FACTS (Flexible AC Transmission System).

This paper studies to maintain steady the bus voltage by using cooperative control unstable the bus voltage[2]. A control method was sequence control and concurrent control[7-9]. First, sequence control was secured the momentary reactive power to reactive power control by the power system state. Second, concurrent control was reliable the power system by calculating necessary reactive power using the voltage sensitivity in power system[10]. This method was applied to simulation by using program power system analysis and by constructing HMI (Human Machine Interface) system.

A cooperative control of power compensation equipment was feasibility to improved voltage stability and supply reliability by securing momentary reactive power in power system. A location was necessary cooperative control to secure high power quality due to important facilities system. So, the location was concentrated in FACTS and Shunt equipment for control the voltage and reactive power. This paper was modeled by substation location reference to select possible control reactive power. The bus voltage of interested section was checked and analyzed voltage sensitivity by controlling the RPCE. The RPCE characteristics were shown bus voltage and reactive power in figure 1. Voltage sensitivity was calculated by the voltage change in each bus.

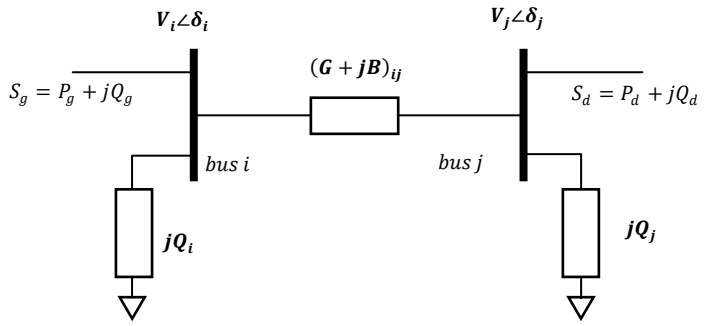


Figure 1: Elementary Bus and Reactive Power in Power System

Bus voltage sensitivity was calculated as equation (1) and (2).

$$S_i = \mathrm{V}_{i=1}^{ki} \frac{\Delta V_i \Delta Q_i}{\Delta Q_i} \quad (1)$$

$$S_{i-j} = \mathrm{V}_{j=1}^{kj} \frac{\Delta V_j \Delta Q_i}{\Delta Q_i} \quad (2)$$

Where :

V_i = self-bus voltage sensitivity was shown i bus voltage change (Vi) by control reactive power (Qi) of bus i.

V_j = other buses sensitivity was shown j bus voltage change (Vj) by control reactive power (Qi) of bus i.

Qi, Qj = reactive power at buses.

Si, Si-j = total apparent power at bus i.

II. LITERATURE REVIEW

A. Algorithm for Control Power System

Active power and frequency showed same characteristic in total power system, but reactive power and voltage showed different characteristic in local power system. Concept of hierarchical voltage control was shown figure 2. First voltage control operates reference by second-side voltage in step-up transformer. Second voltage control operates on observing the target bus voltage to control setting reference voltage of operator. Third voltage control operates to control voltage and reactive power in total power system by adjusting reference voltage for control target bus.

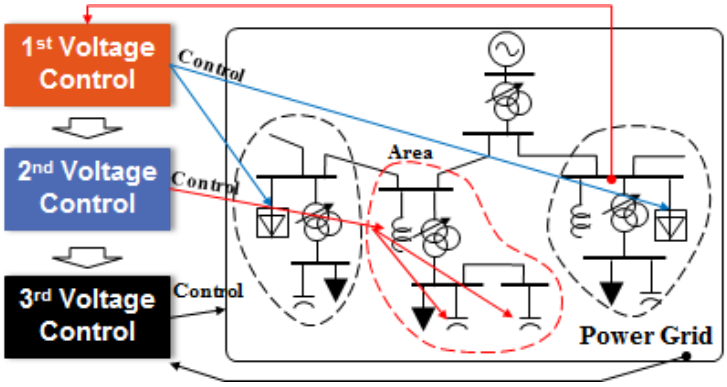


Figure 2: Concept of Hierarchical Voltage Control

Voltage stability was controlled reactive power by using generator or compensation equipment in power system. Generator in distribution power system was disadvantaged on power distribution of reactive power capacity by connecting long distance. So, it was controlled surrounding reactive power compensator. The reactive power has been controlled for voltage stability by flow chart in shown figure 3.This flow chart was observed bus voltage, control reactive power out of range the reference voltage, and to secure momentary reactive power within the reference voltage.

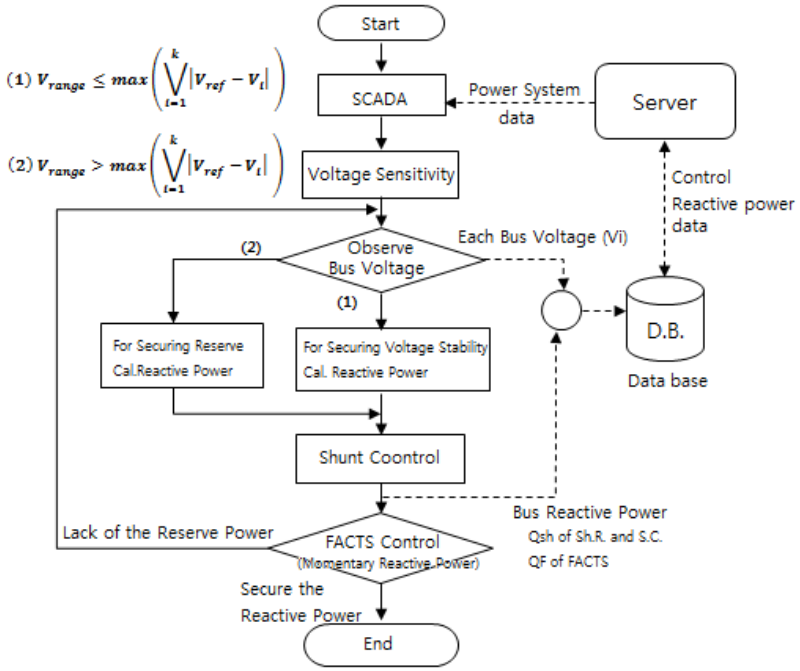


Figure 3: Reactive Power Control Flow Chart for Voltage Stability in Power System

Improving voltage stability was calculation voltage sensitivity in power system by acquired real power system data (status of bus voltage, reactive power, and compensation equipment etc.). The bus voltage was observed range of reference voltage value. If out of range bus voltage, control by operating of FACTS and calculation reactive power in shunt equipment. Or else, reactive power was secured to draw-back operating FACTS for using control fast reactive power response speed. Database was stored power system data by changing power system operating status. A momentary reactive reserve power calculated FACTS and RPCE capacity in power system, as (3).

$$Q_F^{need} = V_{F=1}^{kF}(Q_{Fop} - Q_{Fres}) \qquad (3)$$

Here, Q_F^{need} was necessary reactive power in FACTS, Q_{Fop} was operating reactive power in FACTS, and Q_{Fres} was setting reactive power in FACTS. To secure momentary reactive reserve power in FACTS, shunt elements controlled sequence control to be over zero of Q_F^{need} capacity value.

III. PROPOSED WORK

A. *HMI System*

Monitoring for the power system was developed simulator for control reactive power in shown figure 4. Date-Base was stored data of real power system or simulator. And HMI was monitoring to control FACTS or compensation equipment by using python program.

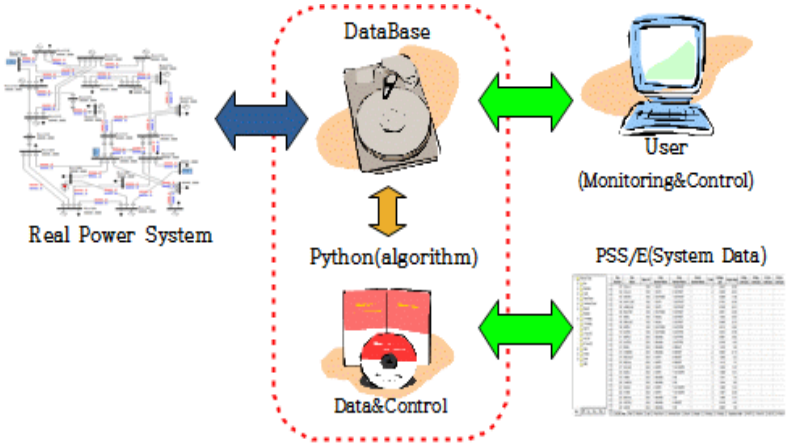


Figure 4: Power System Simulator and HMI Structure Diagram

The cooperative operating algorithm is mapping by controlling the RPCE in shown figure 5.

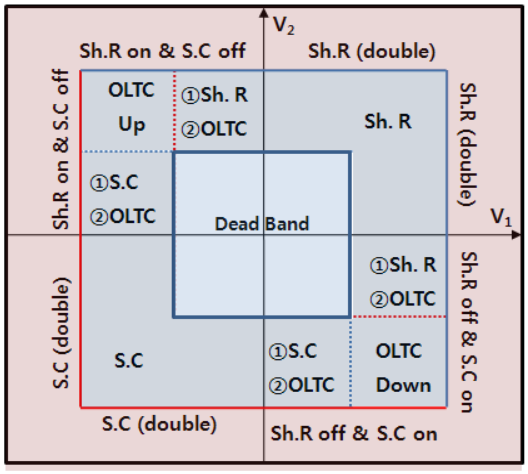


Figure 5: Cooperative Control Operating Algorithm

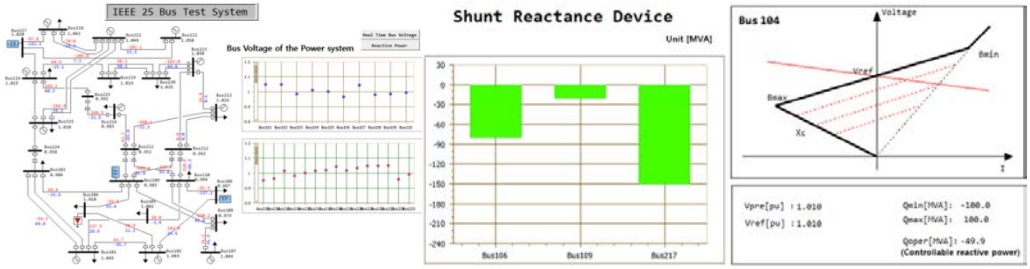
B. *Study Case*

Case study was performed to add specific load bus and reactive power equipment in IEEE 25 Bus power system. It was calculated initial load flow in modified IEEE 25 Bus power system as shown in table 1.

Table 1: Load Flow Data in Modified IEEE 25 Bus Power System

Capacity		*P [MW]*	*Q [MVA]*
Generator		3918.0	1441.9
Load		3778.0	726.2
Reactive power devices	Shunt	-	-250
	FACTS	-	-49.9

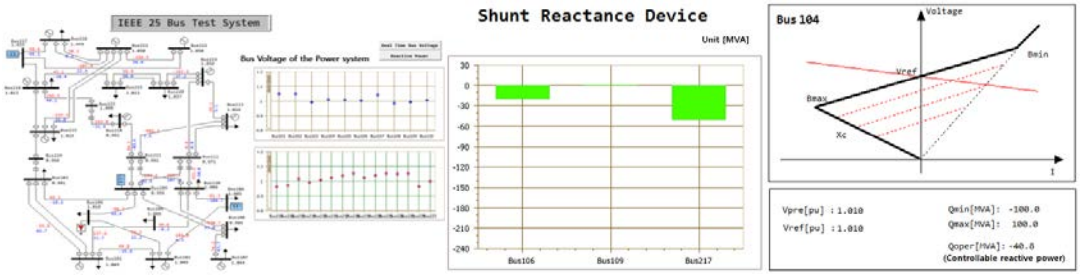
HMI simulation result was shown figure 6. It shows active and reactive power capacity in power transmission line and operated RPCE in each bus. Reference voltage was maintained 1.01[pu].



(a) (b)

Figure 7: HMI monitoring Using Power System Data (Initial state). (a) was HMI Power System; (b) was Reactive Power Control Capacity in Power System

Sequence control was secured momentary reactive reserve power in FACTS on steady state of bus voltage in power system. FACTS system was secured the reactive power in shown figure 7. Momentary reactive reserve power was secured -40.8[MVA]. Concurrent control was control reactive power by replied voltage change by increasing specific bus load or by bus load failure. Simulation result, each bus voltage showed to increase than the reference voltage.



(a) (b)

Figure 7: HMI Monitoring Using Power System Data (sequence control state). (a) was HMI Power System; (b) was Reactive Power Control Capacity in Power System

Reactive power was control the bus voltage in power system and improved voltage stability by secured momentary reactive reserve power. HMI monitoring and control was checked simulation in power system.

IV. CONCLUSION

This paper has been developed the HMI system and improved voltage stability by securing reactive power in power system. There has being developed and supplies that the cooperative system of the RPCE. Cooperative algorithm has been converged to the target voltage for voltage-reactive power control by using the STATCOM and the RPCE in the central power substation. It was calculated the RPCE capacity that control capacity was input reactive power and voltage control by performing calculation of load-flow, fault state, and voltage sensitivity of voltage-reactive power in the off-peak, mid-peak, and peak load in the substation. Cooperative algorithm was a in the follows. First, reactive power capacity was calculated bus voltage sensitivity of each bus voltage by changing reactive power. Second, it was judged whether sequence control or concurrent control by checking voltage and frequency. A reactive power was controlled to secure and maintain bus voltage. Case steady state, proposed algorithm was sequence control by securing reactive reserve power shunt and FACTS. Case transient state, proposed algorithm was concurrent control by maintaining bus voltage by control fast response speed in FACTS. The HMI system was monitoring and controls the sequence and concurrency control by using the proposed algorithm. Therefore, this developed HMI system was considered to improving voltage stability and would be applied to the power IT.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Steady State Operation Approach of Renewable Sources in SmartGrid Based on the PSCAD/EMTDC

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Abstract---

Background/Objectives: When large scaled and dispersed renewable sources such as wind power generation systems and PV systems are interconnected to the smart grid based on information and communication technology, a variety of quality problems in smart grids may be occurred and then they can make serious problem to power operation in smart grid.

Methods/Statistical analysis: The modeling and analysis of information and communication technology oriented smart grid system including renewable sources such as wind power system are essential for the voltage quality problems in steady-state operation when wind power systems are interconnected with smart grid system. This paper deals with the voltage variation characteristics in steady-state operation based on the comparison between theoretical method of symmetrical component method and PSCAD/EMTDC model method of commercial S/W.

Findings: It is clear that that the proposed approach is useful tool for the countermeasure of power quality problems and issues of smart grid interconnected with renewable sources such as wind power generation (WP) system.

Improvements/Applications: This will be expected as a technical guideline for interconnection of renewable sources such as WP systems and PV systems in smart grid.

Keywords--- Smart Grid System, Renewable Sources, Wind Power Generation System, Grid Connection, Steady State Operation, Voltage Quality Problems.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Recently, various environmental issues such as air pollutions, lack of fossil energy source, nuclear accident, have been occurred. And Korea government has estimated that wind power generation (WP) system among the renewable sources will be occupied by 37% in 2020 and by 42% in 2030.According to Renewable Portfolio Standard (RPS) starting from 2012, a number of green energies are expected to interconnect with the smart grid based on information and communication technology[1]. However, some power quality problems such as voltage sag, voltage swell, harmonics, interruption and so on can be occurred if a large and dispersed scaled WP system is introduced and operated in the 3 phase primary feeders of smart grid system, and also it can cause malfunction of protection devices including substation relay and re-closer of 3 phased primary feeders. Therefore, this paper proposes the voltage variation characteristics in steady-state operation of smart grid including WP system by using PSCAD/EMTDC S/W which is the most representative S/W tool in power engineering field, and also performs several simulations on the real case of Kim-Nyoung primary feeder (D/L) of Cho-Cheonsubstation(S/S) in Jeju-island, which is interconnected with 1.5[MW] WP system.

II. MODELING FOR REAL DISTRIBUTION SYSTEM WITH WP

A. Modeling for Real DS

In order to figure out voltage variation characteristics of customer sides, a modeling of real primary feeder based on the single phasedline diagram approach, Kim-Nyoung D/L) of Cho-Cheon substation(S/S)in Jeju-island, is performed as shown in Figure 1. From distribution substation to WP system of 1.5[MW] which is located at the end of primary feeder (D/L), it is divided into 6 blocks by important nodes which are location point of protection devices such as circuit breakers and re-closers, blanching point and changing point of cable size.

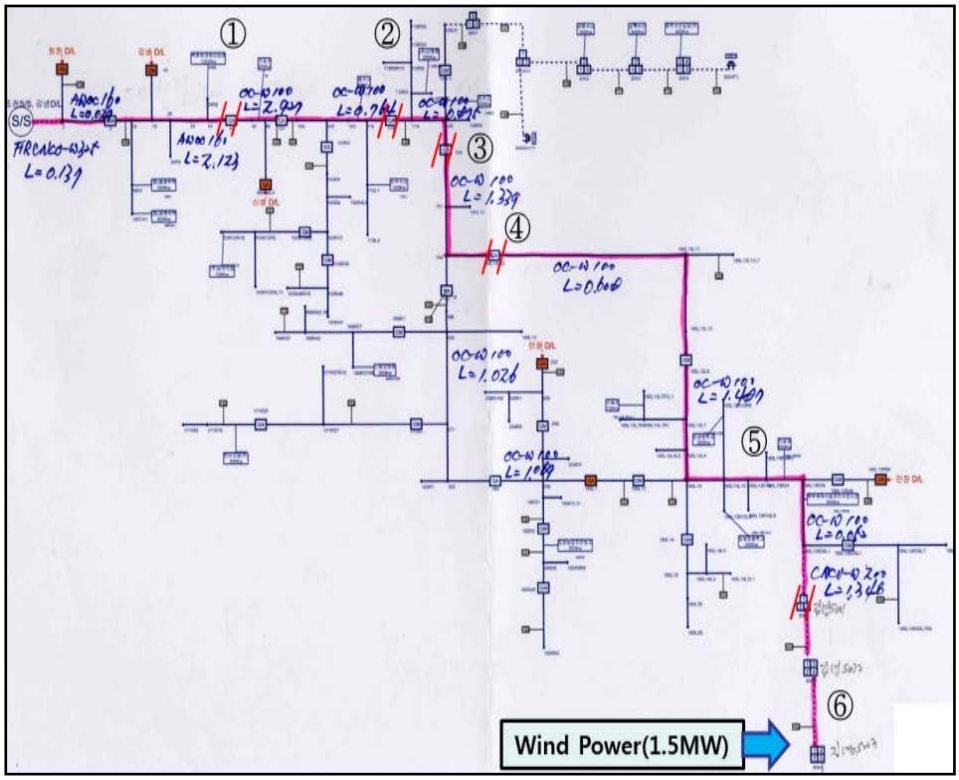


Figure 1: Single Line Diagram of Real Distribution System with WP of 1.5[MW]

The total capacity of customer loads (KW) in a primary feeder of smart grid is calculated by summation of both low voltage customers in secondary feeder which are expressed by kWh load and high voltage customers in primary feeder which are kW load as shown in Figure 2[2-5].

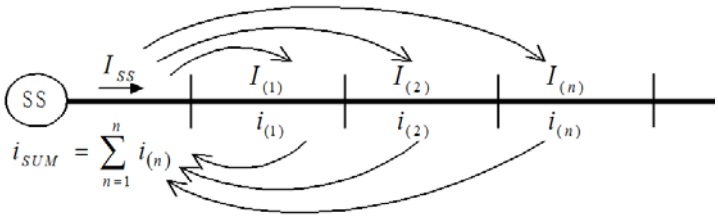


Figure 2: Load Modeling of Primary Feeder

As shown in Eq. (1), the desired value of each block ina primary feeder of smart grid can be expressed from the correlation between the estimated value and the measured value. Where,$I_{(n)}$ and $i_{(n)}$ are the measured and estimated currents of n blocks, respectively, and I_{SS} is the measured total current, and i_{SUM} is the estimated total current in the primary feeder.

$$I_{(n)} = i_{(n)} \times \frac{I_{ss}}{i_{SUM}} \quad (1)$$

The load of each block can be obtained by detailed load data of each section in Figure 3. Therefore, total load amount is estimated and then desired load capacity can be obtained by proportional equation as shown in Figure 4 in the case of 5[MW] peak load.

● Details of Single Line Diagram
● Title: Jocheon-Kim_Neying
● Date of preparation: 01/28/2011

Section No.	Facility 1.	Facility 2.	Type of Cable.	Phase	Length(m)	Load of High V	Load of Low V	
							(KVA)	(KVA X %)
101	CB	2	CF 325 X3	ABC	137	0	0	0
	2	3	EW 160 X3	ABC	29	0	0	0
	2	1	EW 160 X3	ABC	30	0	0	0
102	3	18	EW 160 X3	ABC	660	0	225	56.07
	18	19	EH 100 X3	ABC	48	0	0	0
	19	20	EH 100 X3	ABC	71	0	0	0
	20	22	EH 100 X3	ABC	88	0	0	0
	22	34	EH 100 X3	ABC	606	0	485	158.22
	34	41	EW 160 X3	ABC	350	0	0	0
	34	34R6	EW 58 X3	ABC	241	0	30	8.24
	20	20R5	EH 38 X3	ABC	136	0	90	46.92
	19	19	ZZ 0 X3	ABC	0	0	0	0
	18	18R7	EH 38 X3	ABC	228	0	90	45.8
	18R7	18R7A1	EH 38 X3	ABC	7	0	0	0
103	41	42	EH 100 X3	ABC	56	0	0	0
	42	44	EH 100 X3	ABC	105	0	0	0
104	101	102	EH 100 X3	ABC	48	0	0	0

Figure 3: Load Data of Each Section in Kim-Nyoung D/L

37177.846 : 5000 = 3079.45 : ① section =414.15kW
37177.846 : 5000 = 3093.27 : ② section =416.01kW
37177.846 : 5000 = 7902.54 : ③ section =1062.80kW
37177.846 : 5000 = 20601.70 : ④ section =2770.70kW
37177.846 : 5000 = 2444.21 : ⑤ section =328.72kW
37177.846 : 5000 = 56.67 : ⑥ section =7.62kW

Figure 4: Calculation of Real Load Capacity by Proportional Equation

B. Algorithm for Voltage Drop Calculation Considering WP

The conventional methods for voltage profile calculation in smart grid can create the voltage profile by only considering one direction from power source side to load side. However, the voltage rise as well as voltage drop can be occurred according to the reverse power supply of WP system. Therefore, this paper presents a novel strategy to think over the reverse power supply of WP system. In order to consider the direction of power supply and power factor of WP system, the load current(I) is divided into 2 separate parts which is real value(Ip) and imaginary value(Iq). As the 3rd quadrant do not have the forward direction (+)of power supply from sourceside to loadside and the leading power factor as shown in Figure5,the voltage drop calculation must be performed by only considering the backward direction (-) of power supply and lagging power factor. Therefore, the voltage risephenomena due to the backward direction of power supply may occur in the 3rd quadrant. Based on the same procedure, the voltage profile calculation in other quadrants can be obtained[6-8].

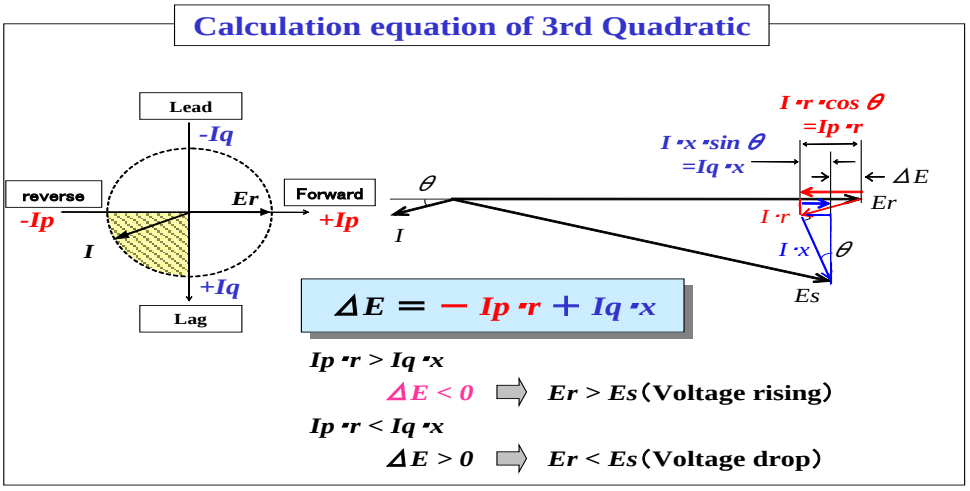


Figure 5: Voltage Profile Calculation of 3rd Quadratic

Figure 6 is a simplified modeling for one-line diagram of Kim-Nyoung primary feeder. The voltage drop and rise of each section can be obtained by the proposed algorithm.

