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A Research Using Private Cloud with IP Camera and Smartphone Video Retrieval

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Abstract

In this thesis, A video information system uses IP camera, which transmits video information to HOST via Streaming Server or ftp server. But there's problem that HOST cannot retrieve video information without video information transmitted from IP camera. So in this thesis, host-active application program is developed, which can retrieve video information from HOST with only IP camera's IP address. By installing cloud server in the HOST, which smartphone can send videos to it regardless of network realms such as Wi-Fi, LTE or AP and transfer smartphone's video information to cloud server anytime using wired or wireless networks. So by installing a Private Cloud server in HOST, which provides unrestricted environment where user can develop and launch application programs and sync smartphone to it. Smartphone's video information is synced with Private Cloud ubiquitously using wired or wireless networks such as AP, LTE or WIFI and stored to Private Cloud so smartphone or IP Camera's video information is always stored in Private Cloud server which can be used as evidence when there's crime. Also employees can save materials of meeting which is saved to corporation's Private Cloud server in real-time and enables remote monitoring for employee in office to cooperate with employee in remote locations.

Keywords: *We would like to encourage you to list your keywords in this section*

1. Introduction

Video Information System in the past installed CCTV camera to certain locations and transmitted video information, which was retrieved in camera and transferred to HOST, and HOST was used for storing received video information. Recently, we can easily encounter Video Security Systems, which are based on IP Cameras. These Video Security Systems are cheap to install in the first place, does not requires maintenance cost, and can be easily extended, which makes them remarked as the best security systems. IP cameras are based on embedded system because of problems such as installing space, cost, and stability issues. There are a lot of restrictions for accessing or managing tons of IP cameras. There are weak points such as restrictions of clients' numbers, which can connect to IP Camera directly and simultaneously, and also resource deficiencies due to embedded environment. Especially if IP Cameras are comprised of more than two types, there's a problem with compatibility, which not only makes management harder but also affects video service. In conclusion, there is a big issue for unifying multiple types of cameras.

In this thesis, HOST computer is used as unified management system for IP cameras. This thesis solved problems such as deficiency of resources and multiple clients connecting to HOST simultaneously, which are derived from problems that clients cannot connect to IP cameras but only have access to HOST computers to get IP camera's video informations. And

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the problem derived from multiple types of IP cameras is solved with developing HOST computer exclusive application program.

Recent video information system uses IP camera transmits Video information to HOST via streaming server or FTP Server, which disables HOST to retrieve video information if there is no video information sent from IP Camera, and CCTV cameras or IP Cameras have to be fixed installed to certain locations. In this thesis, experiment is done by installing application program functioning as IP Camera to smartphone which user carries at all times, which enables individuals to ubiquitously use video information system. In the experiment, there was no problem with using same Wi-Fi network as smartphone uses, but when smartphone is connected to LTE or AP networks, there was a problem which smartphone constantly changes its IP address according to its location which makes host unable to retrieve smartphone's information using network due to personal information protection in smartphone. In IT areas nowadays, there are hot issues such as removing boundaries between infrastructure resources like dispersed servers, storages and networks or PC and mobile devices' resources using virtualization or grid computing technology to enable using services ubiquitously and efficiently.

In this thesis, A video information system uses IP camera, which transmits video information to HOST via Streaming Server or ftp server. But there's problem that HOST cannot retrieve video information without video information transmitted from IP camera. So in this thesis, host-active application program is developed, which can retrieve video information from HOST with only IP camera's IP address. By installing cloud server in the HOST, which smartphone can send videos to it regardless of network realms such as Wi-Fi, LTE or AP and transfer smartphone's video information to cloud server anytime using wired or wireless networks. So by installing a Private Cloud server in HOST, which provides unrestricted environment where user can develop and launch application programs and sync smartphone to it. Smartphone's video information is synced with Private Cloud ubiquitously using wired or wireless networks such as AP, LTE or WIFI and stored to Private Cloud so smartphone or IP Camera's video information is always stored in Private Cloud server which can be used as evidence when there's crime. Also employees can save materials of meeting which is saved to corporation's Private Cloud server in real-time and enables remote monitoring for employee in office to cooperate with employee in remote locations. When in emergency situation, only running application program in smartphone automatically stores video information to HOST's Private Cloud Server, which prevents the threat of crime. Application used in this thesis is tested with smartphone running android operating system. This thesis is comprised of following chapters. Chapter 1: introduction, Chapter 2: design directions regarding system embodiment, Chapter 3: the system's embodiments and results of experiments, and is finalized with conclusion in Chapter 4.