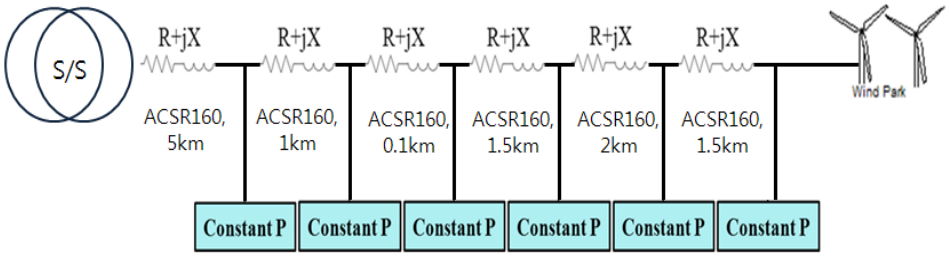


Figure 6: Configuration Diagram of Kim- Nyoung D/L with WP

In this paper, the load of each section is assumed as constant-power loads. Initially, active power in the each section considering WP can be calculated by Eq. (2), (3). The load current of each section is also calculated by Eq. (4). Finally, the voltage drop can be obtained by Eq. (6) with the impedance in Eq. (5).

$$P_{ns'} = P_{ns} - P_{wind}\ [MVA] \quad (2)$$

$$P_n = P_{ns} \times \cos\theta [MW] Q_n = P_{ns} \times \sin\theta [MVAR] \quad (3)$$

$$i_{np} = \frac{P_n}{\sqrt{3} \times V \times \cos\theta} i_{nq} = \frac{Q_n}{\sqrt{3} \times V \times \sin\theta} \quad (4)$$

$$Z_n = (R \times \cos\theta + X \times \sin\theta) \times l \quad (5)$$

$$\Delta V = k \times I \times z \quad (6)$$

Where $P_{ns'}$ is apparent power considering WP, P_{ns} is apparent power of n section, P_{wind} is WP output, P_n is active power of n section, Q_n is reactive power of n section, Z_n is line impedance of n section, l is length of line, k is coefficient of power supply system, I is line current, z is line impedance.

C. Modeling for Doubly-Fed Induction Generator(DFIG)

Figure7 shows a total control block diagram of DFIG. First of all, MSC is consisting of 5 components like left side of Figure7. These components are a estimation of stator flux (①), a calculation of synchronism phase angle(②), current controller(③), control of generation amount, torque of generator(④), control of rotation speed(⑤) and control of reactive power that is related on excited current supply by a generator(⑥). On the other hand, Grid Side Converter (GSC) consists of 4 components like right side of Figure7. It consists of calculation of phase angle (a), current controller (b), DC control (c) and control of reactive power (d). Based on this concept, DFIG of 1 [MW] can be modeled using PSCAD/EMTDC as shown in Figure8[9-15].

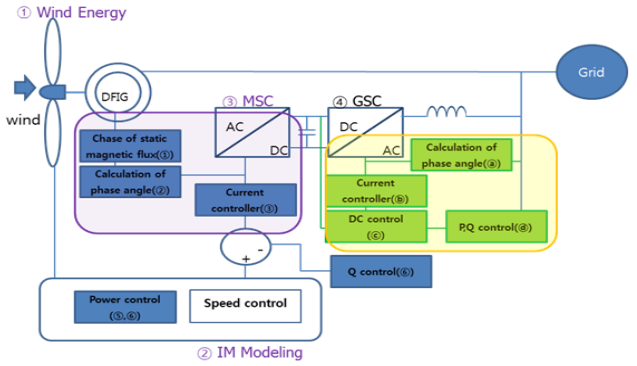


Figure 7: Basic Configuration of DFIG

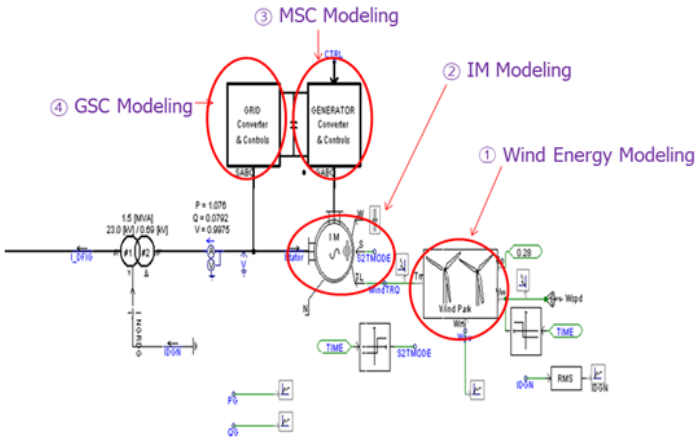


Figure 8: Modeling for DFIG Using PSCAD/EMTDC

III. SIMULATION AND ANALYSIS

A. Theoretical Voltage Drop Calculation

This paper assumes a daily load curve which is composed of 1.5[MW] of off-peak load, 5[MW] of middle load and 10[MW] of peak load in Kim-Nyoung primary feeder (D/L). Table1 showsthe characteristics of voltage profiles of each block when WP system is not installed. Here, it is based on 22,900[V] of phase to phase voltage.

Table 1: Voltage Drop Rates of Each Section without WP

	Voltage drop rates of each section [%] (based on 13,200[V])					
Load of total section	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
1.5MW	0.37	0.47	0.48	0.57	0.59	0.59
5 MW	1.23	1.56	1.59	1.91	1.96	1.96
10MW	2.47	3.11	3.17	3.83	3.92	3.92

During the off-peak load (1.5[MW]), it is found that the voltage drop rates are very small. But in peak load (10[MW]), the voltage drop rates are getting bigger than the off-peak load. Table 2 is the simulation results of secondary feeder voltages at the end blocks (Section 5 and 6) when WP is not interconnected. The turn ratio of 13,200/230[TAP] of pole transformer (P.tr) is assumed and also the 2% of voltage drop rate at the nearest customer point from P.tr and 8% voltage drop rate at the end customer point from P.tr are assumed. From the simulation results, it is clear that all customer voltages of each block in smart grid can be kept within the proper limits which is 220[V]±6% based on secondary load.

Table 2: Customer Voltage of the First and End Point of P.tr at the End Section of D/L without WP

		Voltage [V] (Using 13,200[TAP])	
Load capacity of total section		The first customer point of P.tr	The end customer point of P.tr
1.5MW	Section 5	227.99	226.01
	Section 6	227.99	226.01
5MW	Section 5	223.29	218.89
	Section 6	223.29	218.89
10MW	Section 5	216.58	207.78
	Section 6	216.58	207.78

Table 3 is the characteristics of voltage drop rates of each block when WP system of 3MW is interconnected at the end of section. In case of off-peak load (1.5[MW]), all of voltage drop rates are obtained in negative values according to the voltage rising through the reverse power flow of WP output. In case of peak load (10[MW]), the voltage drop rates are getting smaller than those of without WP in Table 1.

Table 3: Voltage Drop Rates of Each Section with WP of 3[MW]

	Voltage drop rates of each section [%] (based on 13,200[V])					
Load of total section	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
1.5MW	-0.37	-0.48	-0.49	-0.68	-0.99	-1.22
5MW	0.87	1.11	1.13	1.41	0.86	0.44
10MW	2.10	2.68	2.73	3.44	2.56	1.85

Table 4 is the customer voltages characteristics at the secondary feeder of the end blocks (Section 5 and 6) when the WP of 3[MW] is interconnected. In case of off-peak load (1.5[MW]), the customer voltages at the nearest customer point from P.tr have caused overvoltage conditions which is not maintained within the proper limits. Therefore, it is clear that some quality problems in smart grid can be happened ifalarge WP system is introduced to the primary feeder in smart grid system.

Table 4: Customer voltage at the first and end point of P.tr at the end section of D/L with WP of 3[MW]

		Voltage [V] (Using 13,200[TAP])	
Load capacity of total section		The first customer point of P.tr	The end customer point of P.tr
1.5MW	Section 5	232.61	231.29
	Section 6	233.15	231.83
5MW	Section 5	225.82	221.42
	Section 6	226.80	222.40
10MW	Section 5	219.72	210.92
	Section 6	221.32	212.52

B. PSCAD/EMTDC Modeling

Figure9 is the modeling of Kim-Nyoung D/L using the PSCAD/EMTDC, which is divided into 6 sections. The section data of simulation is as shown in Table 5.

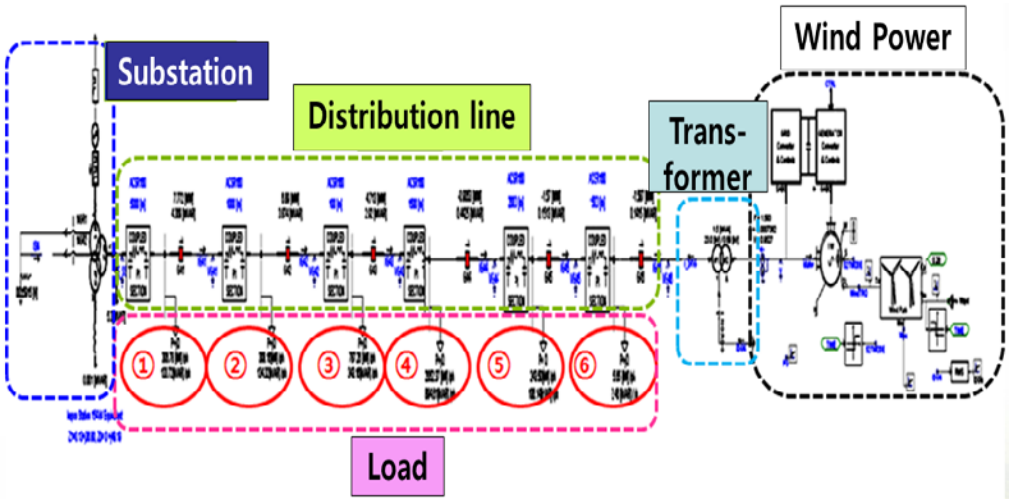
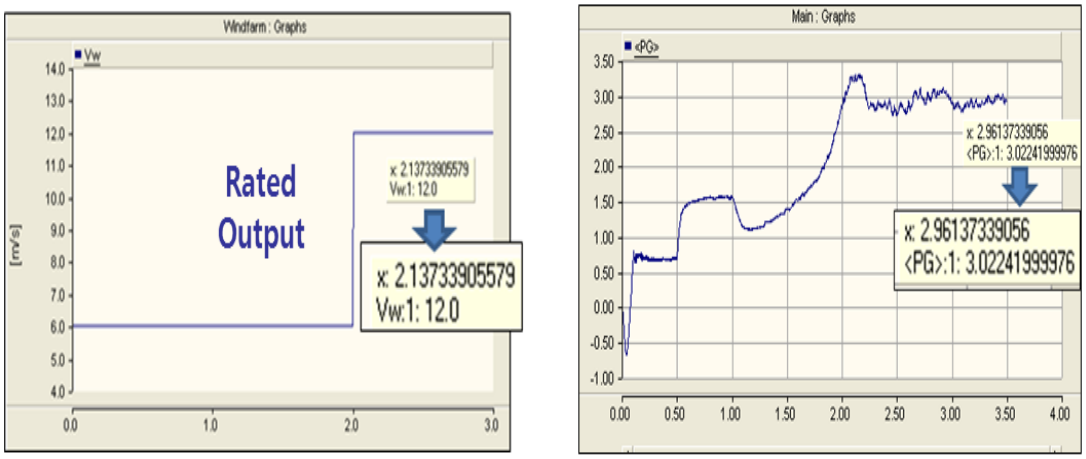


Figure 9: Modeling of Kim-Nyoung D/L

Table 5: Section data of Kim- Nyoung D/L

Bank	% Impedance of Transformer			
	Z12(45MVA)	Z23(15MVA)	Z31(15MVA)	Base
	15.970	6.690	25.380	100MVA
LineConnection	Y – Y – Delta			
Base Line to LineVoltage	22.9[V]			
Power Factor	0.9			
Distribution Line (ACSR160/95)	Positive/ negativephase sequence component :3.47+j7.46 Zero phase sequence component :11.99+j29.26 Section 1: 3.5km, Section 2: 1.0km, Section 3: 0.1km, Section 4: 1.5km, Section 5: 2.0km, Section 6: 1.5km,			
Type of Load	Constant P (1.5[MW], 3[MW], 5[MW])			
Interconnecting transformer	Z =j6(1250kVA) = j480(100MVA)			
Wind Power	DFIG, 1.5[MW], 3[MW], 5[MW]			

When WP system of 3[MW] is interconnected based on the daily load curve which is composed of peak load of 10MW), middle load of 5MW and off-peak load of 1.5MW, Figure10 (a) shows a output characteristics forthe wind velocity ranging 6~12[m/s], and Figure10 (b) is the output characteristic of WP system of 3[MW].



(a) Variation of wind velocity (b) 3[MW] output of WP

Figure 10: Simulation Results Using PSCAD/EMTDC

Figure11 shows voltage characteristics of section 5, 6 in off-peak load (1.5[MW]) when WP system of 3[MW] is interconnected. It is confirmed that the theoretical calculation in Table 4 is identical to the simulation results of PSCAD/EMTDC in Figure11, and then the proposed modeling is practical tool for operation of smart grid. It is also found that the bigger problems of voltage quality can be occurred when a large scale WP system is introduced to primary feeders.

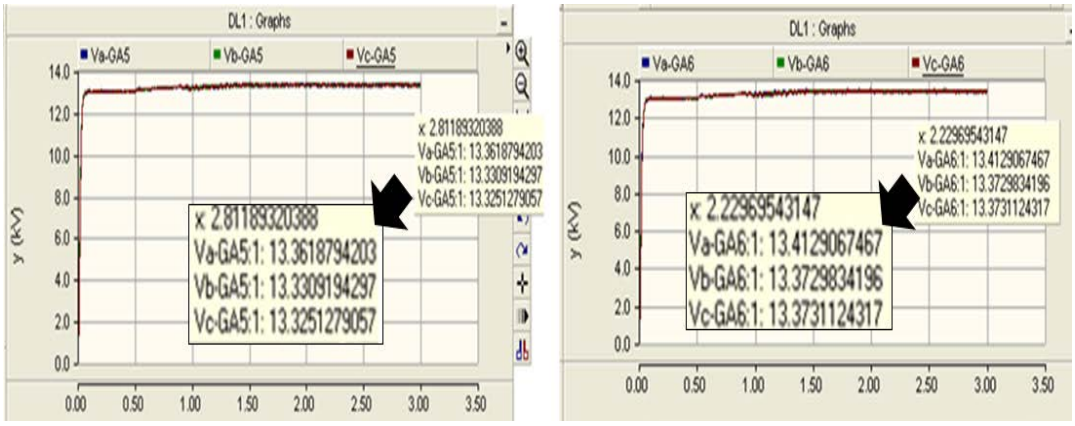


Figure 11: Voltage of Section 5(left), 6(right) in case of light load with WP

IV. CONCLUSION

This paper has modeled field distribution system and DFIG and performed the simulation on the customer voltage characteristics. The simulation results are summarized as follows.

(1) As the theoretical calculation is identical to the simulation results of PSCAD/EMTDC S/W, it is confirmed that the proposed modeling is useful and effective tool for the simulation.
(2) According to operation of the real smart grid system, it is found that the bigger problems of voltage quality can be occurred when large scaled renewable sources such as WP system are introduced to primary feeders in smart grid system.
(3) It is clear that that the proposed approach is useful tool for the countermeasure of power quality problems and issues of smart grid interconnected with renewable sources such as wind power system (WP).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Proposal of a Verification Method for Embedded System Design

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Abstract---

Background/Objectives: With advancements in technology and system miniaturization, modern software is now aiming to develop service oriented software such as Internet of Thing (IoT) and distribution system such as cloud computing.

Methods/Statistical analysis: However, modern software is facing resource limitation when building such new software in conventional single embedded systems. One of the solutions to solve the resource limitation of single embedded system is building multiple embedded systems and limiting number of functions assigned in each system. Since the number of assigned functions on each embedded system is limited, numerous calls between the multiple embedded systems occur when performing a function.

Findings: Due to such numerous calls between the multiple embedded systems, the entire system becomes more complex and as developing such complex system, many products are created during design phase thus increasing the cost of time. Also, as the number of products in design phase increases, development time for implementation phase increases too. As a result, the time required to verify the design is increased greatly. In order to verify system design, this paper conducted a study for automation process of verifying design phase products based on V-Model among other various software development processes. For this study, Gray box based requirements analysis was conducted and limited products of design phase resulting from the analysis was used. Based on the result of the limited products of design phase, an automation system to automatically convert the result to a system model using model converter was built for model checker.

Improvements/Applications: In such way, invested cost of time to enter into integration test on V-model and model verification process was saved and, it was possible to verify suitability of the model through the verification result from Model-Checker.

Keywords---Embedded System, Integration Test, Model-Converter, Verification Automation, V-Model.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Modern software is aiming to develop service oriented software and distribution system for data processing to fulfill user satisfaction[1]. Running such software on conventional single embedded system causes resource limitations[2]. In order to solve such resource limitations, a solution which divides and assigns functions of a single embedded system into multiple embedded systems is proposed[3]. In other words, multiple embedded systems each with limited functions run together organically to run the entire system.

Software composed of multiple embedded systems has distributed functions thus occurrence of numerous calls between each system is inevitable. In other words, the entire system becomes more complex due to large number of calls. As the system becomes more complex, the number of products in design phase increases and as a result, the cost of time to create such products increases. Also, as the number of products increases, the cost of time for implementation increases. Eventually, the increased cost of time in design phase and implementation phase causes increased cost of time for product verification for each phase.

In order to reduce such cost of time, previous studies applied various methods on each software development phase such as Model-Driven Development (MDD)[4,5], and Unified Model Language (UML) to represent the complex system in simpler way. They also used Component-Based Development (CBD) to reduce the cost of time through reusability[6]. However, MMD requires greater time and cost and it can only be used in large scale[2,5]. For UML, lack of user guideline information causes improper use resulting in too high level of abstraction[2,7]. For CBD, it puts great emphasis on implementation phase thus it requires higher cost to be invested[7,8]. Also, there is an implementation problem due to embedded system's characteristic of having both hardware and software components[9].

On this paper, in order to solve the time cost problem caused by call relationships between different embedded systems, a study to automatize integration test by automatically converting products from design phase to System-Model using Model-Converter was conducted. Also, through this study a basis to perform integration test on products of design phase without going through implementation phase was built on a software development process V-Model.

The rest sections of this paper are organized as follows. First, on section 2 the trend of research related to conventional embedded system development is going to be reviewed. On section 3, the proposed method to reduce time cost on V-Model and the composition of Model-Converter are going to be explained. On section 4, the proposed method and Model-Converter are going to be explained by using a small scale software development example. On section 5, based on the proposed method, the actual integration test automation is going to be applied and corresponding result is going to be analyzed. On the last section, section 6, the actual influence of the integration test automation on verification time is going to be verified to reveal the actual contribution of this study.

II. RELATED RESEARCH

On this paper V-Model was used to check the verification time reduction through integration test automation. V-Model is a concept created by integrating and systemizing the fact that test has to be applied throughout the entire development process, not just on the process of finding errors on the codes, with the development process.[10] (Figure 1)

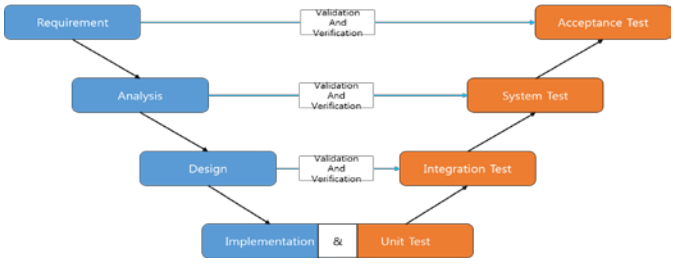


Figure 1: V-Model

Conventional studies usually used development methodology to study system's analysis phase and design phase[11]. For the cases of MDD and UML especially, complex system was represented in abstract model which can be visualized thus helping developers to understand major characteristics of the software[12]. For the case of CBD, MDD and UML were applied on embedded system domain. In case[13], it is proposing a method of specifying requirements based on status of system components and in case[14], among the three main components that together build embedded system, actuator, controller, and sensor, the controller which controls the entire system is suggested to be specified mainly. In case[15], requirements specification by using Gray box based requirement specification and design phase products is proposed and it was confirmed that by using such method it is possible to reduce the required time for system development.

However, when previous studies are applied onto V-Model, analysis phase and design phase products phases are not verified. When system is developed with unverified products, later on when such unverified products cause problems additional development cost and time are produced.

III. SYSTEM DESIGN VERIFICATION USING GARY-BOX MODEL RESTRUCTURING

The limitations on previous studies can be divided into two. First, verification on products from analysis phase. Second, verification on products from design phase.

In this paper, between the two problems the verification problem on design phase is going to be discussed. In order to verify suitability of design phase products, this paper suggests a method of automatizing design phase products verification process to use them directly on V-model without entering into implementation phase. Detailed explanation is described as follows;

First, for verification it is required to define which products among various products in design phase are going to be used. In this paper state diagram through gray-box based analysis model as mentioned earlier in [13] is going to be used. The Gray-box based analysis model is an analysis model in a form of combination between sequence diagram and state diagram. It is designed to check states of components according to message passing of sequence diagram. In other words, it is designed to check whether components can reach to desired state according to message passing.

By using such characteristic of state diagram, it is possible to extract system model which can verify system states and by using mutual cooperation specification and model checker, it is possible to check whether the extracted system model is suitable for the products of design phase.

Second, when converting state diagram created through Gray-Box analysis into system model, there is a problem of connecting each component in state diagram to proper component in system model. In order to solve such problem, tools for state diagram writing and system model verification are going to be selected and common components between the two tools are going to be extracted. Based on the common components, state diagram is going to be converted by using converting tool then it is going to be inserted into system model to process verification.

By using these two methods, the processes of reducing the required time for verification of products of design phase can be summarized as follows;

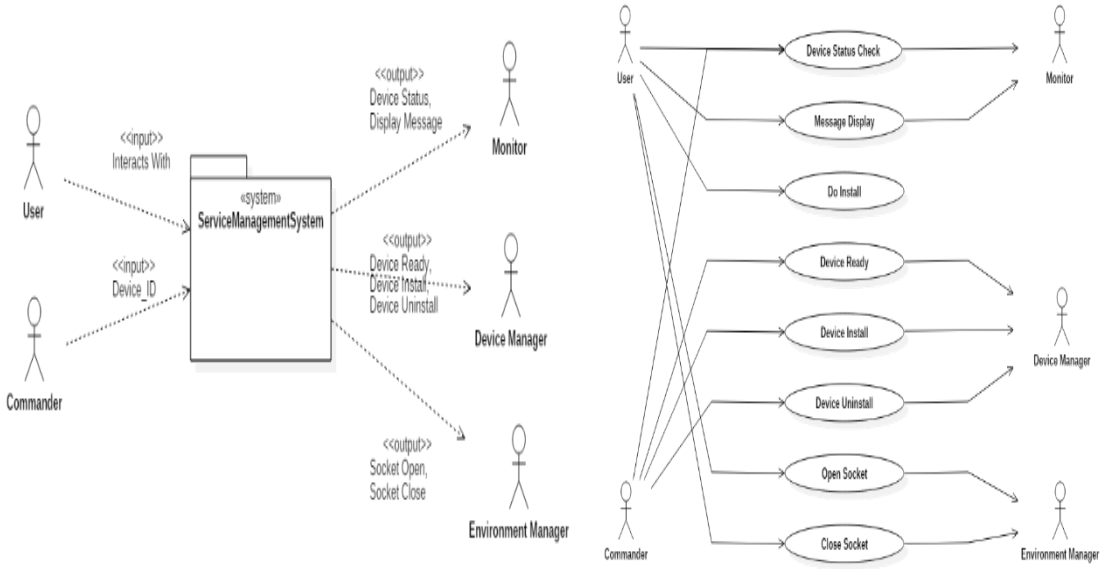
Step 1: Conduct specification in perspective of black box. Specification in perspective of black box uses context diagram, use-case diagram, and use-case specification as defined in[16].

Step 2: Conduct specification in perspective of Gray box testing. The specification in Gray box testing perspective is composed of state diagram, sequence diagram, external interaction scenario specification, internal component cooperation specification, and unit component specification as defined in[15]. However, this study aims to reduce required time for obtaining and verifying suitability of the products by using Gray box analysis model, which is composed of state diagram and sequence diagram, and component mutual cooperation specification thus not every product defined in[15] is used.

Step 3: Convert state diagram into system model

Step 4: Use system model verification tool and component mutual cooperation specification to verify the suitability of the system model.

Among steps 1 ~ 4, the actual time reduction by using automation as proposed on this study takes place in step 3 and obtaining suitability of design phase products takes place in step 4.



(a) Context-Diagram (b) Use-Case Diagram

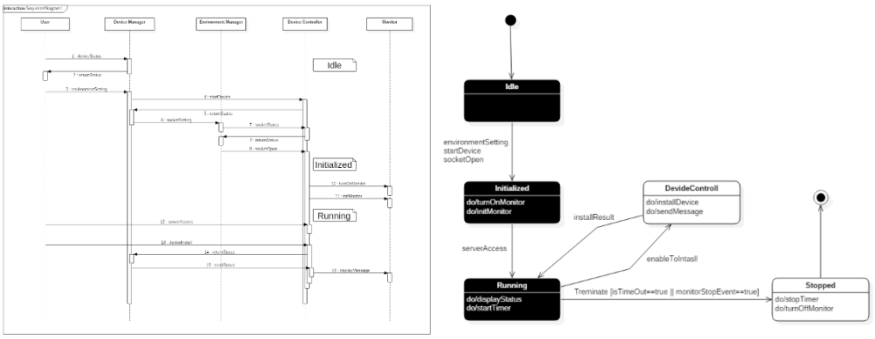
Figure 2: Products Obtained by Using Specification in Black-Box Perspective (Diagrams)

As defined in [16], the specification in black box perspective mentioned in step 1 uses context diagram, use case diagram, and use case specification. (Figure 2) and Table 1 shows the products written by using specification in black box perspective and it has the same specification writing style as conventional use case specification.

Table 1: Gray-Box Analysis Model and System Model's Convertible Components (Use-Case Specification Document)

Use-Case Name	Do Install
Actor	User
Summary	Install the user-entered device.
Basic Flow	1. The user starts this use case by transferring the name of the device to be installed using Terminal. 2. The system installs the user-entered device and passes the installation result to the user. 3. This use case is terminated when the device entered by the user is installed.
Alternative	A1. If the user does not connect within 10 seconds, the use case is terminated. A2. If the user does not transmit the Device name within 10 seconds, the use case is terminated.
Preconditions	The socket is open for chatting.
Postconditions	The message entered by the user is displayed in the Monitor.

Step 2's specification in Gray box perspective conducts verification by using state diagram, sequence diagram, and component mutual cooperation specification among various products defined in [13] thus by reducing the usage of products the required time to obtain and verify suitability of products can be reduced. (Figure 3) used conduct result from step 1 to write controller's state diagram and sequence diagram.



(a) Sequence-Diagram (b) State-Diagram

Figure 3: Sequence Diagram, State Diagram

In step 3, as shown on Table 2, the required time for product verification can be reduced by automating model writing for system model verification using model converter which automatically converts models by using Gray box analysis model and system model's convertible components.(Figure 4)

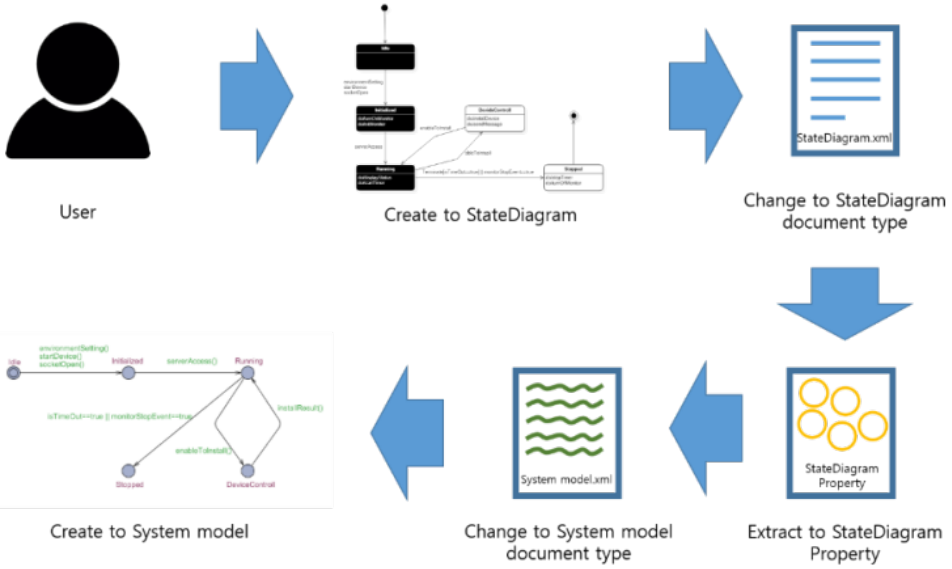
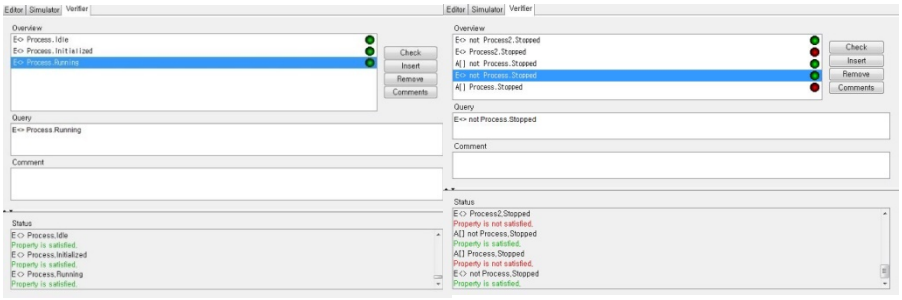


Figure 4: Model-Converter Operation Process

Table 2: Gray-Box Analysis Model and System Model's Convertible Components

	State Diagram (StarUML)	System-Model verify Tool (UPPAAL)
File type	XMI	XML
state	<subvertex> State id, State name	<transition> name
Message	<transition> state id, message id, message name	<transition> message name, label
Message Property	<transition> guard, specification	<transition> label kind, label message
Source	<transition> source	<transition> source ref
target	<transition> target	<transition> target ref

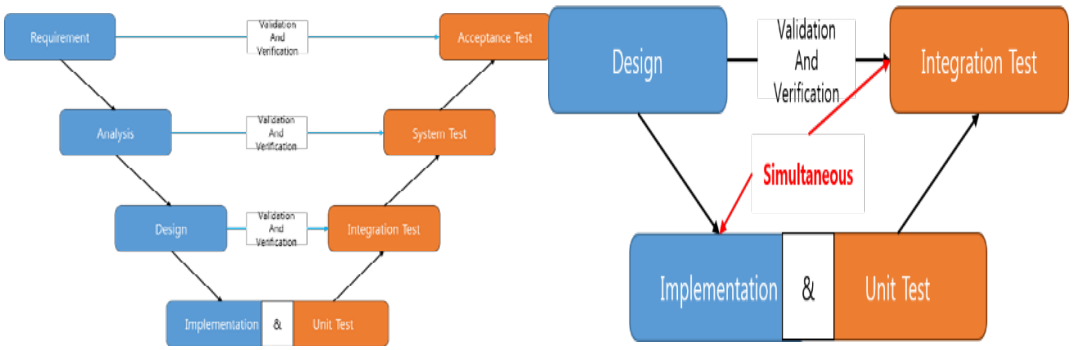
In step 4, automatically converted system model is verified by using system model verification tool to obtain suitability of system model which is built based on design phase products.(Figure 5)



(a) Satisfied (b) Not Satisfied

Figure 5: Model Verification Result of System Model Verification Tool

In other words, through such steps the time required to reach integration test can be saved by skipping other phases in V-Model.(Figure6)

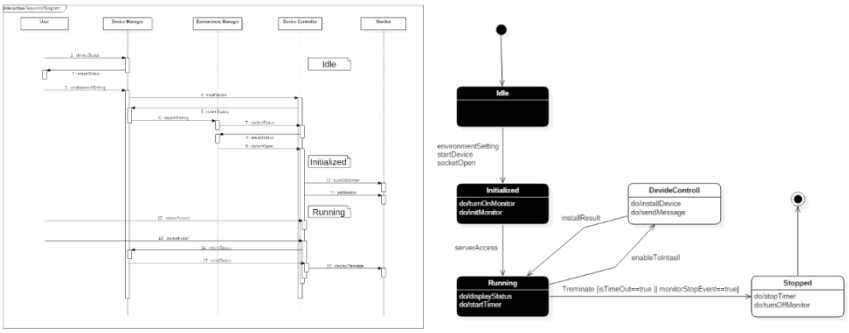


(a) General entrance phase (Sequential) (b) Entrance phase based on this study (Simultaneous)

Figure 6: Integration Test Entering Process of V-Model

IV. CASE STUDY: OSGI SERVICE MANAGEMENT SYSTEM

In order to assess the design verification method proposed by this paper, such proposal was applied onto device installer module of a service management system which uses OSGi.



(a) Sequence-Diagram (b) State-Diagram

Figure 7: Sequence Diagram, State Diagram

(Figure 7) is a Gray box analysis model extracted through step 1 ~ 2 and status information of message controller which was already distinguished is expressed on sequence diagram. According to (Figure 7-a), on device manager an environment Setting message created by certain action is sent to device manager. In order to run device installer module, device manager sends module run command to device controller through internal startDevice event. Environment Manager sends socketOpen event to device controller for chatting. Device controller processes the received event and as a result, it can be observed that the system status is changed from idle to initialize. Based on the state diagram written in such way (Figure 7-b), the component mutual cooperation specification Table 3 and system model (Figure 8) are going to be written and the written

model is going to be converted by model converter. Then, system model which is supported by model checker tool is going to be automatically written and such system model is going to be verified through model checker tool. As a result, the written model's suitability can be verified according to (Figure 9).

Table 3: Component Mutual Cooperation Specification

Source	CurrentState	Condition	Stimuli	Transformed state	Destination	Verify result
Device Manager	Idle	None	StartDevice	Idle	Device Controller	
Environment manager	Idle	None	SocketOpen	Initialized	Device Controller	
Device Controller	Initialized	None	TurnOnMonitor	Initialized	Monitor	
	Initialized	None	InitMonitor	Running	Monitor	

Verification result is equivalent to (Figure 9) and result from model checker tool is going to be recorded on verify result in Table 3.

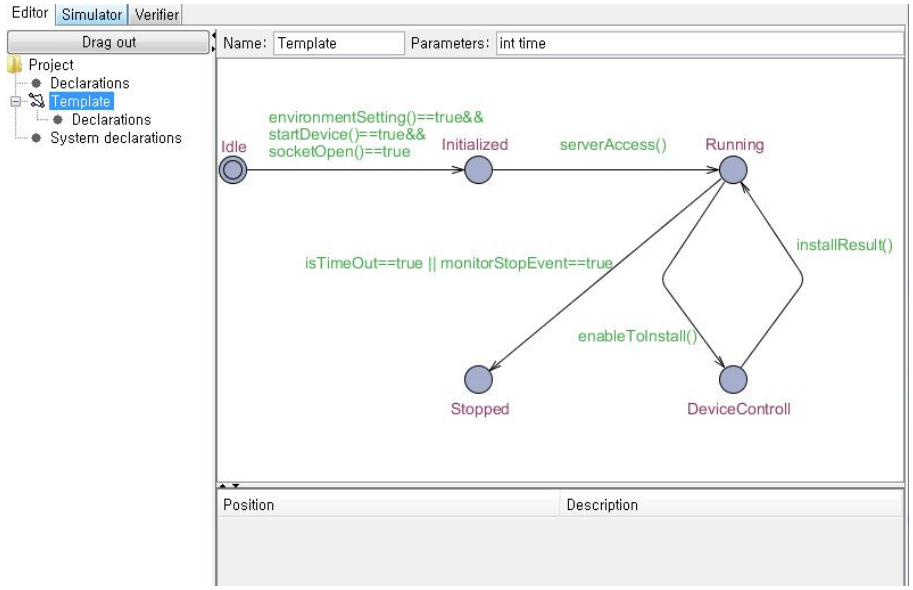


Figure 8: System-Model

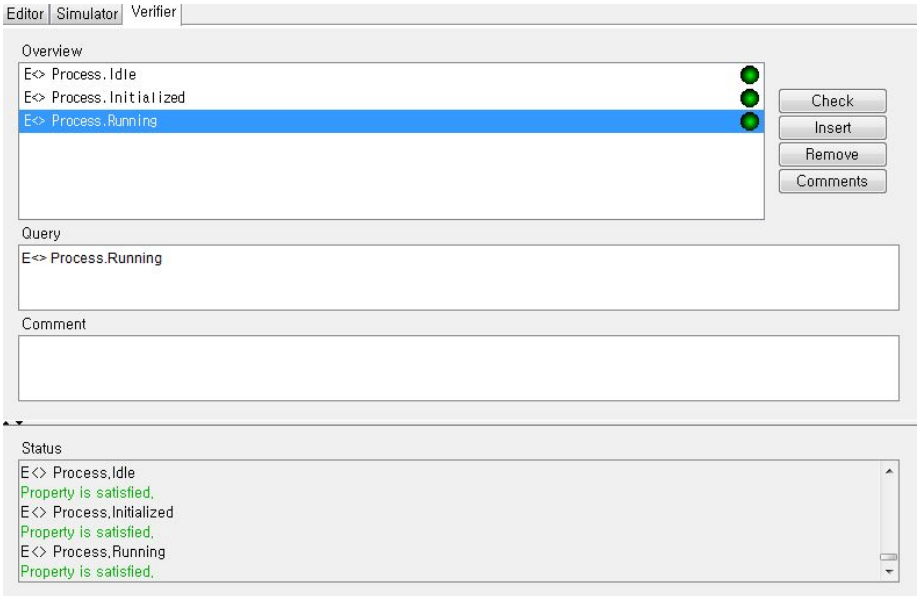
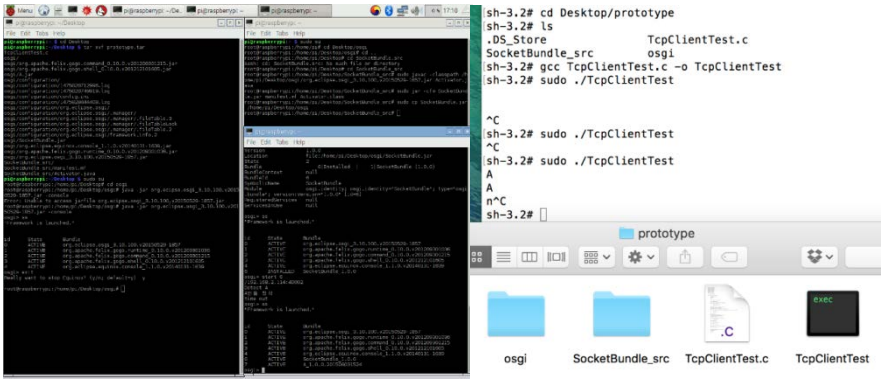


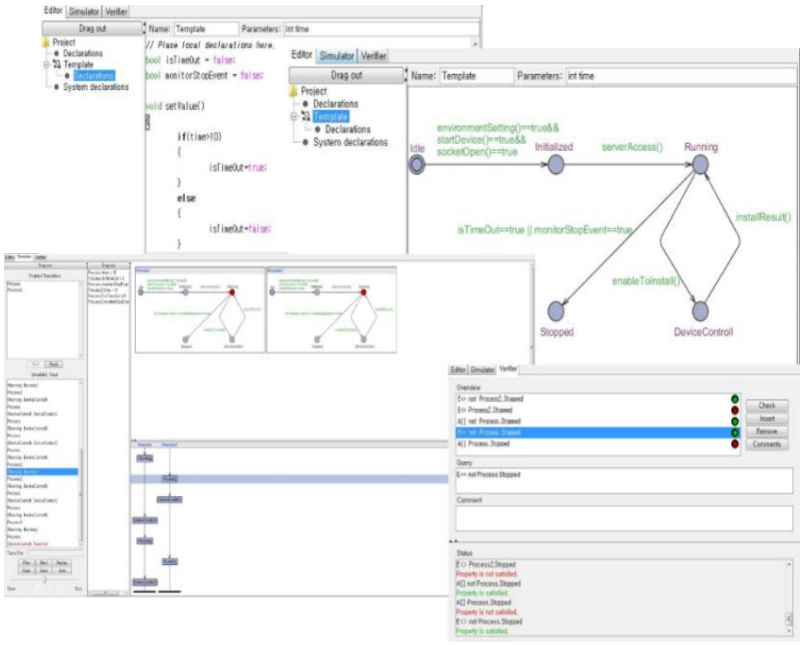
Figure 9: Model-Checker Tool Result

V. EVALUATION OF RESULT

Software written based on case study is shown in (Figure 10-a) and the hardware where the corresponding software was run is Raspberry Pi3 and OS was RASPBIAN JESSIE ver. September 2016.



(a) OSGi Service Management System (b) User



(c) Result

Figure 10: Case Study Result

Table 4: Effects of Automation

	V-Model	Proposal	Description
Design phase	10 hour	10 hour	Equivalentworking
Implementation phase	8 hour	8 hour	Equivalentworking
Integration Test phase	40 min	25 min	Time decrease(be caused by automation)
Design error early discovery support	X	O	Advance Integration test phase(be caused by automation)

For software implementation phase based on case study, it took 8 hours and for design phase, it took 10 hours. And, for integration test it took 40 minutes.

The application of automation process on system model writing for integration test took 25 minutes. As a result, for integration test there was 15-minute time benefit and since the entire implementation phase was skipped, total 8 hours and 15 minutes of time benefit was acquired and also it was possible to find design errors before entering into implementation phase Table 4.

VI. CONCLUSION

This paper was able to make two contributions through its proposed method for embedded system design verification.

First, it confirmed that it is possible to verify design phase products without entering into V-model's implementation phase by using products of Gray box requirement specification method such as state diagram, component mutual cooperation specification, UML tool, and system model checker tool. In other words, it confirmed that before entering into implementation phase, by checking design suitability it is possible to reduce possible design errors.

Second, by automatizing creation of system model, which is required for verification of design phase products, it confirmed that automation of integration test is possible and required time for such step can be saved.

However, there are problems such as limited range of reference data for the case study's design and implementation phases. Also, when using system model verification tool user is required to have basic knowledge on writing source codes and queries to verity models thus the user has to spend additional time to write such codes and queries.

Furthermore, for automation process positional modification of system model is required to obtain visibility of resulting system model which is converted from state diagram. Also, simulations have to be ran manually.

For future research, in order to solve such problems enough data should be gathered from expanded case study and case study organizations. We are also planning to conduct a study on making source code of system model verification tool and automatizing simulation run and query generation.

ACKNOWLEDGMENT

This research was supported by The Leading Human Resource Training Program of Regional Neo industry through the National Research Foundation of Korea(NRF) funded by the Ministry of Science, ICT and future Planning(No.NRF-2016H1D5A1909989)

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

A Study on RF Cavity Filter Miniaturization Ceramic Resonator

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Abstract---

Objectives: As the configuration of base stations changes, the miniaturization of a filter has become an essential requirement for communication system. Therefore, we have conducted a study to miniaturize a filter.

Methods/Statistical analysis: In this paper, we have designed a resonator by using ceramic to minimize its size. Moreover, a duplexer filter of a cellular band was designed and manufactured. The manufactured sample of the filter was measured for the comparison of the performance and the results were compared and analyzed with the conventional metal cavity filter.

Findings: The cavity filter utilizing ceramic was designed to have the return loss ≥15dB, the attenuation ≥85dB, and insertion loss ≤3dB at 824MHz ~ 894MHz band, which is the cellular band. The manufactured ceramic resonator filter had the return loss of 18dB, the attenuation of 85dB, and insertion loss of 1.8dB~2.4dB. It had similar characteristics with the conventional metal cavity filter, while its size and weight was less than half comparing to the conventional metal cavity filter.

Improvements/Applications: This study results will be able to miniaturize the filter for the small-power base station and small cell.

Keywords--- Ceramic, Filter, Resonator, Duplexer, Dielectric Resonator.

* *Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Due to the spread of smart devices such as smart phones and smart pad, the amount of data transfer among communication devices has increased drastically. Particularly, the amount of data transfer increases in a highly populated region increases further explosively. Consequently, the number of high-power base stations, which was used in the previous generations of the telecommunication, is maintained or reduced while those of medium- or low-power base stations are rapidly growing.

In addition, the development of the Internet of Things (IoT) is expected to increase the number of devices with built-in communication chip, which will cause the data traffic to be increased even further. Therefore, it is projected that the 5th generation (5G) telecommunication, which is expected to be commercialized by 2020, and IoT will increase data transmission by 1,000 times than the conventional 4th generation telecommunication and the rate of contact per base station per time more than 1,000 times. Various technologies have been developed to transfer and process more data.[1]

Thus, the base station of 5G, which is expected to be commercialized in the year of 2020, uses Carrier Aggregation (CA) and Heterogeneous Network (HeNet) and the configuration of the base station is expected to be changed into the forms such as Small Cell and Distributed Antenna System (DAS).The CA technology is a data processing technology and it allows using many frequency bands as a group. The HeNet technology binds networks utilizing different protocols.[2]

The configuration of the base station will be changed to Small Cell, Distributed Antenna System (DAS), which decreases the use of high-power based station, covering a large area, and increase the number of medium- and small-power base stations to establish a dense coverage area.[3]

Figure 1 shows the coverage area and output depending on the base station configurations.

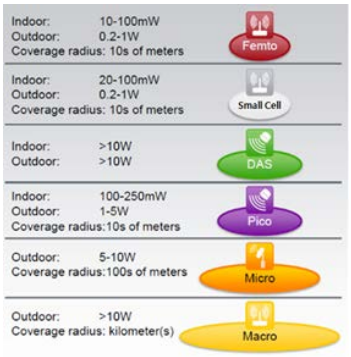

Figure 1: Coverage Area and Output by Base Station Type

Figure 2 shows the density of the base station's coverage area used by the telecommunication base stations.

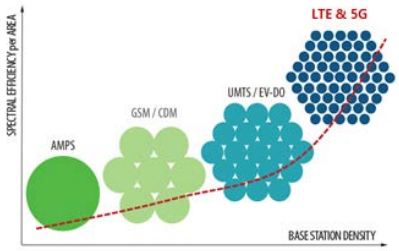

Figure 2: Coverage Density by Mobile Communication Base Station

As the configuration of a base station is changed to small cell and DAS types, it became essential to miniaturize the filter, which should be fitted in a smaller base station.[4]

This paper describes the conventional ceramic filters and introduces a new method to miniaturize a filter by using ceramic.

II. MATERIALS AND THEORY

A. General Filter Theory

A filter in the telecommunication passes through only desired frequency components among many frequency components and attenuates other unnecessary signals.

To only pass desired frequency component, it requires a resonance composed of "L", an inductance component, and "C", a capacitance component. The combination of these two can pass a designated frequency value or filter the frequency (Figure 3).

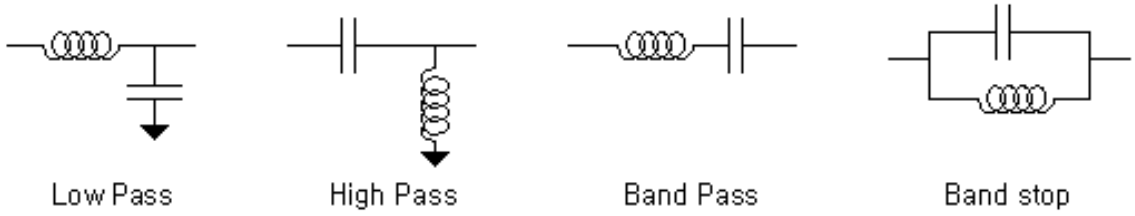

Figure 3: Base Filter Equivalent Circuit

To compose a filter, the order is as important as the combination of "L" and "C". The order of a filter determines the shape of the passing characteristic and the attenuation characteristic. However, the characteristic and the size have a trade-off relationship. The better characteristic increases the size of a filter, which is a weakness.

A filter can be classified into three types depending on the configuration of a filter. They are lumped element filter, planar filter, and Cavity filter types.

- The Lumped element filter: The simplest resonator structure that can be used in RF and microwave filters is an LC tank circuit consisting of parallel or series inductors and capacitors. These have the advantage of being very compact, but the low quality factor of the resonators leads to relatively poor performance. Lumped-Element LC filters have both an upper and lower frequency range. As the frequency gets very low, into the low kHz to Hz range the size of the inductors used in the tank circuit becomes prohibitively large. Very low frequency filters are often designed with crystals to overcome this problem. As the frequency gets higher, into the 600 MHz and higher range, the inductors in the tank circuit become too small to be practical. An inductor of 1 Nanohenry (nH) at 600 MHz isn't even one full turn of wire.
- The Planer filter: Microstrip transmission lines (as well as CPW or stripline) can also make good resonators and filters and offer a better compromise in terms of size and performance than lumped element filters. The processes used to manufacture microstrip circuits are very similar to the processes used to manufacture printed circuit boards and these filters have the advantage of largely being planar. Precision planar filters are manufactured using a thin-film process. Higher Q factors can be obtained by using low loss tangent dielectric materials for the substrate such as quartz or sapphire and lower resistance metals such as gold.

The Cavity filter has a very good characteristic but it is only used in a large base station because it is large and heavy.[5-6]

A Cavity filter is composed of a feeder, a cavity, and a resonator. A pole consists of a cavity and a resonator. As binding multiple poles, it creates a band to make a filter.

A cavity, a resonator, and the order of pole determine the size of a filter. Therefore, in order to miniaturize a filter, it is necessary to reduce the order of a pole or decrease the size of a cavity or a resonator.

To reduce the size of a cavity and a resonator, it is possible to change the shape of them. Moreover, there is a way to alter the dielectric constant by using the following equation (1). A higher dielectric constant can form low-frequency resonance. It indicates that, when forming an identical frequency resonance, a higher dielectric constant can make a smaller resonator.[7-10]

$$f = \frac{C}{2\pi\sqrt{\mu\varepsilon}} \qquad (1)$$

B. The Design of a Resonator

The basic design of a resonator is a cylinder shape or a square column shape. In order to miniaturize a resonator, it is required to either change the shape of a resonator or increase the dielectric constant following the equation (1). The dielectric constant can be increased by surrounding a square column shape or a cylinder shape resonator with a material having a higher dielectric constant than a conventional material. The size and weight of a resonator can be improved by plating silver conductive filmon the top, the bottom, and the through-hole of a resonator (Figure 4).

Figure 4: Structure of Ceramic Resonator

By coating a conductive film on the top, the bottom, and the through-hole of a ceramic base, it maintains the same wave mode of the conventional metal cavity with decreasing the size of it.

C. Ceramic Resonator Filter Design

A ceramic resonator filter has the same circuit design process with the conventional metal cavity filter, which contains the conventional metal resonator, because it uses the same propagation mode with it.

To compare an 800MHz duplexer with the conventional metal cavity filter, a filter was designed by using 8 orders of each Rx/Tx upon the same filter design method.

Depending on the filter design method, a circuit diagram such as Figure 1 can be formed.