2. System Design

In this thesis, Linux is installed on host computer, created network between IP Camera and Host as shown in the Figure 1, and application programs are developed exclusively for IP cameras which can store IP camera's video information, which is divided to certain time length and is saved to host. Experiment also requires installing http server, MySQL server and private cloud server to store smartphone's video information to host, and developing application program for android smartphone which can access to Private Cloud Server and save videos taken from smartphone to Cloud Server.

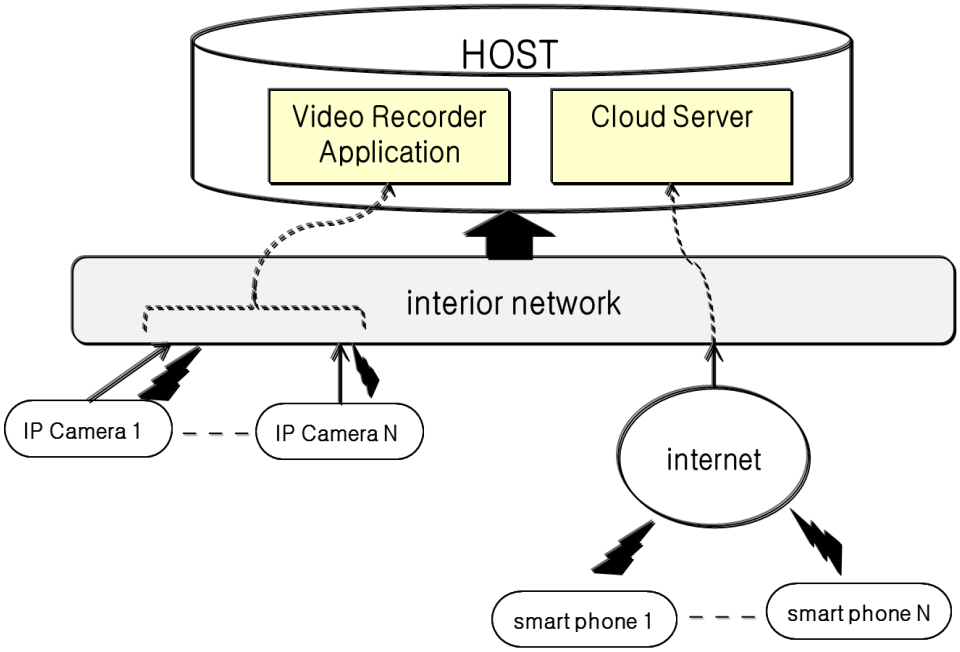

Figure 1. Total System Structure, the Network Camera and Smartphone of Connect to Host

2.1. IP Camera Video Storage Application Design

To service IP camera's videos, it is needed to get digitally converted and retrieved videos and encode them in JPEG files to create and store file, and upload created file to Embedded Web Server to start services. Client requires files based on connection information with Embedded Web Server and retrieves certain video files, which are uploaded from IP Camera. Figure 2 shows the configuration of IP Cameras. If Host is set to heighten security levels, then IP Camera only maintains connection with host, and requests for using IP Camera's services are processed in the HOST instead.