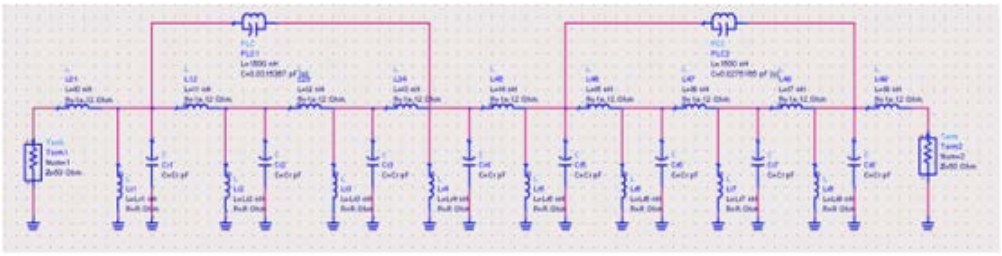

Figure 5: Duplexer Schematic

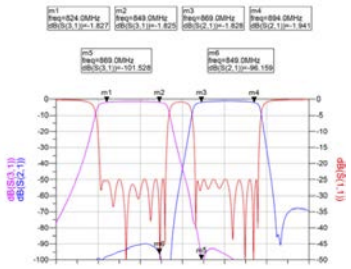

Figure 6: Simulation Results of Duplexer

Figure 6 is the result graph of Figure 5. At the 800MHz band, the insertion loss becomes 1.94dB. Moreover, the return loss is -25dB.

If an 800MHz duplexer is made by using the above design, it will be composed like Figure 7.

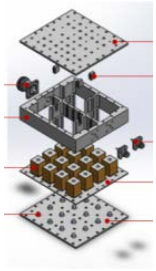

Figure 7: Structure of Duplexer

When the manufacturing process of a ceramic resonator filter is evaluated, it will have the following assembly process order as shown in Figure 7.

First, apply solder cream for soldering on a ceramic resonator. Afterward, place it on a conductive substrate and combining the resonator with the conductive substrate by heating.

Secondly, combine a housing body connector with a bottom board

Thirdly, assemble a cover and a tuning bolt.

Fourthly, tune the assembled filter.

III. RESULTS

A. Test Result

The ceramic powder used for manufacturing a filter had dielectric constant 90. The RF characteristics were measured by using the Network Analyzer (E5071C), Key sight Technologies.

Figure 8 is the inside picture of the manufactured 800MHz duplexer. The inside of the housing and the top, the bottom, and the through-hole of a resonator were silver-plated.

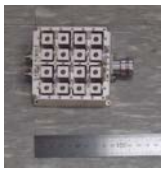

Figure 8: Design of Duplexer

Figure 9 is the measurement result graph.

Rx Band graph shows the insertion loss of 1.8dB. Moreover, the return loss was 18dB. The attenuator value of Tx Band was 85dB.

Tx Band graph shows the insertion loss of 1.8dB. Moreover, the return loss was 18dB. The attenuator value of Rx Band was 85dB.

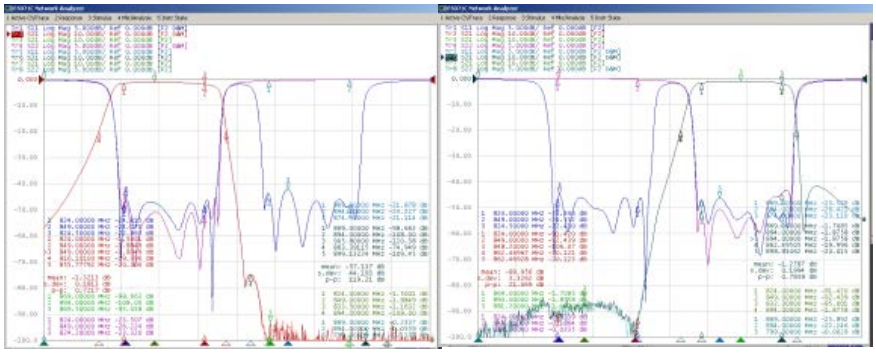

Figure 9: Measured Results of Duplexer

Table 1 shows the measurement results. They were compared with those of a metal cavity filter. When two values were compared at Rx Band 824-849MHz and Tx Band 869-894MHz. The return loss was 18 and 18dB for the metal cavity filter and the ceramic resonator filter, respectively. It was confirmed that two filters had a similar value. For the attenuator, the metal cavity filter and the ceramic resonator filter had 85 and 85dB, respectively. For the insertion loss, the metal cavity filter and the ceramic resonator filter showed 1.5 and 1.8~2.4dB, respectively.

The sizes and weights of two filters were compared. The metal cavity filter had the size of 157x196x40 [mm] and the weight of 1.530g. In comparison, the ceramic resonator filter showed the size of 90x90x26 [mm] and the weight of 495g.

The unit resonator of the metal cavity filter was circular 15x25 size, while that of the ceramic resonator filter was square 12x12x14 size.

Table 1: Comparison of Metal Cavity Filter and Ceramic Cavity Filter of Duplexer

	Metal Cavity Filter	Ceramic Cavity Filter
Frequency(MHz)	800	800
Insertion Loss(dB)	1.5	1.8~2.4
Return Loss(dB)	18	18
Attenuator(dB)	85	85
Size(mm)	157x196x40	90x90x26
Weight(g)	1,530	495
Resonator Size(mm)	15*25	12x12x14

IV. CONCLUSION

This study manufactured an 800MHz Band filter by utilizing the dielectric resonator, made by a ceramic filter. It had a slightly poor loss characteristic compared to the conventional metal cavity filter. However, it had similar return loss and attenuator characteristics with the conventional metal cavity filter. Moreover, the size and weight of a filter were less than half of the conventional filter.

Unlike the conventional resonator composed of only metal or only ceramic, the ceramic resonator was made by coating ceramic with the conductive film. The weight of the ceramic conductor was less than half of that of the DR or that of the metal resonator, where the DR was made by ceramic only.

Therefore, the new design will meet the requirements for the small-power base station, which is less than half in size of the conventional product and has similar characteristics with the conventional cavity filter.

However, it has slightly lower insertion loss compared to the metal cavity filter. It will be necessary to compensate the loss by amplifying the gain at the front-end or at the rear-end.

Since there will be a limit to compensate the gain in the base station, further studies are required to improve the loss of the ceramic resonator filter.

ACKNOWLEDGMENT

This research was financially supported by Hansung University.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Integrated ECA System with Limited Perception Sufficient for Generating Agent Human-like Movement

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Abstract---

Background/Objectives: Grounding language understanding in an embodied conversational agent (ECA)'s virtual space involves spatial situation awareness and human-like movement. For spatial situation awareness and movement, this paper describes how to construct an ECA that integrates language understanding with limited perception-based mapping, spatial awareness reasoning, path finding, and human motion style.

Methods: A realistic perception in the research about virtual human has been simplified and disregarded by using an omniscient perception-based entire map. Also, much research has addressed a conversation requiring spatial situation awareness. Thus, for the integration, the previously developed research related to perception, cognition, and motor was referenced and adopted in the ECA components of the integrated system as ECA requirements.

Findings: The result in this paper addresses that the human-like movement behavior can be accomplished by the integrated ECA system equipped with the mapping that enables spatial situation awareness and does not require the omniscient perception. Compared to the full map-based mapping, the local map-based one in this paper can have efficiency in computation. The computational efficiency is related to localization. The localization problem can be resolved naturally in the process of local map production.

Application/Improvement: Demonstrating an ECA's rich conversations involved with movements may require a complex reasoning. Adopting a symbolic cognitive production system into the integrated ECA system will facilitate the reasoning complexity.

Keywords--- Situation/Context awareness, Virtual Human, Mapping, Path Finding/Planning, Spatial Reasoning.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

This paper describes how to generate an embodied conversational agent (ECA) that integrates language understanding with limited perception-based mapping[1], spatial awareness reasoning, path finding, and human motion style (i.e., actions in BDI 2013[2]). Grounding language understanding in an ECA's virtual space involves spatial situation awareness and human-like movement. For example, in the Mission Rehearsal Exercise, a military simulation, a human platoon leader orders an ECA to secure a med-evac helicopter landing-zone (LZ) located in a remote place, by saying "secure the LZ"[3]. To secure the remote LZ, the ECA needs to take the conversational construct of the LZ and translate this into a spatial concept grounded in the environment. In addition, the problem of how the ECA moves to the identified LZ has to be resolved.

For the LZ spatial concept identification, the ECA needs to perform a spatial representation (i.e., mapping) related to the spatial awareness. Based on the mapping, the LZ spatial concept (i.e., spatial awareness reasoning) is identified by ECA. For the ECA movement, the ECA needs to find a path (i.e., path finding) by mapping and spatial awareness reasoning. On the found path, the ECA needs to demonstrate a human motion style. Then, the motion style (e.g., tactical locomotion in FM 90-1-1)enables the leader to recognize the ECA's tactical situation and the ECA to maintain its existence from a dangerous situation. Thus, ECA human-like movement behavior can be established in an integrated system of the modules such as mapping, spatial situation awareness, path finding, and human motion style. However, little research has been performed on providing an integrated system with the modules.

In military or robot simulations[3-8] and computer games[9-10], a realistic perception has been simplified and disregarded by using an omniscient perception-based entire map. Also, the previous simulations and games have not designed to support the conversation about spatial situation awareness. Instead, every placement node is annotated to indicate nodes reachable from the placement node at the time when a 3D virtual model designer constructs a virtual environment. However, annotating each node as reachable to every other node is time-consuming and impractical[9]. By the spatial cue annotation, the designer cannot predict in advance all the possible behaviors in a dynamic environment. Furthermore, for the spatial situation awareness, annotating all the spatial semantic information to the placement nodes is impossible.

While describing the integrated ECA system construction, the result in this paper addresses that the human-like movement behavior can be accomplished by the ECA system equipped with the mapping that enables spatialsituation awareness and does not require the spatial cue annotation for the perception.

For the integration, developing a unique theory for each module can be daunting work. Instead, the previously developed research[11] was referenced and adopted in the ECA components (i.e., perception, cognition, and motor) of the integrated system as ECA requirements (Figure 1). For the result, human-like movement behaviors involving the LZ identification were presented (section 6).

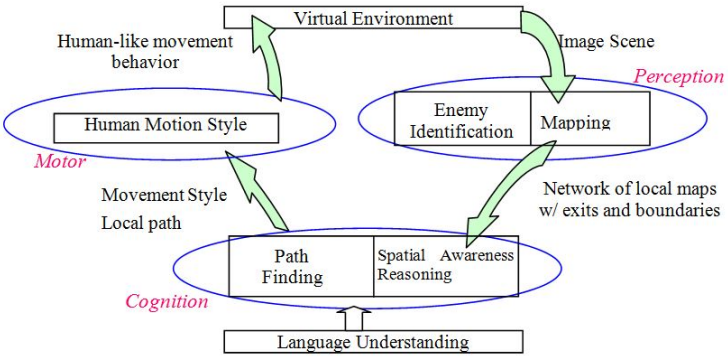

Figure 1: The Integrated ECA System Overview

Figure 2: A Street View of a Simulation Setting

Figure 3: A ECA's Internal View

II. MAPPING

Spatial situation awareness existing in a conversation construct results from an ability to define and represent a space by perceiving and exploring the space surroundings. Thus, mapping is a prerequisite for space identification and ECA movement inherent in the conversation construct. The mapping module described in Hill et al. research[1] was applied in this research. The ECA performed them aping with limited perception (i.e., 110 degree FOV and occlusion by wall) and local map-based mapping methodology. Also the mapping did not require placement nodes with the spatial cues.

A. Local Map Construction

To construct a local map, major characteristics of the mapping were to perceive and define a local space (i.e., local map) and exits between the local maps. The 2-1/2D sketch of a scene12 was used as input. The sketch was the set of boundary edges with depth information. To produce the sketch, an arbitrary number was assigned to each set of polygons corresponding to a building, a ground, and an outer wall (Figure 3). Using standard edge detection techniques and using graphics z-buffer, only visible edges between the ground and the buildings and the ground and the outer wall were identified by the assigned number (i.e., color). The edges were stored in an ordered list.

Exits were calculated where occlusions occurred. For example, exit1 in Figure 4 (a) was the shortest virtual line between the end point on one of next edges in the list and a circle-marked occluding vertex[1].The exit would be calculated as a doubtful exit if the point was the occluded vertex in the relationship of occlusion. Otherwise, the exit would be a doubtless exit. Because ECA's field of view changed, the doubtful exit would turn into as a doubtless one or the length of the doubtful exit would be longer. If the ECA crossed an exit into a new space, then a new local map would be constructed and simultaneously connected into a set of local maps, i.e., a full map.

B. Residue Map Construction

The mapping process was not confined to an ECA local space, including the space (e.g., space on the other side of exit1 in Figure 4 (a)) which had been disregard at the step of the local map construction. ECA behavior could be influenced by the information provided through what was seen down the exit even before the ECA physically entered the new local space. The output of mapping what was seen down the exit was called a residue map. The space over exit1 could be incorporated as a residue map near the ECA position in Figure 10 (b).

When the ECA went through an exit into the new space, the ECA produced a temporary local map for the space. Between the previously produced residue map for the space and the temporary local map, the ECA system selected the map with total size of doubtful exits being small as the local map of the space. Thus this residue map provided in advance local information and facilitated the ECA obtaining less doubtful information about a space.

C. Mapping Examples

In the maps, as in Figure 4, Figure 9 (b), and Figure 10 (b), dotted lines indicated doubtful exits, thin lines indicated doubtless exits, and bold lines indicated boundary edges (i.e., walls). Small dots indicated the ECA locations and big rectangular dots indicated the identified LZs. The enemy location was not displayed on the maps.

Figure 4 show that the ECA could reach the LZ (an area over exit1 in Figure 4 (a)) by this limited perception-based mapping without additional information (e.g., spatial cues with reachability or cover point). Figure 4 (a) was the snapshot immediately after the detour from the space of local map #1 into the space of local map #2, because of an enemy (located near the LZ space). Figure 4 (b) was the plane view of all the local maps that the ECA incrementally produced in order (from local map #1 to local map #4) until the ECA reached the LZ.

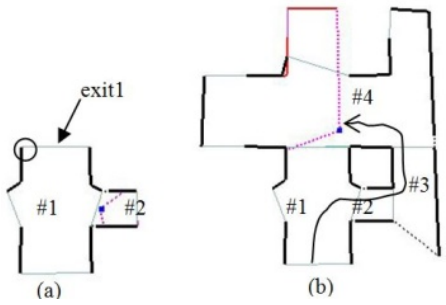

Figure 4: Local maps: the current FOVs were added with dotted red lines from the ECA's location. The circle in (a) Shows an occluding vertex. The ECA's trace is shown by the long arrow in (b).

The local space definition with low-level spatial concepts (i.e., doubtful exit, doubtless exit, and wall), identified by this mapping module, can be used for spatial situation awareness. If the platoon leader (standing in local map #1) orders an ECA to secure the local space where he resides, by saying "secure this region", then the ECA can successfully recognize local map #1 as "this region" by the local space definition technique in this mapping module. Indeed, without the technique, "this", one of the most frequently used demonstrative pronoun cannot be functioned in a conversation construct.

III. SPATIAL AWARENESS REASONING

Only with the low-level spatial concepts used to construct local maps, the ECA cannot understand meanings of complex spatial concepts such as the LZ. Thus, to identify a LZ and to locate the ECA it in the LZ are facilitated by extracting high-level spatial concepts related to the LZ. A high-level spatial concept (e.g., detour route; street; lane of approach) can be composed of all the compound spatial-information produced by low-level spatial concepts.

Spatial features in the current local map were analyzed when the final waypoint in a locally found path was reached and the local space with the final waypoint had been previously unvisited. The problem domain we are dealing with is a well-organized urban setting with streets organized into a grid pattern (Figure 2). The content of spatial awareness reasoning is based on common sense related to spatial rules aboutside street, main street, intersection, side exit, and main exit that were inseparable high-level spatial concepts. Thus, the landing zone in the urban setting was analyzed with those concepts.

Being based on the local maps, the spatial concept resided inside the map was considered as a side street (Figure 5 (c))ifat opposite sides there are only two exits in the local map. The local map became a main street if exits in the long sides are smaller than ones in the short sides (Figure 5 (d)). Intersection seems to be defined as a configuration with 4 streets: each one being perpendicular to each neighboring one, or with 4 exits: each one residing in each street. In the simulation setting, main exit was defined by the exit in the intersection reasoning. Similar-sized exits were firstly paired in order to define the main exit. When 2 sets of exits were identified the exits in the set with the longer one could be identified as main exits.

Because urban structure is mostly well organized, the reasoning module even with disregarding all the 4 exits produces the identification of intersection when two main exits were about 90 degree to each other (Figure 5 (a)) or located approximately in parallel within a similar distance compared with the length of the identified main exit (Figure 5 (b)). Because in urban environment most of intersections and main streets are in contact, the circle curve in figure 5 (e) was also identified as intersection during the main street reasoning process.

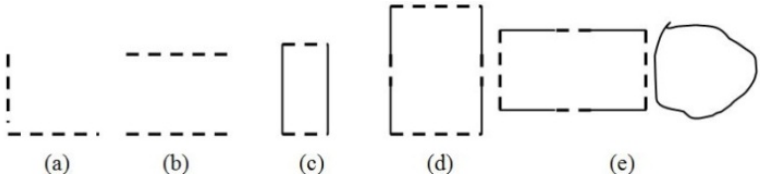

Figure 5: Topologies Used for Spatial Reasoning Rules: Dashed Lines Indicate the Exits, and Straight Lines Indicate Walls

IV. PATH FINDING

The execution of the LZsecuring in the conversation requires an ECA to plan and follow a path. In the research of this paper, the process of next exit selection occurring when entering into a new local space was considered to be same as path finding methodology. Once the next exit was selected, the path finding was reduced to a problem of computing and selecting control points i.e., waypoints to cross the exit into new local space. Only least waypoints (e.g., 1 ~ 2 waypoints) were used if the incremental path-finding paradigm was observed.

A. Selection of Next Exit

The selection parameters for next exit to enter into a new local map were needed when the ECA approached a computed waypoint, identified the goal, and/or recognized that the selected exit was threatened. If enemies were in the ECA FOV and were not occluded by any wall in the local map, then the enemies were threatening the ECA (Figure 7). The exit near the threatening enemy was considered to be dangerous. The next exit was selected by the module with the A* algorithm and the 3 parameters (Figure 6). The fact that the ECA could remember the local information in a local map was assumed. Thus, all the exits in the local map could be used for this next exit selection module. When the ECA had not identified the goal position, the longest exit in the ECA FOV was selected because an intersection seems to be likely located near the longer exit or the exits behind the ECA were merely dangerousor justcrossed.

```
With safe exits in current local map
If Goal exists then do A* with
Min{f(x) = g(x) + h(x)}
Else
   If all exits in agent FOV
then select  the largest exit
```

Figure 6: An Algorithm for the Next Exit Selection

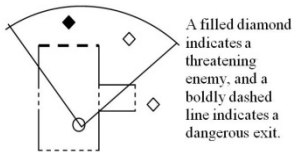

Figure 7: Exit Safety Test

B. Selection and Computation of Waypoint

The waypoints' 6 candidates were computed around the selected exit (Figure 8): two around each end vertex and two around the center of the exit. Two situations were considered: one with an enemy threat, the other without the threat. In case without enemy threat, the path finding module selected waypoints around the exit center to give the ECA a bigger view about the next local space . In contrast, if there was an enemy threat in the ECA FOV (Figure 8), waypoints leading into a spot near the wall (that provides a better cover from the enemy position) were selected based upon relative positions of the ECA i.e., ECA_D, ECA_I, and ECA_S to an enemy. For the relative position computation, the path finding module draws 2 long normal lines to the exit, each line at each end vertex. Then the 2 lines divided the local map into 3 subspaces. If the ECA was located inside the subspace between the two virtual lines where each one perpendicular to the exit was formed by 2 waypoints, the ECA_I waypoints were selected. Otherwise, if the ECA was in same subspace as the enemy, then the ECA_S waypoints were selected. Otherwise, the ECA_D waypoints were selected.

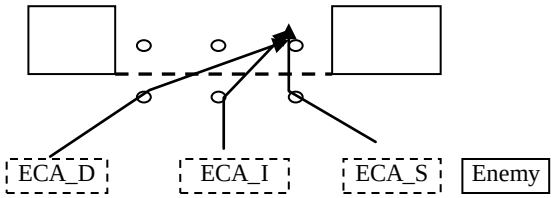

Figure 8: The Selection and Computation of Waypoint: the 6 waypoints' Candidates are Indicated by Circles

V. HUMAN MOTION STYLE

The conversation constructs used in military simulations involves an unexpected enemy situation, like the language, "secure" connotes a potential threat in the environment. Thus, the ECA needs to adopt motion styles compliant with situation awareness. For the characters' animations, the BDI People shop motion module was integrated into the system.

A running motion style was displayed from the current position until the ECA reached the newly selected waypoint when the ECA perceived enemy threat and then escaped the threat. An all-around security moving motion was displayed when the ECA within a certain distance perceived he goal location. Otherwise, the walking motion style was demonstrated. A sitting-firing motion was used to prepare an immediate firing and also to let the leader know the direction of the goal position identified by the ECA. Before the animation ended, for audience the arm-indicating motion was used to indicate the goal position.

VI. EXAMPLE ANIMATIONS RESULT

Two scenarios executing the LZ-securing mission were animated, each in Figure 9 and Figure 10. In Figure 9, the ECA perception component enabled the ECA to produce a local map and identify the enemy (marked by the circle in Figure 9 (a)). By the spatial awareness reasoning rule from Figure 5 (d) (i.e., main street if exits in the long sides are smaller than ones in the short sides), the current local map was identified as a main street. Then the ECA identified the LZ because of the rule from Figure 5 (e) (i.e., most of intersections and main streets are in contact). To escape the enemy threat, the ECA selected exit2 in Figure 9 (b), because the exit was the shortest one among the safe exits (i.e., exit2 and exit4; exit1 which was the crossed exit was not considered as the safe exit). Then to cross the exit, the ECA produced the local path and applied the running motion on the path (from a waypoint to another waypoint, both marked by triangles in Figure 9 (a)).

In Figure 10, the residue map (i.e., the space surrounding the LZ in Figure 10 (b)) could be produced at the ECA position. By the spatial awareness reasoning rule (Figure 5 (a)), the LZ was identified in the residue map since two main exits were about 90 degree to each other. After identifying the LZ, the all-around security moving motion was applied to the ECA until it reached a final waypoint before the LZ.

The sitting-firing motion (Figure 9 (c)) and the arm-indicating motion (Figure 10 (c)) were to help the platoon leader and the audience to recognize the position of the LZ. The right arm was holding the rifle.

As the spatial-situation awareness result of the integrated ECA system, the ECA could successfully identify and locate the LZ and LZ-related high-level spatial concepts (i.e., main street, safe exit, and detour exit). In addition, visual effects of various motions were animated based on situation awareness. In addition to the high-level spatial concepts, the low-level spatial concepts such as exits (e.g., exit1 to exit4 in Figure 9 (b)) resulted from the situation awareness. In "secure this region" example mentioned in section 2, the positions to be protected will be spots near the 4 exits (i.e., exit1 to exit4).

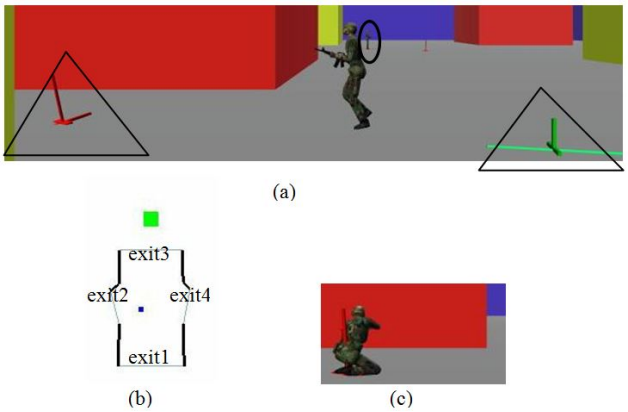

Figure 9: (a) shows the snapshot of the ECA escaping the enemy threat. (b) Shows the ECA's local map. (c) Shows the sitting-firing motion

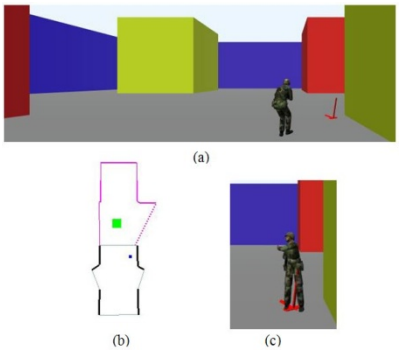

Figure 10: (a) shows the ECA approaching the landing zone. (b) Shows the ECA's local map. (c) Shows the arm-indicating motion

VII. RELATED WORK

Many researchers[13-16] have stated that a full map (i.e., global map) is a connection of local maps and that this connection is a human cognitive process. However, the local map in the virtual environment has been only a search-purpose mathematical decomposition[17] (e.g., tree structure; grid cell) from the full map. Thus virtual human full map-based behavior with omniscient perception[4-7,18] in virtual environments is prone to not being human-like. Their simulations repeatedly generate every reachable node in each grid cell saved in the full map, until an agent reaches final goal state. Then an entire route is at once constructed from the every generated node, regardless of situation awareness with each local-space structure and a final or intermediate goal location. In the full map-based system, an ECA has a difficulty to cope with a conversation construct with demonstrative pronouns (e.g., this; that), because the system lacks the human awareness-based locality.

Computer game characters commonly have a perceptual omniscience. Pretending effort for agent's limited perception should be provided by the system designers in order to accomplish agent's human-like movement behavior. Spatialsituation awareness is frequently programmed into the placement nodes in the virtual environment, rather than into virtual humans[9-10]. Thus, placement nodes in a game map may have information indicating that a location is good for a cover-concealment or that the virtual human should crawl when traversing the node to remain undercover. This programmed spatial situation awareness to the placement nodes does not compete with a generality although it may be efficient in runtime calculation. Also, the designer cannot predict in advance all the spatial semantic information.

HCRC has performed map task corpus research[19] to provide a common corpus for dialogue generating material study. The map task is performed between two speakers (one as instructor and the other as follower). Each has a map that the other cannot see. In our integrated system, different ECAs can represent the environment with different maps based on their own environment understanding, because each ECA can produce a local map based on its local-space understanding. Thus, applying our ECA to their map task corpus research can be possible and interesting because their research is to see how the follower produces the follower's own different map from the instructor's spoken language.

VIII. CONCLUSION

Researchers in the virtual human field have required the virtual world designer to hand-script information (e.g., spatial cues with reachability or cover point) onto placement nodes to help the virtual human map the world. In contrast, the mapping methodology in this research enabled the ECA to map the environment in real-time only with local information based on limited perception, once the virtual world construction was finished without any additional information.

Compared to the full map-based mapping, the local map-based one in this paper can have efficiency in computation. The computational efficiency is related to localization. The localization problem can be resolved naturally in the process of local map production, because the ECA produces the map in relation with immediately surrounding spaces. There can, of course, be a tradeoff between how efficiently the local map is used and how well the map is constructed.

The limited perception-based and locality-based mapping methodology in the integrated ECA system enabled the ECA to identify openings (i.e., exits) and boundary edges necessary to the map construction. The

identification of the exits and the boundary edges is a fundamental factor for spatial situation awareness. Using the identified exits and boundary edges, high-level spatial concepts (e.g., street; detour route; intersection; LZ) that could be used in a conversational construct were also extracted. The high-level spatial concepts and the local maps enabled the production of local paths and human motions that were compliant with situation/context awareness. By the appropriate situation/context awareness, the ECA coped with a dynamic situation. The detour route, for example, was selected by the situation/context awareness about the relation between an enemy position and exit candidates. The production of the local path and the motion style was only based on the local information in the local map. Also, the production was incremental. The successful situation/context awareness was enabled in the integrated cognitive process (i.e., perception, cognition, and motor) with mapping, spatial awareness reasoning, path finding, and human motion style. The integrated ECA system enhanced the ECA human-likeness by the cognitive process.

Demonstrating an ECA's rich conversations involved with movements may require a complex reasoning. Adopting a symbolic production system (e.g., Soar) into the integrated ECA system will facilitate the reasoning complexity.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Educational Content Creation Using Motion Recognition Sensor

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Abstract---

Background/Objectives : Recent knowledge-based information society is under an increasing attempt to use them on the education sector in accordance with the rapid development of information and communication technology successfully applied practices in the education sector are being increased.

Methods/Statistical analysis : In order to recognize hand gestures we were used motion recognition technology. Measuring the depth of the image using a depth camera and by using this data to determines the user's hand position. Is a block assembly proceeds in accordance with the user's hand gesture motion recognition sensor and using the Pocket PC platform to build the system.

Findings : Depth camera is composed of two IR camera and an one RGB camera. It advances the basic image processing using an RGB camera and determines the user's hand position. Then, by using two IR camera measures the depth of the image. It recognizes the hand gestures by using distance of the calculated feature points and angle. By specifying the received gesture data each name to identify the appropriate action. Content can be started via the main menu panel operation. Recognizing a user's finger, to generate the event when in contact with the panel. When assembling the content starting to form a space for the user of the arm operation ranges. Depending on the settings to generate a block randomly. All blocks within the assembly space is subject to the laws of physics apply. Magnetic function is applicable only to a block immediately after the catch is off event. After a block or attached to each other upon completion of dropping, the function is terminated.

Improvements/Applications : Existing virtual reality content was limited only vision switching is possible because using only sensors built in virtual reality devices. In future work will develop the virtual reality simulation system in a variety of fields.

Keywords--- VR, Motion Recognition, HMD, Depth Camera, Hand Gesture.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Recent knowledge-based information society is under an increasing attempt to use them on the education sector in accordance with the rapid development of information and communication technology successfully applied practices in the education sector are being increased. However, the information technology used in the actual educational front is the simplest form of educational content consisting of video or flash consists of a majority[1]. This research has been conducted to develop a new high-quality content. How about this it has been going to this virtual reality based educational content development[2]. Virtual reality technology is a technology that makes you feel that you exist in the virtual space. Existing virtual reality content was limited only vision switching is possible because using only sensors built in virtual reality devices[3]. The purpose of this paper is largely two. Firstly, the manufacturing target is a motion recognition sensor and virtual reality machine incorporating mechanical platform. Second, the interaction is possible block assembly educational content creation of the virtual space due to the user's operation target using the integrated platform.

II. LITERATURE REVIEW

A. Motion Recognition

It is a technique used to recognize a user's action. In this paper, motion recognition is used to recognize hand gestures and hand positions. Use the depth camera to measure the precise depth as the human eye. To identifies user's position and motion of the hand to Identify the position and state of the object that the user is operation. After you specify the joint by hand to point to specific recognition region. According to the movement of a recognition point recognizes the hand movement. It applies by defining the function in accordance with the movement of the hand.

B. Contents System Implementation

It is a process to implement a system to interlock the VR content and motion recognition sensor. Since implementation of the entire content in a virtual reality system, the content is in progress in accordance with the value provided by the motion recognition sensor. Implement a VR system using a 3D physical engine unity. Motion recognition extracted data is used is transmitted to the virtual reality content in C # code.

C. Building Platform System

Linked by a motion recognition sensor and a virtual reality machine is a technology that works as a platform. After implementation is completed with a virtual reality contents system to the Pocket PC by connecting the motion recognition sensor and a virtual reality device shall be composed of one platform. Figure 1 shows the overall hierarchy of platforms and systems[4].

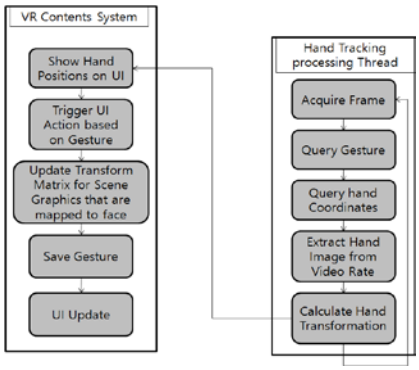


Figure 1: VR Platform Hierarchy

III. PROPOSED WORK

A. Recognize User Gestures

A process of analyzing the user's operation using the user data of the motion recognition. Depth camera is composed of two IR camera and an one RGB camera.(Figure 2) It advances the basic image processing using an RGB camera and determine the user's hand position. Then, by using two IR camera measures the depth of

the image. Based on the basic image processing data and the depth data to calculate the distance between the sensor and hands joint each hand feature points(Figure 3). By calculating the distribution of the feature points to distinguish the left-hand, right-hand. It recognizes the hand gestures by using distance of the calculated feature points and angle.(Figure 4) Limited only use able to recognize hand gestures in advance so as not to be recognized as unnecessary operation. By analyzing the user's finger movements to determine the gesture of the movement(Figure 5). After the grasp gesture is transmitted to the content system in C # script. By specifying the received gesture data each name to identify the appropriate action.

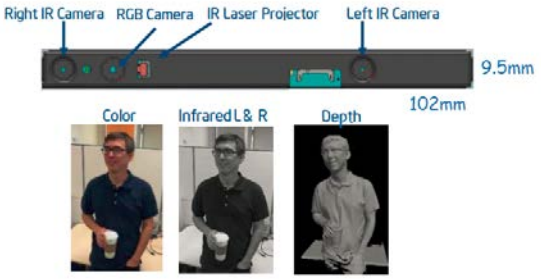


Figure 2: Depth Camera Configuration

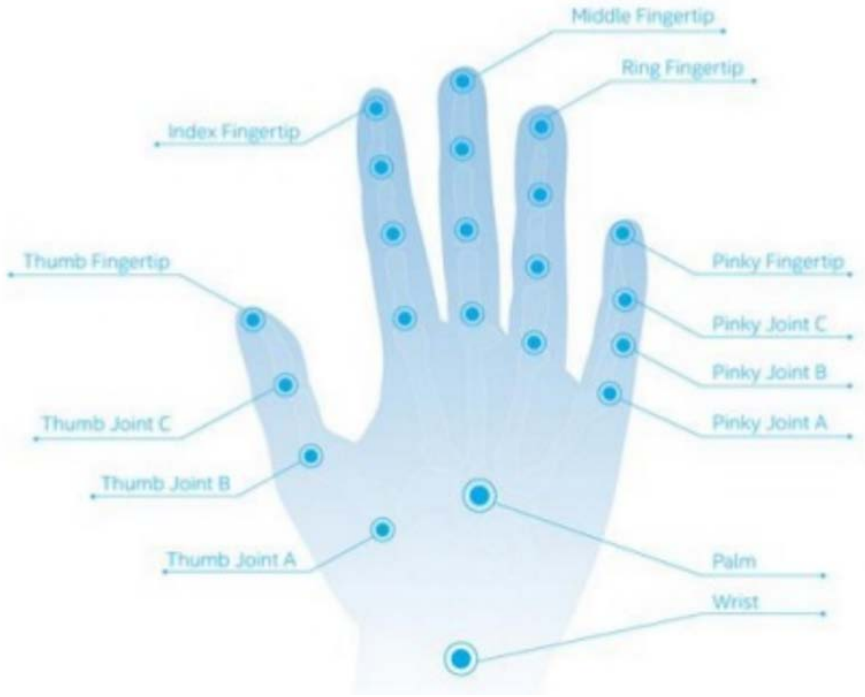


Figure 3: Hand Feature Points

Figure 4: Hand Gestures

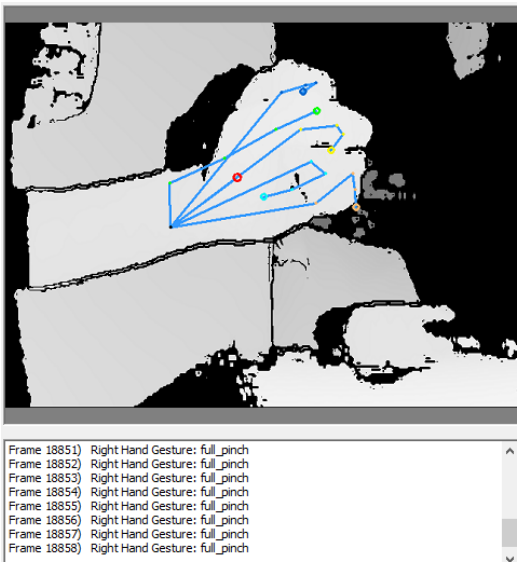


Figure 5: Recognize User Gestures

B. Contents System Implementation

Content can be started via the main menu panel operation. Recognizing a user's finger, a touch event occurs when a touches panel. When assembling the content starting to form a space for the user of the arm operation ranges. Recognizes the user's both hands to the main screen consists of two operations. Generates a block with a random number depending on the settings.(Figure 6) All blocks within the assembly space is subject to the laws of physics apply. If all of the user's fingertip contact, causing the block to catch the event. By judging the event and hand grip being the closest block attached to the hand. This event falls under the fingertips of the hand grip release the catch events. Event catch block moves in accordance with the gravity when released is attached by using a magnetic force to function when faced with other blocks. To determine the block that is closest to the block being a magnetic force is in effect so that the inter-block side faces can be bonded after adjusting the angle and the position of the block. Magnetic function is applicable only to a block immediately after the catch is off event. After a block or attached to each other upon completion of dropping, the function is terminated. A block attached by a magnetic force function have attached without being influenced by gravity. Blocks that are not the coupling is affected by the user's hand movements. Block coupling is completed is not affected by the user's hand movement, only influenced by the catch block events.

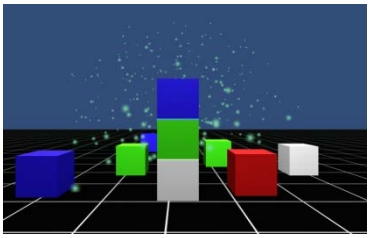


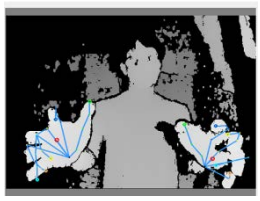
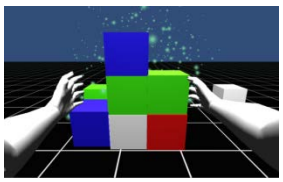
Figure 6: Virtual Block Placement

C. Building Platform System

After the system of completed implementation content was installed on your PC connect the motion recognition sensor and HMD make up the platform. Control platform is performed using only motion recognition in order to enhance portability to display a screen by using a virtual reality device. Motion recognition sensor is attached to a front HMD device, it allows to recognize the user's hand movements. By attaching the front HMD device can accurately position the hand gesture recognition to the actual hand position. The contents system executes automatically when the PC boots.. By exactly

matching the user's hand position is to improve the user's immersive. After the completion of the platform system construction is a state and appearance comparison of user recognition to progress the actual content.(Table 1)

Table 1: System Components

CRecognize user behavior	*Content inside the apply*
	

IV. CONCLUSION

Recent trends in the knowledge-based information society is increasingly try to follow the rapid development of information and communication technology to use them in the field of education. How about this it has been going to this virtual reality based educational content development. Existing virtual reality content was limited only vision switching is possible because using only sensors built in virtual reality devices. This paper was prepared VR sensor-based gesture recognition blocks assembled educational content. By using a depth camera, it provided the recognized data such as your eye. Context can recognize user behavior by specifying the number of a variety of gestures. Attach the motion recognition sensor on the front HMD device and synchronize the user's hand position and hand position of the virtual space. Using a motion recognition sensor enables direct control of the user a virtual reality and proposes a new possibility of expanding fields of use of the virtual reality. In future work will develop the virtual reality simulation system in a variety of fields.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Signal Analysis of Ultrasonic Sensor according to Pressure Change in CNG Tank Using Attenuation Characteristics of Ultrasound

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Abstract---

Background/Objectives: In the present study, a measuring method will be presented by simulating a detection system for CNG fuel amounts as a study of fundamental stage for accurate measurement of gas amounts inside the fuel tank for CNG vehicles.

Methods/Statistical analysis: For experiments, a simulation apparatus for detection of CNG fuel amounts with application of an ultrasonic sensor was configured, and the output signals were verified by variation from 0bar to 8bars by the unit of 1bar.

Findings: As a result, the output signals of the ultrasonic sensor could be seen to be attenuated with an increase in pressures inside the tank, their linearity could be affirmed although there was some difference. By confirming an error ratio of about 5 % through repeated experiments, applicability of CNG fuel measurement could be verified.

Keywords--- Acoustic Wave, Attenuation Characteristic, Clamp-on type, CNG (Compressed Natural Gas), Ultrasonic Sensor.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

Natural gas is an alternative fuel provided with all advantages of rich reserve and economy as well as low environmental pollution effect. In particular, smooth driving is possible as knocking of the engine does not occur due to high octane numbers (about 130) even when the compression ratio is raised, improvement in thermal efficiency and output can be aimed at, and there is an advantage that lean-burn is possible due to the wide inflammability limit[1,2].

Natural gas is a fossil fuel with CH_4 as the main composition, and is divided into CNG(Compressed Natural Gas), LNG(Liquefied Natural Gas), and ANG(Adsorbed Natural Gas) depending on the storage method. Particularly, in the case of CNG, measurement of fuel amounts and detection of leakage are very important from the safety aspect, since it is stored in a limited container by compression to a high pressure of 200bars. However, in the conventional methods of fuel measurement, the fuel amounts inside CNG tank are measured through a pressure sensor, which has difficulties in accurate identification of the fuel amounts.

Measurement method by an ultrasonic sensor is a measurement technique made common generally in the utilization areas such as vibration, distance, etc. by using density differences which can be reflected from the wavelength of acoustic wave in the presence of air and a liquid, and most of it is frequently used in the measurement areas such as flow velocity and water level, etc.[3-8]. However, it is not applied yet to the measurement of fuel levels for media such as natural gas including LNG and CNG, etc.

Therefore, in the present study, an ultrasonic sensor was produced to supplement problems mentioned earlier as a study of fundamental stage to measure gas amounts inside the fuel tank for CNG vehicles, and the results for output signals as a function of pressure changes inside the tank will be affirmed by application of the energy attenuation characteristics of the ultrasonic sensor. Also, by verification of the reproduction characteristics in precise measurements of the produced ultrasonic sensor, the applicability to CNG fuel measurements will be identified.

II. EXPERIMENT DEVICE AND METHODS

Since temperature, outside pressure, frequency, etc. should be considered for the ultrasonic sensor used in the experiments, Pbtio3-based PbNb2O6 ceramic was selected to determine the specifications. Finally, piezo ceramic of a disk type provided with miniaturized size and thickness in MS-40 method was selected and a structure capable of smooth transmission while minimizing the noise of acoustic wave was produced. And design was implemented for the matching assay related to the key part of sensor performance, while backing design was considered with a focus on the matching for optimum transmission signals of energy transfer for the design of Ceramic assy.

The structure of ultrasonic sensors is largely divided into Body assay and Ceramic assay, where Body assay had a focus on reduction of the noise of acoustic wave, and Ceramic assay was produced to allow smooth transmission of the acoustic wave. When energy is transferred by mounting on the outer wall of CNG tank, abnormal receiving signals are produced while being mixed with vibration noise of the tank. To remove this, the radiating face of the receiving sensor was finished with epoxy, with a design for structural avoidance through 3 groundings of the pointed part. Thus-designed ultrasonic sensor is shown in Figure 1.

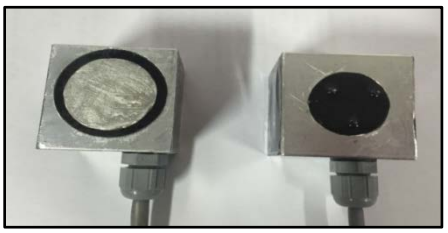

Figure 1: Prototype of Ultrasonic Sensor

The experimental device was designed for the volume of 10bars by reducing a CNG tank capable of charging for200bars to 250bars as shown in Figure 2, and the output signals of the ultrasonic sensor were verified by installation of a separate pressure gauge to identify the pressures inside the tank.

As shown in the figure, the produced ultrasonic sensor had transmission and receiving sensors fixed as a clamp-on type around the tank at the center. The control circuit for the ultrasonic sensor was designed to allow changes in voltage and pulse, while the transmission and receiving sensors were controlled to allow checking for the signals through acoustic wave. And, set-up frequency of the transmission sensor and state of the pulse were checked by utilizing an oscilloscope(DSO1072B),and the data to identify output signals of the receiving sensor varying with pressure was detected.

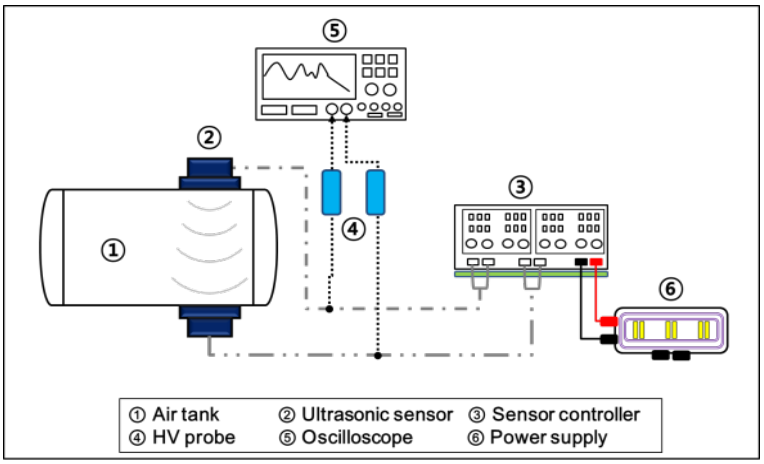

Figure 2: Schematic Diagram of Experimental Device

The major experimental condition is as shown in Table 1, and the risk elements for safety accidents were prevented for the pressure inside the tank by using compressed air instead of CNG. Sensitivity of the sensor was controlled by fixing the voltage of the transmission sensor to be DC 200V,and the number of pulses was set up for 9 ea. so that ringing signals of the sensor could produce the minimum wave. Through single item experiment, the frequency was set up for 76kHz where resonance characteristics inside the sensor were smoothly generated, and precision control was implemented while the optimum frequency was set up through the oscilloscope. And output signals of the ultrasonic sensor as a function of individual pressures were verified by varying the pressure inside the tank from 0barto8bars by the unit of 1 bar.

At the conclusion, to allow the pressure inside the fuel tank to be maintained in a constant state, the temperature was set up for 20(±1)℃ with reference to room temperature by using Temperature & Humidity chamber as shown in Figure 3. To confirm accurate output signals after changing the pressure inside the tank, data was detected 90 seconds later, and repeated experiments were conducted over a total of 5 times.

Table 1: Specifications of Experimental Condition

Target fluid	Pressure(bar)	Temperature(℃)	Count of experiments
Air	0 to 8 from 1 unit	20±1	5

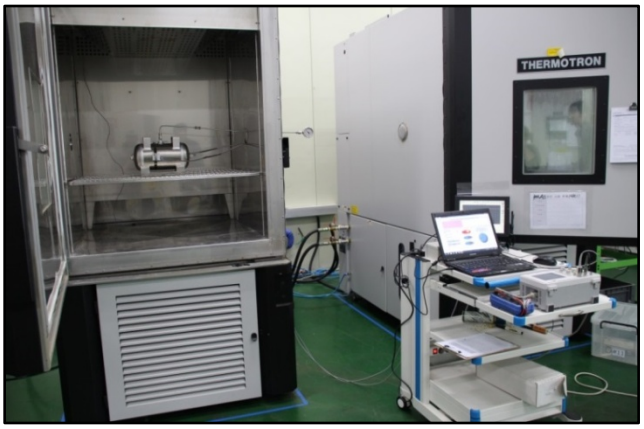

Figure 3: Configuration of Experimental System

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

To identify smooth driving status of the produced ultrasonic sensor, an experiment was conducted at room temperature by mounting the sensor on the simulation apparatus, and the following results could be obtained.

Figure4 shows output signals of the receiving unit after setting up the frequency of the transmission unit of the ultrasonic sensor at 76kHz based on the prior experimental results, and only two sections were displayed to facilitate confirmation of the attenuation characteristics of ultrasonic signals only for the states of 0bar, 4bar and 8bar in the region of 400㎲ to 600㎲ where a clear difference in the attenuation characteristics was exhibited.

In comparison with 0bar, the output signals of 4 bar and 8 bar could be affirmed to be somewhat reduced. This appears to suggest that the amplitude of resonance frequency of piezo ceramic was reduced due to density differences produced as a result of change in pressures inside the tank and that it was the result of the characteristics of the wave which alternatingly repeated physical compression and expansion. And, such attenuation characteristics of ultrasonic wave are considered to be exhibited, as the ultrasonic sensor used in the experiment was produced by using transverse wave characteristics where the direction of electric field produced by application of inverse piezoelectric effect causing mechanical deformation through application of electricity to the piezo ceramic occurred to be the same as the operating direction produced while the material was changed.

Somewhat irregular output signals are attributed to the fact that there were difficulties in cutting of the matching material into a given size in comparison with the piezo ceramic in sensor production and in attachment of the same. In the future, sufficient improvement is considered possible under the circumstances where precise production is enabled by using an equipment system converted to theprocess.

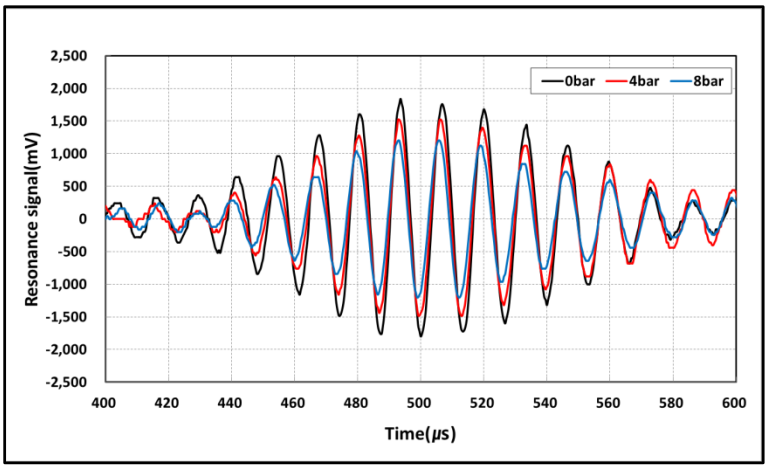

Figure 4: The Response Curve of Ultrasonic Sensor from 400㎲ to 600㎲

To select more precise output signals, temperature and humidity chamber was employed to allow maintenance of the constant temperature around the tank at 20°C.Figure 5 shows the most ideal domain extracted to accurately confirm the attenuation characteristics.