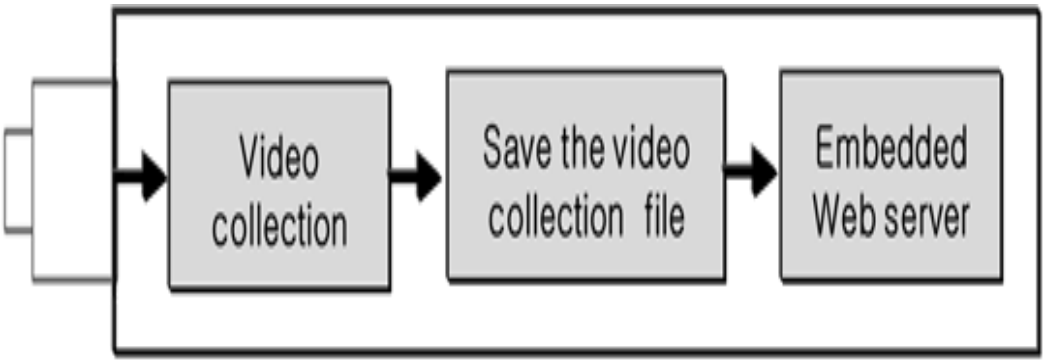

Figure 2. Network Camera Configuration

HOST needs IP camera's IP and port number to maintain connection with IP camera, and it needs ID and Password information for identifying user information to connect and pass identification process. Table 1 shows information needed to connect with IP Camera.

Table 1. mysql Configuration

Access information	Descriptions
camera_id	The location and name of the IP camera
user_id	Connection ID of the IP camera
IP	Connection IP of camera IP
compression	Video compression format
group	Network camera, the groups to which they belong
type	IP camera is type
password	connected Password of the IP camera
port	The port number of IP Camera
channel	IP camera channel
use_camera	The activation of the IP camera

Experiment process requires assigning IP addresses to IP Cameras accordingly, and assigning IP addresses to IP cameras using router as described in Figure 3. This procedure also uses port forwarding, which enables remote connections.

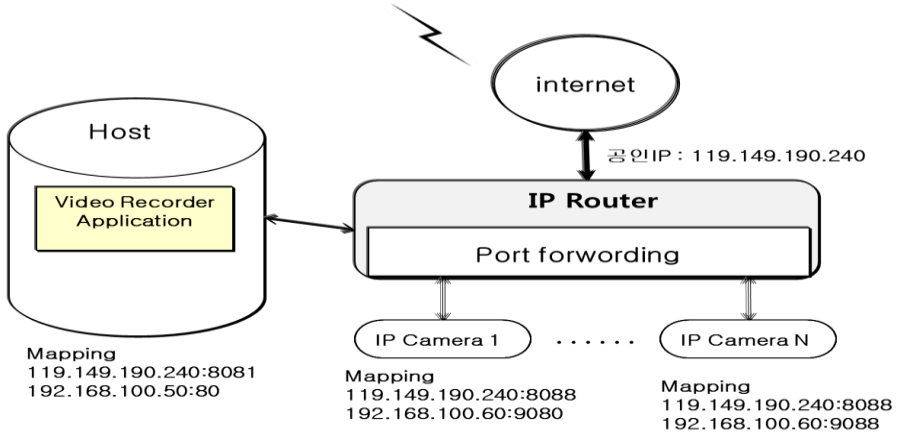

Figure 3. IP Network Configuration

There are different ways to encode ID and Password used with authorization process, which are different among IP Cameras, so field is needed to store different types of IP cameras' encoding ways, and designing separate IP cameras' application programs are also needed. Host retrieves video information directly by using IP camera's IP. And in this thesis, application is designed to create AVI videos of certain time lengths, and save the files to designate location. Figure 4 is application flowchart in infinite loop. Designing definite loop in the infinite loop is needed to create certain length of video files and save them in certain size.