At 0bar between 530㎲and 536㎲, the maximum output voltage of1,440mV was observed, and a tendency could be verified where the value of output voltage was most markedly reduced to 120mV as a result of compressing to 1bar in comparison with 0 bar. And, the attenuated results of 1,320mV, 1,240mV, 1,160mV, 1,120mV, 1,040mV, 960mV, 920mV, 840mV could be affirmed for the pressures of 1 bar to 8 bars.

Such results are considered to be observed since interference occurred for the ultrasonic wave transmitted from the transmission unit to the receiving unit due to density differences of air generated by an increase in pressures inside the tank as mentioned earlier. And the tendency was observed where the output voltage was the largest when the pressure was changed from 0bar to 1bar, suggesting that such results were produced since the attenuation characteristics occurred most markedly as the initial state of tank was the same condition as that of the atmosphere.

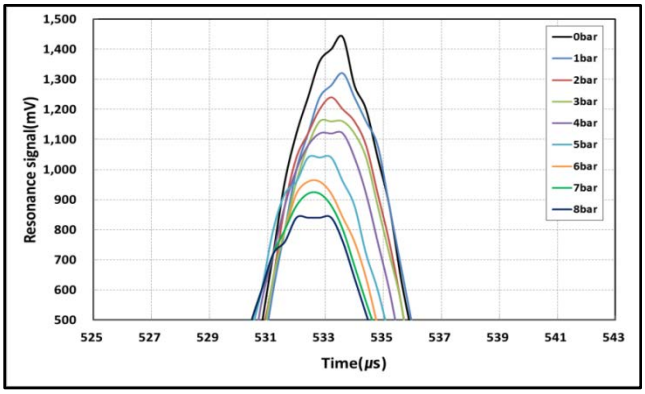

Figure 5: The Response Curve of Ultrasonic Sensor from 525μs to 543μs

Figure 6 shows a change in the maximum outputs of the receiving sensor. According to the detailed analysis results, the output signals reduced stepwise from around about 533uscould be observed. As a result of increasing pressures from the minimum pressure of 1barto the maximum pressure of 8bar, the data of an envelope was observed where reduction occurred by 80mV at the spots of 1 bar to3 bars,40mV at 3 bars to 4bars, 80mV at 4bars to6bars, 40mV at 6bars to7bars, and 80mV at 7bars to8bars. Thus, the cause for the reduced envelope could be considered attributable to the fact that density was accumulated by the pressure as the tank inside was filled with the energy of acoustic wave transmitted and received by the sensor facing unit, and energy was reduced as the resistance component being changed to a high density was affected.

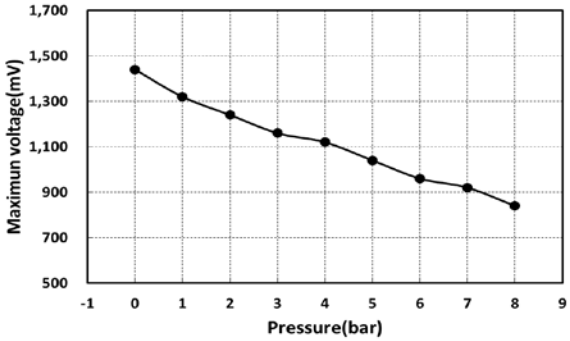

Figure 6: Attenuated Results of Peak Voltage

Figure 7 shows the output voltage detected through repeated experiments. Some differences per section are shown, particularly exhibiting the largest difference of ±4mV in the case of 7bar. However, according to results for reproducibility, error ratio could be affirmed to be less than about 0.5%.Also the amount of change as a function of an increase in pressures could be seen to have linearity even if several processes were subjected to. Hence, the linear reduction of output voltages in the produced sensor is always a capability required to accurately measure CNG pressures, through use of which it is considered that the error range can be narrowed down and the accurate amounts of fuel can be measured more precisely.

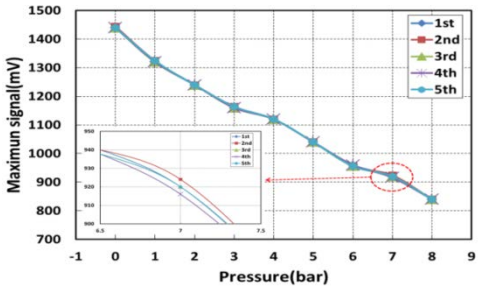

Figure 7: Reproducibility of Ultrasonic Sensor

Figure 8shows the ratio for output voltages at 1~8 bars in comparison with that at 0 bar to identify that output voltages were reduced with an increase in pressures inside the tank. Through repeated experiments, it could be seen that there was a constant change to some extent, although it did not perfectly return to the initial state. Here, it could be identified that the recovery characteristics of returning to the initial state was sufficiently retained which must be always provided for the ultrasonic sensor to repeatedly confirm pressures inside the tank, through which it is considered that more precise output signals can be secured when applied to the object of CNG charged at a high pressure of 200bars.

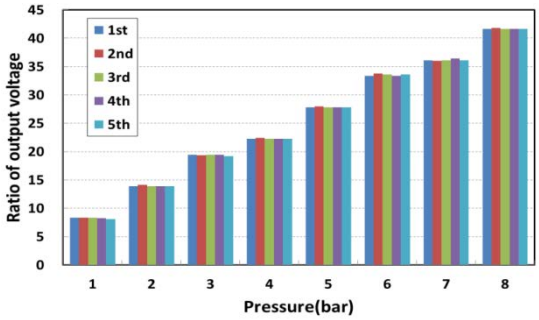

Figure 8: Recovery Reaction of Ultrasonic Sensor

IV. CONCLUSION

Based on the experimental results of detecting energy attenuation characteristics as a function of pressure change inside the tank in a detection simulation apparatus for CNG fuel amounts using acoustic wave of the ultrasonic sensor, the following conclusions could be derived.

a. Change in output voltages from the ultrasonic sensor could be affirmed as a function of change in pressures inside the tank. According to the results of affirming each output voltage by magnifying the domain in a particular time band for more accurate confirmation, it is considered that the attenuation characteristics of the ultrasonic sensor occurred due to density differences in the air produced as a result of increase in pressures inside the tank rather than the structural aspect since the distance due to the tank was limited.
b. Through repeated experiments, the output signals of the sensor could be affirmed to be linearly reduced as the pressures of the tank were increased. Although there was some difference, the characteristics of the sensor returning to the initial state could be identified by affirming that it had a constant change to some extent.
c. In the case of a tank having a given volume, leakage status could also be identified based on the accurate measurements of CNG fuel amounts when more precise output signals were selected according to the temperature around the tank since pressures were also increased when temperatures were increased. And, if the algorithm for driving control of the ultrasonic sensor is applied by conducting experiments under the condition of a broader domain band, it is considered that a higher confidence level can be obtained.

ACKNOWLEDGMENT

This study was financially supported by Industrial Core Technology Development Program (No. 10052064, A fuel-gauge development of efficiency for CNG vehicle with leak detections and active safeties) funded by the Ministry of Trade, Industry & Energy(MI, Korea).

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Study on Using CST+PR to Improve SQLite Recovery Method

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Abstract---

Background/Objectives: Nowadays services involving smartphone app are being put to use in various areas such as disaster information system, Bus Information System (BIS) involving GPS, augmented reality game and library mobile service. These apps utilize SQLite database to save data considering that SQLite is small-sized and may be activated without server system. SQLite Database saves data based on page with record being saved inB-tree leaf page cell. However, B-tree problematically causes memory performance downgrade due to frequent calculation in node.

Methods/Statistical analysis: The study suggested brand new recovery method involving CST+-Tree method to improve these problems. In addition, it performed performance comparison assessment designed to compare existing and suggested methods in terms of performance.

Findings: As a result of performance comparison assessment, it was revealed that the use of suggested method has led to improved recovery method and proved more excellent in performance through performance assessment.

Improvements/Applications: As a result of comparing existing method with suggested method, it turned out that suggested one is more successful than existing one in terms of cash miss number and tree height.

Keywords--- SQLite, Database, B-tree, CST+-tree, Recovery, Smart Phone.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

SQLite Database, whose strength lies in small size and fast speed, is being put to various uses for smartphone, tablet PC or embedded devices. Particularly in the case of smartphone, it is not just used for app-induced services, such as phone book, call record and text message but also for SNS programs such as Cacao Talk and Twitter so messages and user information may be saved. In addition, it applies to various games such as BIS involving GPS-applied LBS, disaster information system, LBS and augmented reality game (Monster Go), library mobile servuces[1]. The reason is that SQLite is small-sized and may be activated without server system. More often than not, SQLite Database file contains high-profile information such as private or financial transaction information. However, such significant information is susceptible to accidental deletion or overwriting that might happen in the situation where users often use such functions as Write and Delete or intentionally may be deleted by crime suspect. Thus, the technology to recover deleted record in SQLite database holds significance [1,2,3]. In connection with this, studies were going on to develop ways of recovering deleted record in database file header and page header if deleted record remains intact. If page header information is initialized, however, deleted record may not be recovered because no way is available to identify record position[4]. Additionally if a succession of deleted record exists in non-allotted area, recovery may not be available because of failure to identify record position. To resolve this, study of deleted record extraction technology involving suggested schema pattern analyzes[5] schema pattern of SQLite database to recover deleted record[1]. The approach is effective in that it may make data recovery even when page header information is initialized.

If data exceeds available page cell area, the initial part of the data is normally saved in leaf page of B-tree page with the remnant being saved in overflow page. Despite that, the existing studies only suggest ways of making deletion and recovery in B-tree page. In addition such approach manages the whole database as a single file, while it uses page as the save unit. The page comprises B-tree and uses B-tree to save the data.

This approach problematically causes recovery performance downgrade being attributed to frequent calculation of tree node resulting from the use of B-tree index. Thus, the study, in order to resolve this problem, suggests recovery method involving CST+-tree index. If suggested method is put to use, it turned out that the suggested one shows better recovery performance than existing B-tree one and suggested method was more excellent than existing one through performance comparison assessment.

II. RELEVANT STUDIES

The study on recovery method for database management system and deleted record recovery is actively underway. Unlike other DBMS, SQLite manages and saves the whole database as a single file and has tables, each of which carries B-tree structure. In addition, SQLite file comprises several pages, each of which serve as minimum unit of SQLite I/O(Input/Output).

A. SQLite's Recovery Method

iPhone SQLite Databases Method

This method is designed to recover deleted record from SQLite database file of iPhone and suggested method to recover deleted record first by analyzing database file format. Such method is designed to recover deleted record by using record header related to user data, record field value and key value [6].

Carving SQLite Databases Method

The method is designed to carve SQLite databases from non-allotted clusters. In addition, the study took the test to identify if access to Rasmus Rii, designed to carve SQLite database files used in Google Chrome, may be applicable for other databases and the used known header values to recover deleted record[7].

CST-Tree

CST-tree (Cache Sensitive T-tree) was proposed to improve efficiency of cache and has the following characteristics. First, it uses the most possible amount of the data to be transferred to cache. Second, it eliminates use of pointer and composes tree in array. Third, it shows the best performance when the size of node block equals the size of cache block.

▪ The dissertation is the extended version of the one titled "SQLite recovery method involving CST+- Tree" that was reported in the 2nd International Seminar (IT) held in Danang, Vietnam, in June 2016.

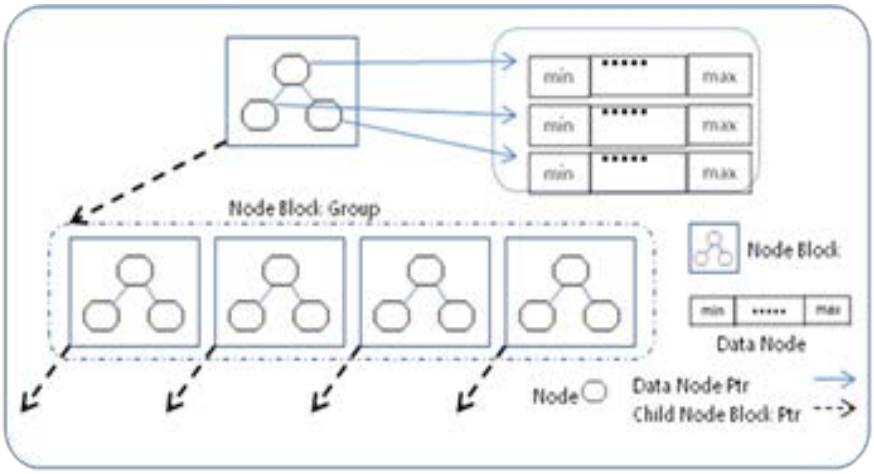

Fig. 1: Structure in CST-tree

[Figure 1] shows CST-tree structure, which uses pointer to connect node blocks. Key values within the node blocks have the maximum value of the data node. Therefore, each node within the node block has pointer that goes to the corresponding data node. In CST-tree, there is no cache miss during binary search in the root node group until it reaches the terminal node group. Cache miss only occurs when accessing the child node group and data node. CST-tree showed superior performance in point search, as compared to other index structures. For range search, however, it resulted in higher cost because it searches through node block traversal. During range search, it incurs in a larger traversal cost than T*-tree [8].

III. CST+-TREE PAGE-BASED SQLITE RECOVERY METHOD

The chapter suggests how to make recovery based on page by using CST tree variant CST+-tree that is recognized to have the best performance in the area of database. CST+ tree displays search performance similar tothat of CST tree and carries modified structure enabling efficient range search. The study uses CST+-tree, whose performance is better than B-tree used as file structure in existing SQLite database system, to design CST+ PR(CST+Page Recovery) model and applies CST+-tree's search, insertion and deletion algorithm[9].

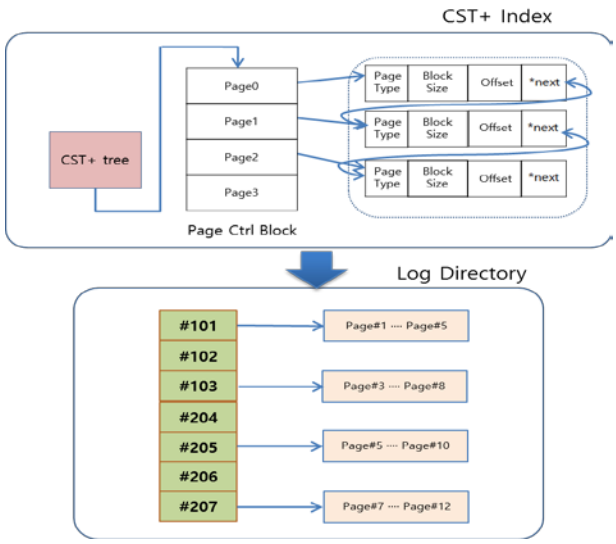

Fig. 2: CST+ PR Method

[Figure 2] is composed of CST-tree index and log directory. This technique enables fast recovery by using Redo Log to perform quick search when there is a failure in a particular SQLite DBMS. Because CST-tree uses front and rear pointers, performance of point search, insert and delete functions is similar but the performance of range search improved by 600~1000% [9].

A. CST+-Tree Algorithm

Data nodes in CST+ PR algorithm are connected as a linked list, in order to overcome the fact that the existing CST-tree is inefficient in range search

Search Algorithm

CST+-tree search algorithm is divided into two stages[9].The 1st stage concerns search to find minimum key value in search range. The 2nd stage is that link list is used to search key values falling into the category of key value found in the 1st stage. In the 1st stage, if searched key value is greater than maximum key value, serve node block on the right side performs search. If searched key value is smaller than maximum one, it means that searched key value exists in current node or in serve node block on the left side. Before moving on to search serve node block on the left side, it is necessary to mark current node. If the search proves unsuccessful even though the range ran to the terminal node, it is necessary to finally perform binary search in data node of the marked node.In the 2nd stage, it is necessary to search key value in given range in data node containing key value found in the 1st stage. If searched value is equal to or greater than maximum value, the search will be completed.

Insert Algorithm

Insert algorithm of CST+-tree is as follows [9]. After searching a node, it will insert a node, if it can be inserted. If there is no room for insert, it will delete the minimum value of data node and insert the value. The deleted minimum value will be inserted to the left-hand side sub-node block. If there is no sub-node block on the left, a new node block is created and node balancing will be checked. When a node block is created in the tree, the current data node will be marked and the new node block and marked data node will be connected with a linked list.

Delete Algorithm

Delete algorithm of CST+-tree [9] is performed by searching the data node, where the key value to be deleted exists. Then the key value and the corresponding record ID will be deleted in the data node. The following explanation will not consider record ID in the data node but will only assume that the key value exists. If there is an underflow (number of keys is less than 1/2) in data node due to deletion, the maximum key value from the left-hand side sub-node will be inserted to the current data node and deleted from the sub-node. If the left sub-node does not exist, then the minimum value of the right sub-node will be inserted to the current data node and it will be deleted from the right sub-node. If the data node disappears due to deletion, replace the rear pointer of the connected data node with the rear point value of the deleted data node. If the node disappears from deletion, check tree balancing within the terminal node. If the node block disappears, check the balancing of entire CST+-tree [9].The word “data” is plural, not singular.

Recovery Algorithm

In the current study, data recovery (reading the key value) and data insert (building index) are processed in parallel to combine the advantages of sequential insert and batch insert [9].

IV. PERFORMANCE TEST

In the current chapter, performance of the B-tree technique and the proposed technique is compared. The existing SQLite technique uses B-tree for recovery and the proposed technique uses CST+ PR, which is composed of CST+-tree. The two techniques are compared in terms of the performance.

A. Measure Experimental Performance

In this experiment, C language was used to measure the cache miss count and tree height for both B-tree technique and CST+ PR technique, which uses CST+-tree. For the performance test, Core i7- 4790(4GHz, 8M Cache), 8GB RAM was used.

B. Compare and Evaluate Performance

<Figure 3> shows cache miss count according to the page numbers randomly created between 5,000 and 53,000 by using B-tree technique and CST+ PR technique, which uses CST+-tree. The proposed technique resulted in smaller number of cache miss count because the proposed technique searches data node and then uses connecting pointer to search the next data node. This reduced number of cache miss; hence it is faster than B-tree method.

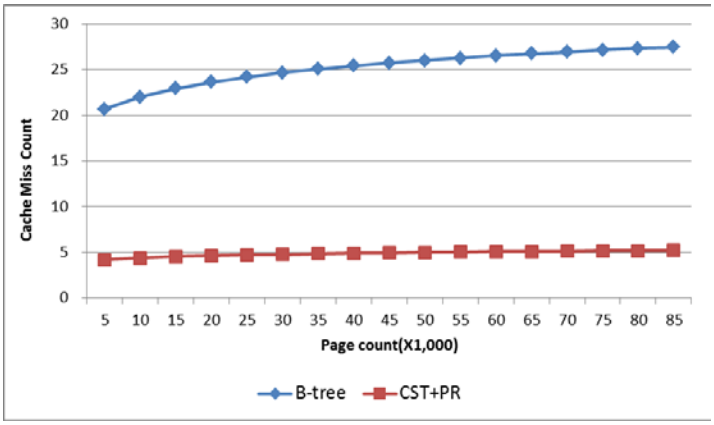

Fig. 3: Cache Miss Count of Page Count

Similar to <Figure 3>, <Figure 4> shows created random number of pages and analyzed the height of trees according to the page count. CST+ PR technique had smaller tree height than B-tree technique because CST+-tree searches nodes one time to find the minimum key value within the search range. CST+-tree is faster than B-tree because it takes less time to find minimum key value due to the difference in the tree height.

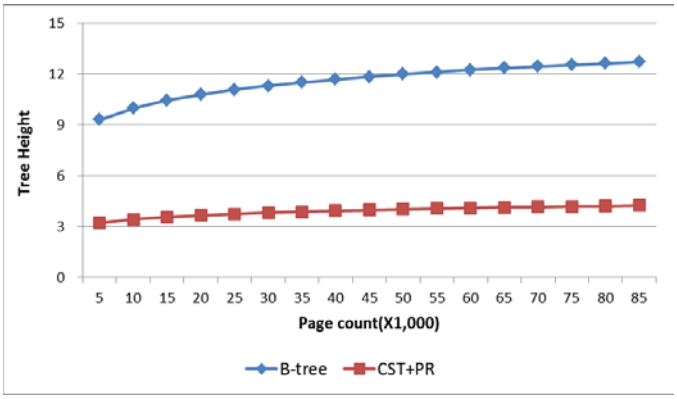

Fig. 4: Tree Height of Page Count

As a result of performance assessment analysis result, it turned out that the suggested one is better than existing one considering that the suggested one uses link pointer in cache miss to search the following data node and it takes suggested one less time to search minimum key value in search range due to difference in tree height.

V. CONCLUSION

Database is quite often used by smartphone or embedded devices. The existing SQLite database recovery method utilizes B-tree. The study suggested CST+ PR method involving CST+-tree proving better than existing one and compared and analyzed existing B-tree method with suggested CST+-tree to assess CST performance. As a result, it turned out that the suggested method is better than existing one. The reason is that in the case of cache miss, it uses link pointer to search the following data node after searching data node, which reduces cache miss times and that it takes suggested one less time to find minimum key value in search range due to difference in tree height. In the future, the study plans to give focus to synchronism in SQLite DBMS involving CST+-tree.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

CAE Analysis of the Robot Control System for the Design of the Smart Automation Facility

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Abstract---

Background/Objectives: : In case of many products placed on the production line in automobile production, some line is personnel visually identifiable, such as CCTV, while the rest areas are not identifiable.

Methods/Statistical analysis: However, because the position of accidents is not scheduled and every accident should be analyzed at every point, every accident is not easy because you need to an immediate response. The record cause of the accident is difficult to understand, not until after the accident for the accident cause analysis of fragmentary and mechanical information so that future accidents have difficulty measures be established.

Findings: To prevent this, the car accident occurred in the manufacturing plant personnel to deploy and monitor in every area of enterprise is too burdensome labor costs too high. In this study, automated car production plant and load transfer system crash, accident collision and records are available for real-time wireless transmission, the administrator determines that situation can be immediately developed the electronic mono rail system(EMS).

Improvements/Applications: You will start to develop the control of EMS and stop control is critical for performing of correct parts CAE analysis to develop a prototype.

Keywords--- CAE Analysis, Control System, Unmanned Automation Facility, Conveyor, Video Recording System.

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Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

The Electrical Mono Rail System(EMS) is a kind of conveyor system. The conveyor system is a conveyor or elevator installation according to the flow if it is determined that the flow of production in a continuous production. This approach is the material on the conveyor, put the product assembly/processing as will be subsequently transported. For example, while the semi-finished product assembly rests on top of the main conveyor line that flows from this process as fair. On the other hand the individual components required for assembly is laid on the conveyor transport system is taken in the sub-line to be supplied to fit the time of the assembly to a predetermined location of the main line. Conveyor system is not only mass production. its coverage in small quantity batch production can be applied to was very spacious Moreover, even cheaper transportation costs. EMS[1] is mainly among manufacturers of electronic products and automobile manufacturing plant manufacturing plants, and says the unmanned Automated Material Handling Equipment used in the production plants, such as food factories. It is advantage to the interval control and flexible over the batch control system using a variety of belts and chains in the system operational as it is operates as a self-controlled manner. 100 years ago from now, Ford is developing a conveyor system, factory automation system goes through the industrial revolution evolved according to the needs of the industry were derived by the current factory automation systems(EMS)[2]. The use of this EMS will improve productivity, excellence in environmentally-friendly province, Noise Reduction, and incident response castle flexibility somewhat expensive, but the way in the modern automotive industry, which are widely used to replace existing automation chain. It is presented the results of efforts to build a smarter (SMART) by EMS for the definition of these weaknesses EMS one step beyond in this research paper.

II. MAIN TOPIC

A. Development Objectives of the Study

If transferring a number of products has been produced within the car manufacturing plant has been manning the production line can also check the area as possible with the naked eye. On the other hand, it is also impossible to confirm the area. In the former case, if the accident happened in the incident is relatively easy, whereas the naked eye cannot confirm place, it was not until the state line was stopped after the accident is confirmed that it is possible and probable cause analysis. For example, the conveyor carrying the load for the between the various production lines such as vertical rise to the second and third floors, unmanned automated line of descent when visual confirmation is impossible, and in particular, conflict between the conveyor and loading in this section the crash of the goods occurs frequently. But it does not have to buy a certain point, immediately correspondence is not easy. In addition, it is difficult to know the cause of the accident has not been written. The next point is difficult to measure because the accident occurred after an accident caused by a short analysis and mechanical information. The burden of enterprises for labor costs per person placing the cursor in the local car manufacturing plant accident, it is impossible. This study is the Industrial Estate Authority of on-site customized technology development. The production history of sudden crashes and crash load of automobile production plant within the automated system would be. The development of wireless transmission to the manager in real time, the automatic conveyor could be able to assess the situation immediately. Sound possible with the conveyor and the impact sensor and the real-time image recording apparatus For this purpose, the development of a radio transmitter to send an image to install and to solve the various problems described.

B. The Contents of the Development Study

There is its own automation equipment, video recording and wireless transmission capabilities for CAE analysis and incident response for unforeseen mechanical strength and durability of the main part. It developed a real-time image recording device for unattended and automated production equipment installed conveyor and records the sudden crash course and, in the case of the load falling conveyor stops equipped with recording devices automatically detect the crash and sends a signal to other conveyor nearby also it stops at the same time. And receive the stop signal as described above, collision, crash due to shock or even more than a certain decibel is based on more than sound sense to also stop after an accident process can be operated again send a safety signal. It also allows a user to wirelessly transmit the incident in real-time to determine the production line. Casualties by adjusting the flexibility to produce products in a manufacturing plant in Smartrol technique[3,4] developed in this study and smooth processing of difficult to find the cause catastrophic accident case, This system that reduce accidents may contribute to increased productivity in the

following three things with the development objectives and to carry out research. First, the increase in carrying capacity of 1.5 tons and with a 3 ~ 4mm precision in unmanned conveyor control automation development, and second, important site CAE analysis for the exact stop control, third, wireless video recording device developed for the outbreak incident response. This study focuses on wireless technology video recording device developed for the most important outbreak incident response.