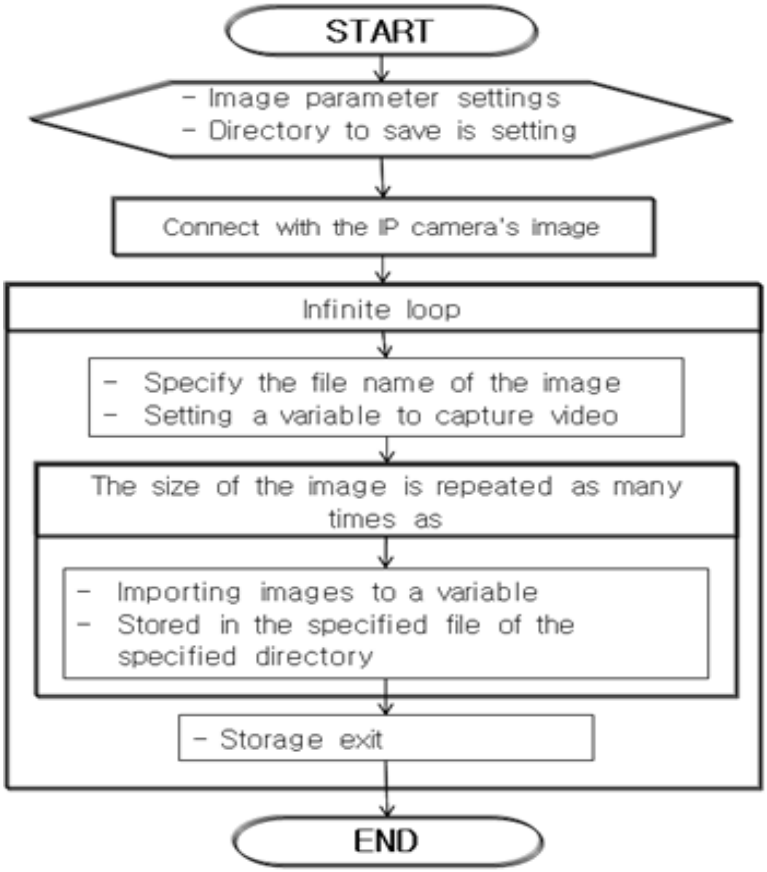

Figure 4. Application Flow Chart

2.2. Private Cloud Server Installation

Corporate users want to receive previously owned IT assets in cloud service forms, but does not want their data to be shared with others. Regarding network level security, Public cloud, which is offered in public service environments, needs higher levels of security relatively to Private Cloud. Corporate users have intention to pay expenses if stability and security are guaranteed. And they even build private cloud service in the corporation or use hybrid cloud services. In this thesis, Private cloud server, http server and php are installed, which can be used for operating cloud web services. And MySQL server is also installed, which is needed for login authorization process, and SSL is installed for password authorization for sync services.

To enable smartphone to sync with HOST's Private Cloud server remotely, port forwarding configuration is set as shown in Figure 5.

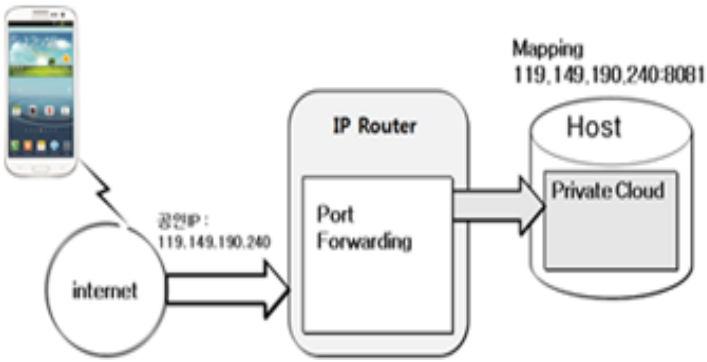

Figure 5. Configuring Router Port Forwarding for Private Cloud

2.3. Android Application Design

In this thesis, cloud sync application is installed to smartphone, which is running android operating system. Application enables sync between directory set from Host's Private Cloud server and android smartphone's directory. Also, android camera application program is developed, which saves videos in the synced directory. Figure 6 designs application's layouts using application program's flowchart, and sets basic file names used to save it. All actions are in infinite loop. And due to cloud's characteristics, which file is needed to be saved completely to be synced, so application is set to repetitively save videos in approximately 10 seconds length.