III. DESIGN AND DISCUSSION

A. The development of unmanned automated transfer vehicle (EMS) control part of increased load capacity 1.5 tons and with a 3 ~ 4mm stop accuracy capacity

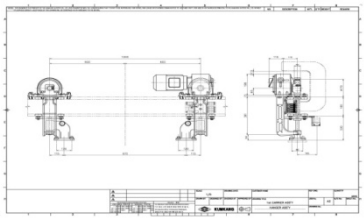


Figure 1: Previous 2 Point Trolley of Driving Part1

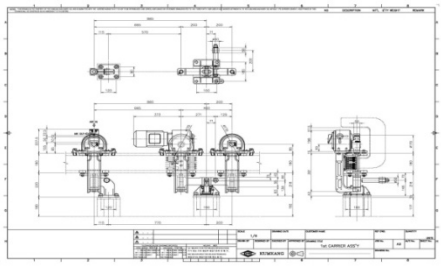


Figure 2: Advanced 3 Point Trolley for 1.5ton Loading of Driving Part1

In figure1., it is a two-point driving the trolley makes 1.5 tons of heavy load can switch to a three-point driving trolley of figure2. can be caused by increased weight, as confirmed by the following figure3. and figure4. it became possible because of the eccentric problems addressed by the application of the balance weight (balance weight).

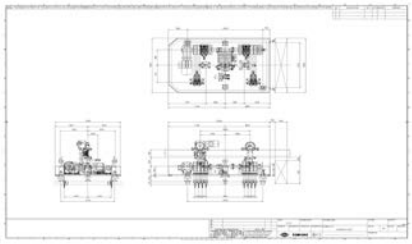


Figure 3: Previous 2 Point Trolley of Driving Part2

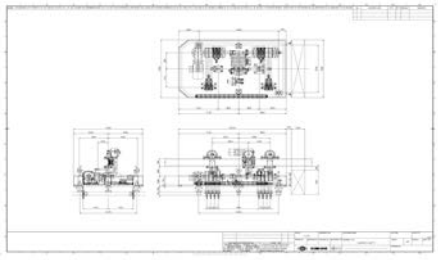
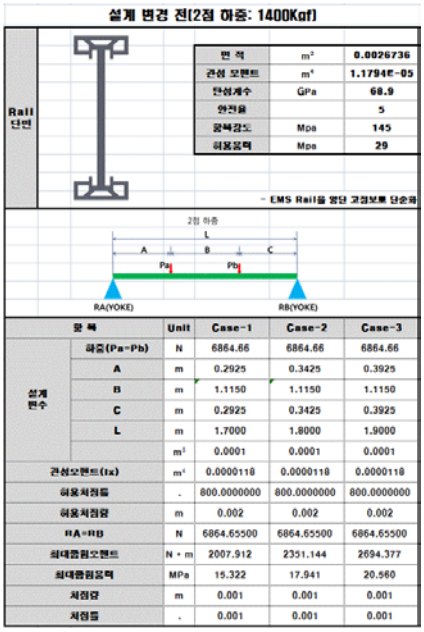


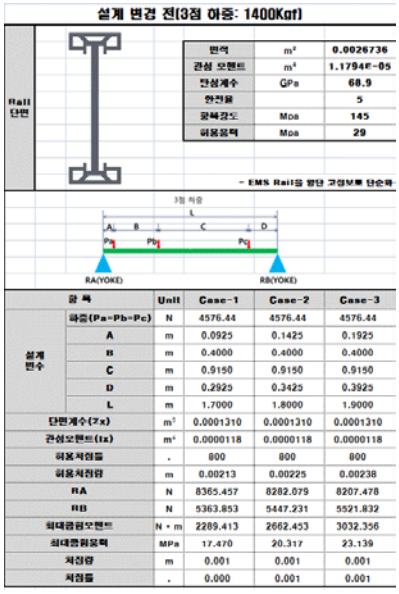
Figure 4: Advanced 3 Point Trolley of Driving Part2

The eccentricity is caused by the increased weight of the third carrier. The weight of these problems is designed to reinforce the secondary carrier. In case of the weight to the primary carrier is installed, handling (loading) is difficult when UP / DOWN part of the EMS in the correct part of the bonded to the third carrier. Thus, the weight has been installed on the secondary carrier part. As a result, the accuracy of the eccentric and stuff when bonding dissimilar parts is able to increase. That is, there was a summary of the increase in load due to the weight of the second carrier transport increased. And at two points with two deflection caused by the weight of the connecting part of one wheel of a car carrier and a second carrier transporting part of the development it was replaced by three points. The following shows the material mechanical basic principle 5). Figure5. shows a two-points trolley, figure6. shows a three-point trolley. It shows the trolley calculated at each 1.4 ton. Figure7. shows a three-point location and the position of the trolley when the load-bearing capacity of the trolley have been increased to 1.8ton. In figure5., figure6. and figure7., there were also attached rail-related calculations to assist individual understanding.



설계 변수	항목	Unit	Case-1	Case-2	Case-3
	하중(Pa=Pb)	N	6864.66	6864.66	6864.66
	A	m	0.2925	0.3425	0.3925
	B	m	1.1150	1.1150	1.1150
	C	m	0.2925	0.3425	0.3925
	L	m	1.7000	1.8000	1.9000
		m²	0.0001	0.0001	0.0001
관성모멘트(Ix)		m⁴	0.0000118	0.0000118	0.0000118
허용처짐들		.	800.0000000	800.0000000	800.0000000
허용처짐량		m	0.002	0.002	0.002
RA=RB		N	6864.65500	6864.65500	6864.65500
최대굽힘모멘트		N • m	2007.912	2351.144	2694.377
최대굽힘응력		MPa	15.322	17.941	20.560
처짐량		m	0.001	0.001	0.001
처짐들		.	0.001	0.001	0.001

Figure 5: Previous 2 Point Trolley of Basic Calculation (1.4 ton)



설계 변수	항목	Unit	Case-1	Case-2	Case-3
	하중(Pa=Pb=Pc)	N	4576.44	4576.44	4576.44
	A	m	0.0925	0.1425	0.1925
	B	m	0.4000	0.4000	0.4000
	C	m	0.9150	0.9150	0.9150
	D	m	0.2925	0.3425	0.3925
	L	m	1.7000	1.8000	1.9000
단면계수(Zx)		m³	0.0001310	0.0001310	0.0001310
관성모멘트(Ix)		m⁴	0.0000118	0.0000118	0.0000118
허용처짐들		.	800	800	800
허용처짐량		m	0.00213	0.00225	0.00238
RA		N	8365.457	8282.079	8207.478
RB		N	5363.853	5447.231	5521.832
최대굽힘모멘트		N • m	2289.413	2662.453	3032.356
최대굽힘응력		MPa	17.470	20.317	23.139
처짐량		m	0.001	0.001	0.001
처짐들		.	0.000	0.001	0.001

Figure 6: Advanced 3 Point Trolley of Basic Calculation (1.4 ton)

항 목		Unit	Case-1	Case-2	Case-3
설계 변수	하중(Pa=Pb=Pc)	N	5883.99	5883.99	5883.99
	A	m	0.0925	0.1425	0.1925
	B	m	0.4000	0.4000	0.4000
	C	m	0.9150	0.9150	0.9150
	D	m	0.2925	0.3425	0.3925
	L	m	1.7000	1.8000	1.9000
단면계수(Zx)		m^3	0.0001310	0.0001310	0.0001310
관성모멘트(Ix)		m^4	0.0000118	0.0000118	0.0000118
허용처짐등		-	800	800	800
허용처짐량		m	0.00213	0.00225	0.00238
RA		N	10755.588	10648.387	10552.472
RB		N	6896.382	7003.583	7099.498
최대굽힘모멘트		N · m	2943.531	3423.154	3898.743
최대굽힘응력		MPa	22.462	26.122	29.751
처짐량		m	0.001	0.001	0.002
처짐등		-	0.001	0.001	0.001

Figure 7: Advanced 3 Point Trolley of Basic Calculation (1.8 ton)

In addition, EMS control design that accurate control possible is as follows. The stop control of up to 3 ~ 4mm been designed as a next improvement to the EMS control development. Drive unit is designed in consideration of the accuracy and durability of the control driving wheel. Figure8. and Figure9. below shows the EQUIVALENT 2D drawings and ROCK device front, right side, flat part of the ROCK device.

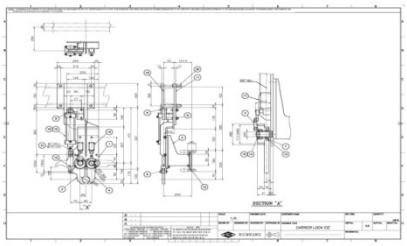


Figure 8: Drawing of ROCK EQ'(2D)(Support & Level)

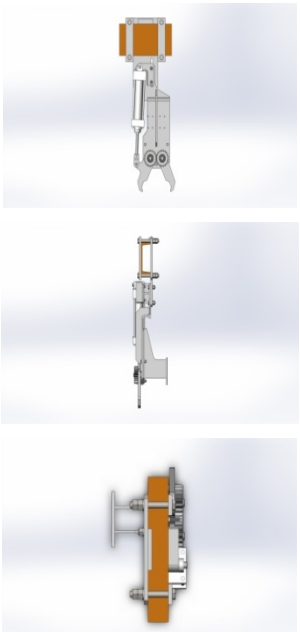
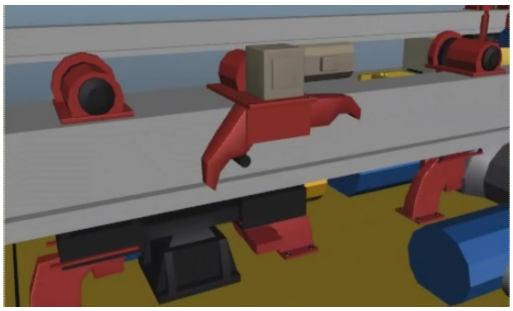


Figure 9: Drawing of ROCK EQ'(3D) (ROCK equipment(front view), ROCK equipment(side view), ROCK equipment(top view))

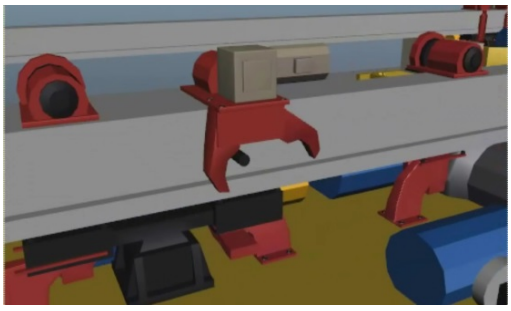
B. Important Areas CAE Analysis for Accurate Stop Control

Position Control CAE Analysis

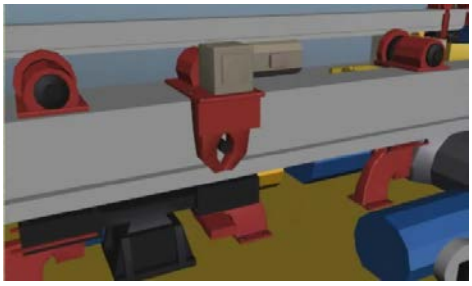
Each point of the three conveyors EMS is designed to be as 1.5TON is applied. Existing designs are 1.0TON. When the two branches of the conveyor are installed, the performance is not good in the quietness and the load backrest. In the simulation of figure10 and figure11, the range of interference and collision between the rail and the conveyor, it can be seen the load limit of the titration. If the case of the present study increased with three points, the contacts of the conveyor is too stable that EMS system may be capable of supporting a load of up to 1.5TON without going to the fracture strength. Simulation of this study was used for 3D EXPERIENCE (Manufacturing Planning) of DASSAULT used in digital production and manufacturing. Here, it was confirmed with the movement of the interference EMS assembly system. Figure10 and figure11 are indicated by the position control process order. Before entering the EMS, it showed the possibility of implementing automated by showing the interference level down to the entry and then, the product descent. The simulation can also create a movie into two. Also, to capture the necessary confirmed whether the interference in the performance at the time of IN and OUT Shift Up and Down, Grab operation in each of the processors. Currently, the contact was stretched to the increase in the payload weight from 1.0TON to 1.5TON. However, long-term plans to expand to more than 2.0TON move along the large, sophisticated parts of the vehicle. When the payload weight is increasing, difficulty in development are thought to go up in proportion to the weight of the payload weight.



(a) Position Control of Step 1

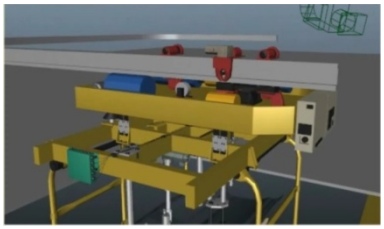


(b) Position Control of Step 2

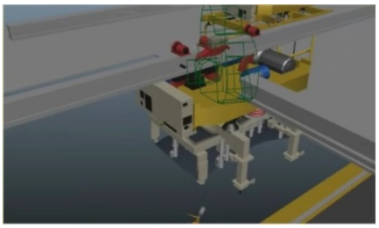


(c) Position Control of Step 3

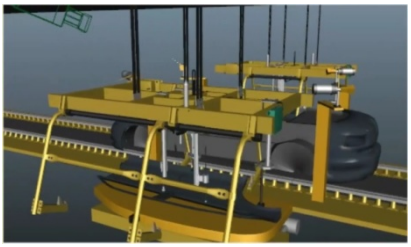
Figure 10: Position Control Processing by Each Step



a) EMS System in



b) EMS System out



c) Product Unloading of EMS System

Figure 11: System in-out and Product Unloading

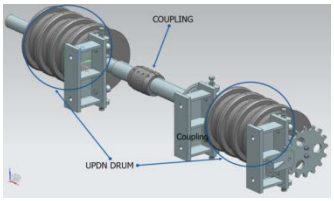
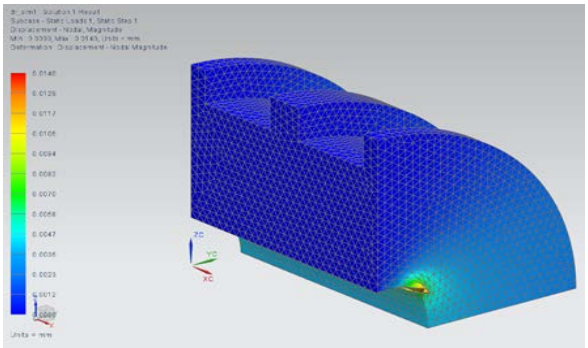
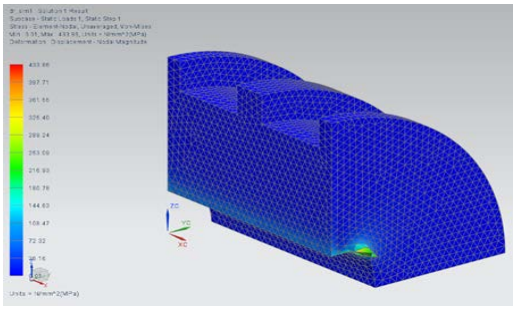


Figure 12: Up-down Drum and Coupling

This assumption is necessary for performing the simulation analysis of figure12. After that do not affect the analysis result Chamfer belt and simplify the shape of the bonding surface portion makes the idealized model of superposition.



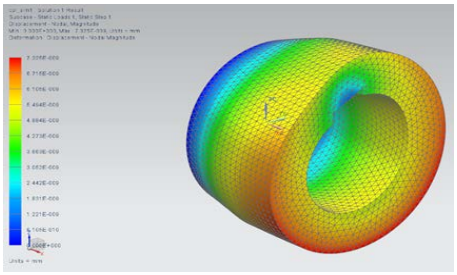
a) Displacement(min: 0, max: 0.0140mm)



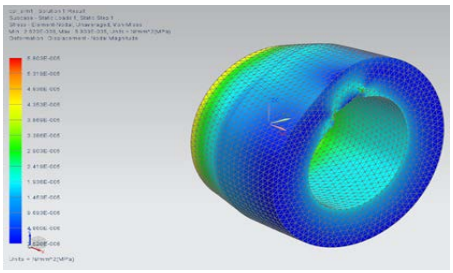
b)Deformation(min: 0.01MPa, max: 433.86MPa)

Figure 13: Up-down Drum Simulation

Figure13. of the element type is a 3D Tetra10. Element number is 43 043 and 65 766 Node number. Boundary and loading conditions by a transfer force of a key due to a symmetry boundary conditions in the model-like rotation axis as a load distribution (pressure) analysis is carried out only 1/4.



a) Displacement(min: 0, max: 7.325E-9mm)



b) Deformation(min: 2.620E-8MPa, max:5.803E-5MPa)

Figure 14: Coupling Simulation

Coupling the analysis part is to simplify the bolt portion that does not have a significant effect on the analysis. The results are shown in figure14. below. Element number in this analysis is 30,042, Node number is 47 595. The boundary conditions and the load conditions are in the boundary condition due to the symmetry of the shape model. Torque Coupling inner wall of the rotating shaft are as boundary conditions.

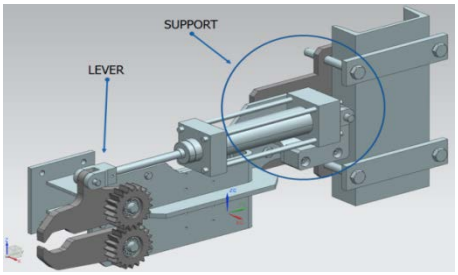
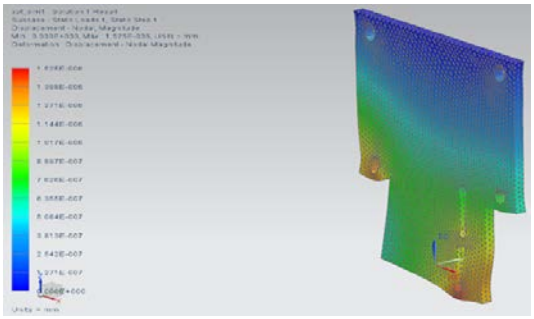
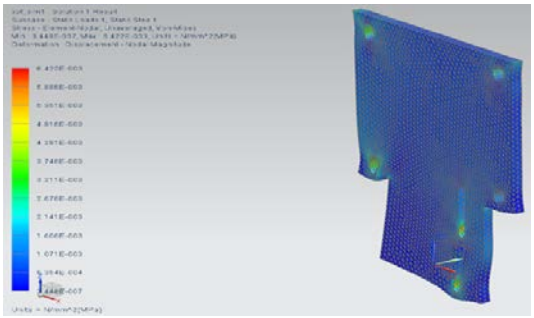


Figure 15: Level and Support

Interpretation of three-dimensional modeling of the target figures of Support and Level around a drawing of figure9. are carried out. The results are shown in figure15. Creating a simplified shape and an ideal model by assuming the chamfer portions do not affect the analysis results which perform deformation analysis and displacement analysis (figure16.).



a) Displacement(min: 0, max: 1.525E-6mm)



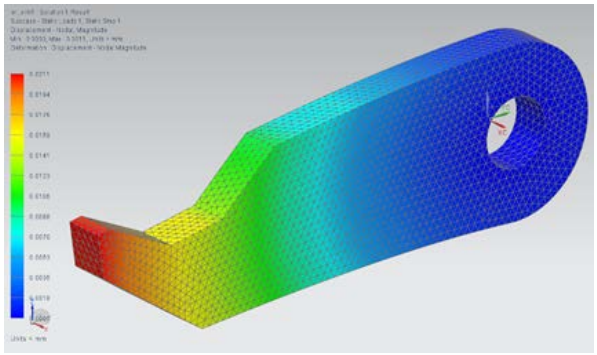
b) Deformation(min: 3.448E-7MPa, max: 6.422E-3 MPa)

Figure 16: Support Simulation

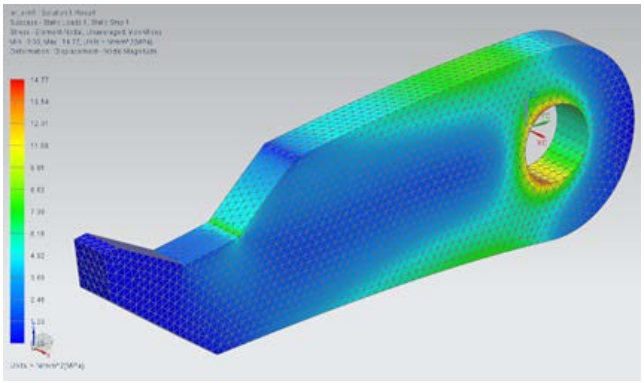
Figure16. is a 3D Tetra 10 of the element type previously used. Element number is 26,375, node number is 46 479. The boundary conditions and the loading condition is the boundary condition due to Clamp. Boundary conditions are considered to be part of the bolt for supporting the load of the entire structure.

Finally, the analysis of the Level shows figure15. Chamfer simplifies the shape of which does not affect the analysis result, and delete the Gear part to perform a displacement analysis and deformation analysis (figure17.).

3D Tetra10 the element type can also figure17. and element is 26,287, Node number is 42.145. Loads and boundary conditions should be part of the Gear Carrier structures. Load condition is considered to be a load for over position correction Clamp the Main drum by inertia.



a) Displacement(min: 0, max: 0.0211mm)



b) Deformation(min: 0, max: 14.77 MPa)

Figure 17: Level Simulation

Analysis of the results indicated that Displacement and Strain Analysis is a small amount that is less than 1/50. This result can not interfere with the production from the EMS know the analysis result should the degree of displacement and deformation occurs in almost negligible.

Photo 1: Prototype of EMS 3point Trolley with having Installed 4 Monitoring Cameras

IV. CONCLUSION

EMS (Electronic Mono Rail System) which is used in various fields such as automobile manufacturing process, if you cannot see the eyes of the people of unmanned and automated difficult to establish if the accident causes and countermeasures. To this end, the result of loading dosage of the enlargement of the car is performing CAE analysis critical areas for design and precise control of the EMS stop control with the correct stop rate about the same increase obtained the following results.

1. Despite it increased to 1.5 tons of eccentric loading problems for unmanned automated transfer control to satisfy the 3~4mm stop rate increase the load capacity can be developed through the application itself has a weight balance (weight balance).
2. EMS was carried out important parts of the stop control for accurate CAE analysis (unmanned automated transfer parts). Positioning CAE simulation helped design the survey for interference in-out, product loading-unloading, shift up-down, etc. grab. Furthermore, by analyzing the main components influencing the CAE analysis calculates the maximum, minimum displacement and deformation helped design.
3. Schedule EMS system, a portable weight obtained through the design and analysis as described above are available with competitive systems in other similar industries that require automation to adjust and reduce the payload weight on the same principle, and leading industrialization and unattended automation It is considered to make the lead stand.

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INTERNATIONAL JOURNAL OF PHARMA AND BIO SCIENCES

ISSN
0975-6299

Analysis of Depth Perception in Smart Phone HMDs

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Abstract---

Background/Objectives: New Content on head mounted displays can cause visual discomfort. The objective of this research is to improve the viewing experience on smart phone based head mounted displays.

Methods/Statistical Analysis: Through an experimental setup we demonstrate how existing stereoscopic content can be displayed differently applying different settings for the head mounted display. The different settings represent different virtual viewing distance. Content is processed and rendered as clips. These clips are screened to test viewers on calibrated smart phone based head mounted displays. We then conducted a survey asking the viewers to evaluate the viewing comfort of the different settings.

Findings: The test persons each watched six movie clips with a duration of 30 seconds and had to read the numbers from -3 to 3 printed on a virtual test chart, each representing values ranging from positive to negative parallax. After viewing the movie clips on a smart phone based head mounted display, the test persons were requested to evaluate the comfort level during the viewing of the test pattern at different distances. The test persons where asked to give a score between 1 (very uncomfortable) up to 5 (very comfortable) for each viewing situation. The survey was analyzed and showed that virtual further viewing distances have a tendency to be more comfortable for most viewers. Our survey shows that the movie clip representing a virtual 10m screen positioned around 7m distance from the viewer was perceived as the most comfortable.

Improvements/Applications: The virtual viewing distance can increase the comfort in virtual reality applications. Taking account human factors, application developers can improve the viewing experience for the users.

Keywords--- HMD (Head Mounted Display), VR (Virtual Reality), Stereoscopic 3D, Depth Information.

**Corresponding Author*

Special Issue on "Engineering and Bio Science"

I. INTRODUCTION

HMDs for the consumer market appeared since the early 1990ies. Table 1 shows the field of view of around 30° created the impression of watching a television at a certain distance. Today, smart phones owners can use accessories such as Google Cardboard. Where the old devices, replacing commonly used shutter glasses[1],used to be monitors only and needed to be attached to a player or computer, the new generation of HMD uses the high displays of smart phones with a horizontal resolution of 2.5K or more. While smart phones offer new possibilities for creating stereoscopic content[2] their superior displays with magnifying lenses increase the viewing angle and allow to create more immersive virtual reality experiences than before[3]. Today HMDs have a field of view between 90° and 210° and usually use the smart phone sensors and onboard computer for interactivity and visualization. Stereoscopic Content can be provided in form of 3D cinema and 3DTV movies or 3D games. These media were usually produced for other stereoscopic display devices. The subject of this study is to evaluate the perception of depth of this contents specifically on smart phone based HMDs. We will further analyze the viewing situation of existing stereoscopic 3D contents and evaluate different settings that can optimize the viewing and comfort experience on smart phone based HMDs.

Table 1: HMD Overview

Model	Year	Resolution	2D3D	FOV
CAE Electronics	1995	1280 x 1024	3D	127°
Sony Glastron	1998	800 x 600	2D 3D	28°
I-O Display Systems	2001	800 x 600	2D 3D	26°
Cybermind NL	2001	800 x 600	2D 3D	30.2°
eMagin	2005	800 x 600	2D 3D	40°
Samsung Gear VR	2015	2560 x 1440	2D 3D	96°
StarVR	2015	2560 x 1440	2D 3D	210°

II. RELATED WORKS

The various stereoscopic media have different content production guidelines. Current production practices can be described as follows:

1) 3D Photography: In stereo photography a commonly accepted rule of thumb is the $1/30^{th}$ rule. It states that the stereo base can be safely assumed to be $1/30^{th}$ of the distance from the camera to the foreground[4].
2) 3DTV: One of the first 3DTV broadcasters to establish production guidelines for 3D contents for television was BSKYB. While having a depth budget of 3%, positive parallax should not exceed 2% and negative parallax not exceed 1% considering screen sizes in the range of 46 to 70 inches[5].
3) 3D Cinema: Stereoscopic production practices do not have a single production guide. However The CMS MSU Graphics & Medialab, Moscow has published the metrics of over hundred stereoscopic 3D movies including natively shot movies as well as conversions[6]. The latest report analyzes a trend in production metrics for 3D cinema movies towards a depth budget of less than 1.6% with positive parallax not exceeding 1.1% and a negative parallax within the range of 0.5% in average.
4) 3D Computer Games: Stereoscopy in computer games is mostly handled individually be the games manufacturers. It is often a setting to be adjusted by the user who has little knowledge about the effects of visual perception. Our former research presented a solution for automatic depth parameter setting in video games adapted to the screen size[7].

The large variety of contents creates a large number of cases, for viewing situations on smart phone based HMDs. In this study we will focus on the most common case: the reproduction and viewing of existing stereoscopic 3D movies on a smart phone based HMD. In order to cover a generous latitude of positive and negative disparity, we will assume maximal disparity values ranging from negative 3 (for objects coming towards the viewer) and positive 3 (for the most far backgrounds) in the existing contents.

A. The Zone of Comfort

A general problem of vision on stereoscopic displays is the vergence accommodation conflict. Shibata, Kim, Hoffman, & Banks did research to predict visual discomfort with stereoscopic displays. Their experiments show that a zone of comfort exists within a situation where focal distance and vergence are in an acceptable correlation for the viewer[8]. Figure 1 shows how this zone becomes smaller with shorter viewing distance.

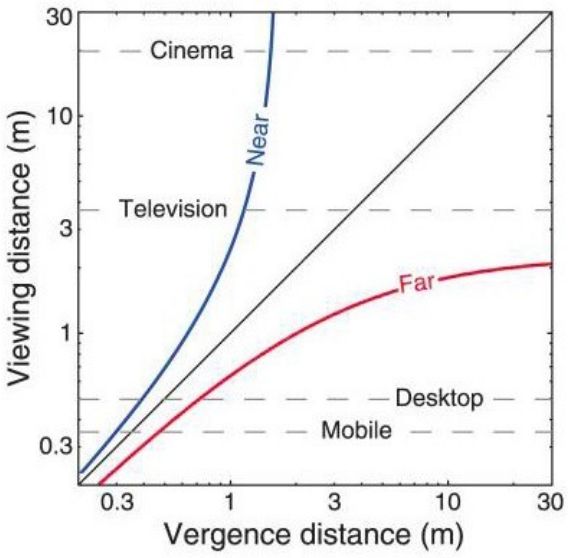


Figure 1: Zone of Comfort

III. PROPOSED METHOD

In order to evaluate the different types of contents on smart phone based HMDs, we will

1) Derive the stereoscopic parameters for this viewing device
2) Compare these parameters with the parameters of the different content types
3) Propose how the content for display on smart phone based HDMs can be optimized

Figure 2 shows the schematic setup of a simple magnifier described by Kramida and Varshney for their research about the vergence accommodation conflict on HMDs[9]. For the test set up we will use a simple cardboard HMD holding a smart phone. The metrics of the experimental setup are shown in table 2.

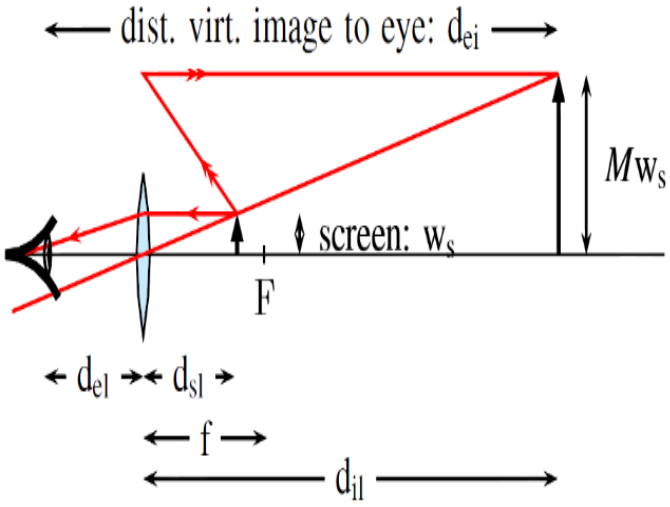


Figure 2: Simple Magnifier

Table 2: HMD Magnifier Metrics

Parameter	Value	Variable
lens diopter	21.5D	-
focal length	46.51mm	f
eye relief	35mm	d_{el}
screen distance	36mm	d_{sl}
display width	126.1mm	w_S

A. Virtual Screen Size

In order to apply the appropriate stereoscopic parameters we need to determine the size wi and distance del of the virtual screen from the eye. For this we use the thin lens formula to determine the magnifying factor *M*.

$$\frac{1}{d_{sl}} + \frac{1}{d_{il}} = \frac{1}{f} \quad (1)$$

$$M = \frac{d_{il}}{d_{sl}} \quad (2)$$

In our model as shown in Figure 2 we obtain *M*=4.5. As we use a magnifying lens the focus is towards infinity, the virtual screen image is projected at a distance *d*il=161.3mm. The real screen size depends on the size of the smart phone display. Table 4 shows the metrics of popular models by release date. Screen size and horizontal resolution need to be divided by two, since the whole display is used for both eyes side by side.

B. Stereoscopic Parameters

According to this setup we obtain a slightly different setup then in 3D Cinema or in 3DTV. The point of Zero-Parallax would be situated at about 16cm in front of the viewer, if the two images where overlapping like on a 3D display. The effect of the magnifying lens lets the viewer focus near to infinity. However since the image on most smart phone based HMD is immersive, we are not able to distinguish between screens at 16cm or at 1.6m since our accommodation is constantly towards infinity, only the disparity gives us the depth cues necessary to locate the objects in space.

Considering the research on the zone of comfort[7] and observing Figure 1 showing Viewing Distance versus Vergence Distance, we can assume that our viewing distance similar to the cinema situation with 30m and above. The plot of the near line shows that a vergence distance around 1.6m would still be within the zone of comfort. While this gives a wide latitude for viewing VR content, it also shows the difficulty to view very close objects e.g. in the haptic range.

IV. EXPERIMENT

For setup viewing of different types of content we choose use a smart phone Galaxy Note3. Our screen has a width of 12.61cm, slightly less to bring the center of each optical axis to same size areas on the display. Larger and smaller displays need an adjustment. Google provides a cardboard viewer adjustment calculator for that purpose[10]. Maladjusted smaller displays will tend to move the contents closer to the viewer, while larger displays will increase the depths.

A. 3D Content Cases

When we consider the different types of contents significant differences in stereoscopic space perception become visible, especially because objects on the Zero-Parallax plane would be far outside the zone of comfort:

1) 3DTV Content: 3DTV Contents can be adapted to smart phone based HMD displays. As in 3D Cinema the power of 3D effects is due to the crossing of the Zero Parallax plane. Due to the immersive nature of smart phone based HMD displays, this effect is seriously reduced. The overall depth budget seems to be reduced and generally pushed towards the far.

2) 3D Cinema Content: While existing contents can be viewed on smart phone based HMD Displays, it is obvious that a major part of the stereoscopic viewing experience will be different. First of all the immersive field of view takes away the screen borders and therefore also the screen plane. The whole content is moved towards the positive parallax. Out screen effects cannot occur as spectacularly as it is the case in 3D Cinema.
3) Youtube VR360 Content: Youtube VR-Player Software retrieves Optical parameters from different manufacturers and is therefore able to adjust the correct far point according to the size of the display.
4) Custom made content: Content that is rendered in WebGL as an example needs to consider the metrics of the glasses used for viewing. This is why many smart phone HMD Manufacturers often propose their own player as a bundle with the HMD hardware.

A direct transposition leads to a viewing experience that is constantly on at the limit of the physiological tolerance and could lead to discomfort over longer viewing periods. In this research we will focus on the case of 3DTV and 3D Cinema content.

B. Test Chart Experiment

In order to verify the effects of the different set-ups, we created a test chart representing the disparities occurring in 3DTV Content and in 3D Cinema movies. Table 3 shows a depth range from -3% to +3%. These values cover most of the average disparities explained in the above mentioned production methods. The pixel values are on the base of two full HD images with dimensions of 1920x1080 pixels. The zero parallax is the screen plane. In 3D Cinema or 3DTV this is generally the location of the screen itself. The negative parallax makes objects appear to be positioned in front of the screen plane. The positive parallax makes objects appear to be behind the screen plane. We have extended our test pattern beyond the normal range, to observe limitations in the perception of depth.

Table 3: Disparity Test Chart

Parallax %	-3	-2	-1	0	1	2	3
disparity pixels	-58	-38	-19	zero parallax	19	38	58

In order to visualize the limit of the screen white arrows have been added to the border. They are located at zero parallax. A thin pattern in the zero convergence plane shows possible geometric distortions. Figure 3 shows the stereoscopic test pattern.

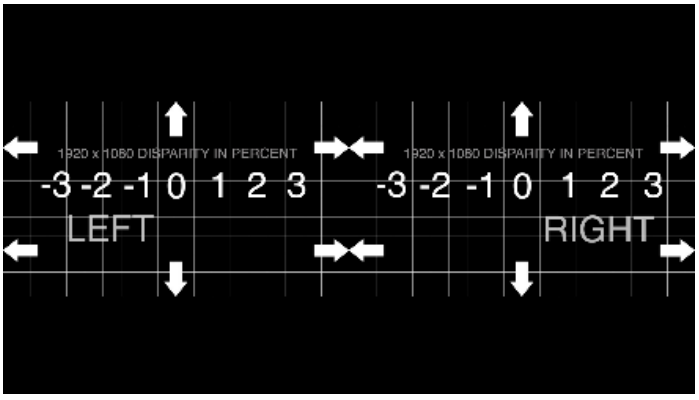


Figure 3: Disparity Test Pattern

C. HMD and Viewer Calibration

A very critical point is the correct HMD and Viewer Calibration. Figure 4 shows the general principle of the virtual screens. Unlike in 3D movies in cinema the two images are not exactly superposed. The fact that the screens are so close to the eye and due to the offset of the two virtual screens because of the viewer's individual interpupilar distance, small alignment errors can seriously affect the perception of depth and bring the content very quickly out of the fusionable viewing area. Roland and Gibson have demonstrated the constraints and precision required during the process of calibration[11].

Although Google provides with Cardboard a very affordable headset, the viewer app allows a sophisticated calibration procedure. Figure 5 shows the parameters available to adapt the VR Player to the

parameters of the head set as well as to the user's individual physiognomy. These settings can be generated on the google website and saved as a bar code. While this calibration is necessary to assure visual comfort and precise depth positioning, it is even more crucial when it comes to Augmented Reality applications. Superimposed objects might not be where they are supposed to be and projected walls or floors might seem closer or deeper then perceived with the natural vision[12].

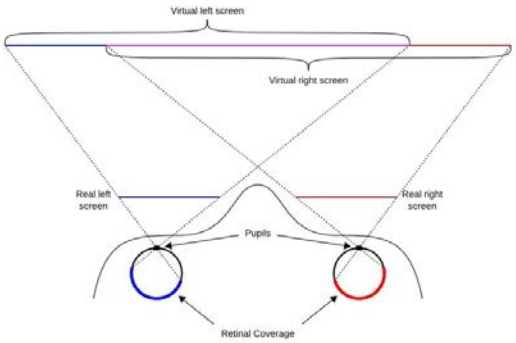


Figure 4: HMD Calibration Diagram

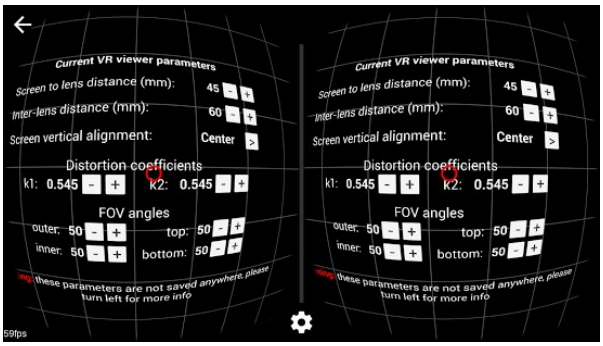


Figure 5: Youtube Viewer Calibration Settings

D. Optimization of Stereoscopic Content

As shown before, the viewing experience of existing stereoscopic contents in 3D Cinema or 3DTV differs from the experience perceived on a smart phone based HMD. Major adjustments can be performed to optimize the viewing experience:

1) Choose a large display with high resolution. Table 4 shows an overview of the metrics of recent smart phones that can be used in HMDs
2) Proper calibration of the HMD display
3) Proper calibration of the VR Player software
4) Move the 3D contents towards the back to bring it closer to the focus zone
5) Consider rendering a *floating screen plane* to recreate the feeling of a screen plane and simulate a 3D Cinema viewing experience

Table 4: Smart Phone Display Metrics

Company	Model	Screen	Resolution	PPI	Pixel	Year
Apple	iPHONE 5s	4"	1136x640	326	0,078	2013
Google	NEXUS 5	4.95"	1920x1080	445	0,057	2013
Samsung	Galaxy Note3*	5.7"	1920x1080	387	0,066	2013
LG	L3 G3	5.5"	2560x1440	538	0,047	2014
Samsung	Galaxy S6	5.1"	2560x1440	577	0,044	2015
Samsung	Galaxy Note5	5.7"	2560x1440	518	0,049	2015
LG	LG V10	5.7"	2560x1440	513	0,050	2015
Sony	Xperia Z5 P	5.5"	3840x2160	806	0,032	2015
* our setup						

V. EXPERIMENTAL REPOSITIONING IN VR SPACE

While the conventional VR Players simulate a scaled down screen on the Virtual Screen, these players allow no further adjustment and optimization of the 3D Contents. We would like to recreate the viewing situation as if the viewer was using another 3D display such at the cinema screen13. We therefore use a 3D animation program to draw a virtual screen and place our test patterns as a texture on it. The virtual camera is positioned at the virtual viewing position. And the Interaxial Distance (IAD) is set to match the human vision at 6.5cm. The software allows to render a spherical image for each eye. We repeat this step for each eye, and we render the image to a squared 4K image, the highest resolution, that the Youtube Player can display. Figure 6 shows the construction of a 10m large screen as a 3D model with our test pattern applied as texture in the 3D software. The virtual cameras in the animation program allow us to adjust the point of convergence of the cameras. In our example we will set this convergence distance to 5m from the virtual camera, and we keep this constant through the whole sequence of test images to keep a consistency of depth14. Finally we will project the right test pattern only visible for the right eye, and the left test pattern only visible for the left eye. For the purpose of evaluation of the distance in the VR space around the 10m screen, we add a series of numbers from 1 to 10 marking the distance in meters from the camera.

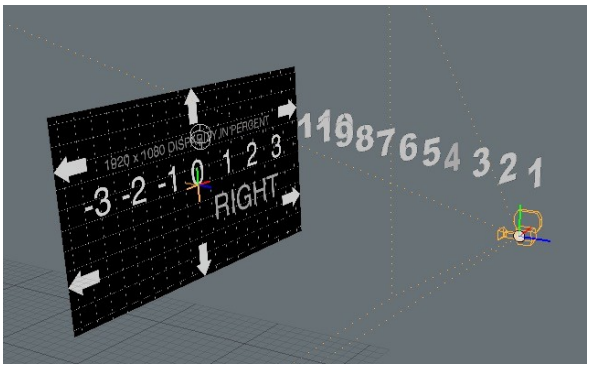


Figure 6: Projection in 3D Space

In order to make the Youtube VR Player display the image in stereoscopic format. Two additional steps are necessary. First we need to composite the left and right images in an *above-below* format. In this step the vertical resolution of each image is scaled by half, in order to fit the full frame. Figure 3 shows the composited test pattern. In a second step we need to inject stereoscopic metadata, as well as metadata qualifying the images as VR360 movie. This is done with the help of a metadata injector provided by Youtube.

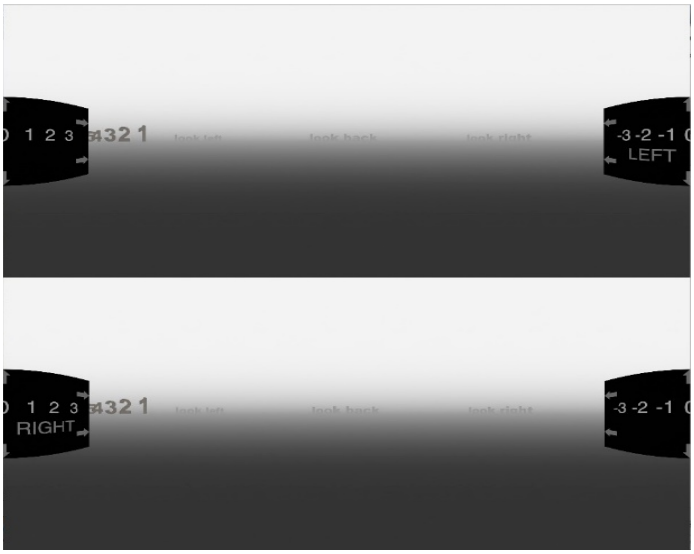
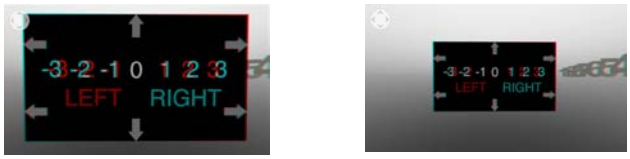


Figure 7: 3D Pattern in 4K Resolution and Above Below Format

Finally the resulting movie is uploaded to the Youtube Website. The injected metadata, triggers the VR Player to display the VR Controls and allow now to choose monoscopic, stereoscopic and cardboard viewing methods. The result of two different example movies as anaglyphic VR360 movie can be seen in Figure 8.

VI. EXPERIMENTAL TESTING OF DIFFERENT VIEWING SETTINGS

In this section we describe the test we have made in our lab with 40 randomly selected persons, in order to evaluate the described viewing methods. The result is not representative, and would need to be repeated on a larger scale. However we can observe a trend and indicators, which will be examined in further research.



(a) (b)

Figure 8: Test Movies Example in Youtube Player (anaglyph) (a) Distance 5m (b) Distance 8m

Using a calibrated Cardboard-Type HMD Device with a Note3 smart phone, we have exposed each test person to the following situations.

1) The content is the test pattern as described above
2) The HMD device is the same for all observers
3) The calibrated Youtube VR Player is used for playback of all movies.
4) Six movies with the settings as shown in table 5 as a stereoscopic VR360° movie.

The test persons are requested to watch each movie with a duration of 30 seconds and to read the numbers from -3 to 3. This is to evaluate different situations of positive and negative parallax in the test pattern. After viewing the six movies in the HMD Viewer, the test persons were requested to evaluate their viewing experience on a survey. For each clip we requested to evaluate the comfort level during the viewing of the test pattern at different distances. The test persons where asked to give a score between 1 (very uncomfortable) up to 5 (very comfortable) for each viewing situation.

VII. RESULTS

The test persons have viewed and evaluated the comfort score of the same stereoscopic 3D contents shown with the settings shown in Table 5. Table 6 shows the result of this test viewing. Although the test was performed on only a small number of test persons, we can see that the mean standard deviation of the results, stays in a relatively similar range. We also concluded from interviews after the viewing that most test persons had experienced similar levels of comfort during the test screening.

Table 5: Test Chart Movie Parameters

Nr	Screen size	convergence	IAD	distance
1	10 m	5 m	6.5 cm	5 m
2	10 m	5 m	6.5 cm	6 m
3	10 m	5 m	6.5 cm	7 m
4	10 m	5 m	6.5 cm	8 m
5	10 m	5 m	6.5 cm	9 m
6	10 m	5 m	6.5 cm	10 m

Table 6: Survey Results

distance	MSD	valid percent (frequency)				
		1	2	3	4	5
5 m	2.000.70	24.00(12)	52.00(26)	24.00(12)		
6 m	2.400.86	10.00(5)	54.00(27)	22.00(11)	14.00(7)	
7 m	3.720.88		10.00(5)	26.00(13)	46.00(23)	18.00(9)
8 m	3.181.02	8.00(4)	14.00(7)	36.00(18)	36.00(18)	6.00(3)
9 m	2.641.10	18.00(9)	26.00(13)	34.00(17)	18.00(9)	4.00(2)
10 m	2.260.99	26.00(13)	32.00(16)	34.00(17)	6.00(3)	2.00(1)

For some test persons even fusionning the two images to a 3D image at a close distance was difficult. Other persons could adapt but mentioned it takes an effort to watch the numbers. Viewing the 3D test pattern rendered as VR360 movie, created in general the a more comfortable viewing experience, then watching it in the Youtube VR Player with its automatic settings for 3D. The content is virtually pushed more far behind the screen plane.

In both last cases, the content is severely scaled down to fit with correct aspect ratio within the field of view of one eye. All observers noticed at far distance the effect of stereoscopic 3D was degraded, and the negative parallax almost not perceivable anymore. After all all test persons found for themselves a viewing situation where still enough stereoscopic 3D experience could fit at a certain distance of the projected screen.

Looking at the numbers, we can draw a first conclusion: If the screen is closer to the viewer, the viewing situation is generally judged to be uncomfortable for most of the viewers. On the other hand, if the screen is at the farest, this does not bring the maximum comfort for most of the viewers.

Figure 9 shows the results of the comfort survey as a graph. Two things become clearly visible by visualizing the result: The maximum comfort for most viewers is for the virtual projection screen positioned at 7m from the viewer. Further distances decrease the viewing comfort for most viewers. The second point is that the comfort does not seem to increase in a linear way from uncomfortable to comfortable and again to uncomfortable. We notice a clear gap between the 6m mark and the 7m mark.

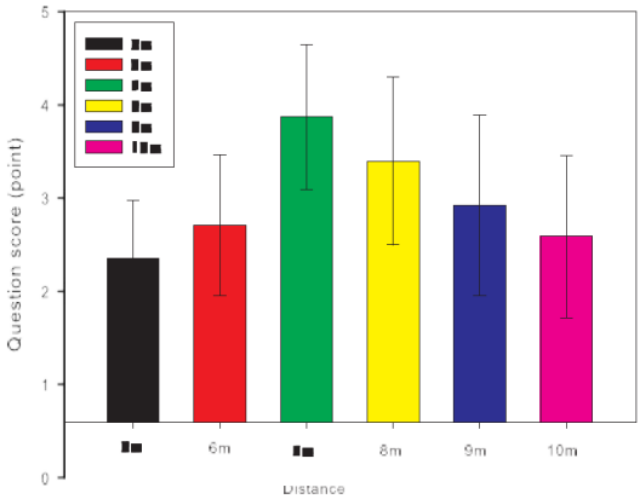


Figure 9: Test Pattern Viewing Comfort Survey

VIII. FURTHER RESEARCH

In the present experiment, we have changed one factor (the screen distance) and kept the other parameters constant. When examining displays in similar research other human factors need to be considered as well[15]. We will repeat the experiment with different setups for virtual camera convergence when generating the 3D test movies.

IX. CONCLUSION

We have compared and analyzed different production guidelines for stereoscopic content creation such as 3DTV and 3D Cinema. We have demonstrated the space perception of different media and described the particular features of 3D perception on smart phone based HMDs: The results have a direct effect on contents creation and adaptation: Smart phone based HDM stereoscopic content requires meticulous calibration. Its particularity is the accommodation which is constantly at infinity. With these parameters we can consider a stereoscopic space ranging from infinity to approximately 1.6m in front of the viewer, this is the range that is considered to be in the zone of comfort. To optimize the viewing comfort of existing stereoscopic contents we have proposed further optimization options. Using stereoscopic test patterns and 3D animation software we have positioned the 3D content at different distances while keeping the virtual convergence constant. Our experiments and the following survey was

performed on a small number of subjects, but could show a trend towards a most comfortable viewing distance, with our setup of a virtual 10m screen positioned around 7m distance from the viewer. One of the main issues of smart phone based HMDs is the omnipresence of the vergence accommodation conflict when viewing stereoscopic contents. This can only be overcome with another type of display. However adapting the stereoscopic content within the zone of comfort and respecting the specific viewing properties will allow content producers to further enhance the user experience.

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