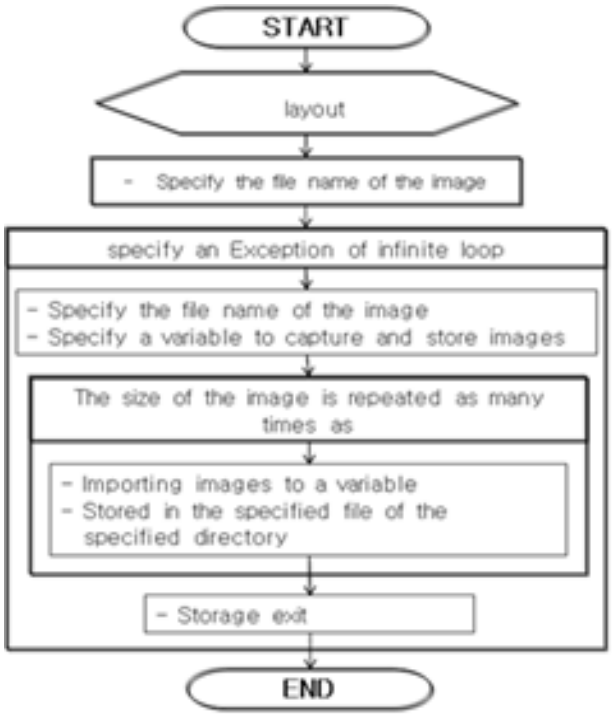

Figure 6. Android Application Flow Chart

3. System Implementation and Experiments

In this thesis, Linux, Private cloud server, http server and MySQL server, and OpenCV Library are installed to host computer. OpenCV Library is used for retrieving IP camera's video information. And application program for IP Camera and application program for android smartphone are also developed, which can access to Private Cloud server and save videos taken from smartphone to Cloud Server

3.1. IP Camera Applications Implementation and Testing

This thesis's video library uses Open CV. Setting for selecting IP camera from program source and retrieving video information in the network uses IP camera's IP and port numbers to pass through IP camera's authorization process, and to connect with IP Camera. In this thesis, ID and Password used in authorization process to gain access is set to IP Camera as shown in Table 2. Designation of file names is year-month-day-hour-minute order as shown in Figure 7, and retrieved video is shown in Figure 8.

Table 2. Import Camera Videos

```
capture =cvCaptureFromFile("http://glory:glory @119.149.109.240:8163/video.cgi?.mjpg");
```

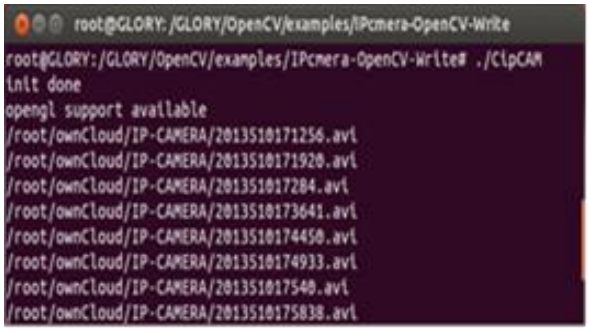

Figure 7. IP Camera Image File Creation

Figure 8. IP Camera Image File Creation

3.2. Private Cloud Server Installation and Testing

In this thesis, private cloud server for Linux and http server are installed in the HOST, and operated in the HOST to enable multiple clients to gain access to private cloud server simultaneously. And used MySQL server for authorization process in

accessing private cloud server. ID and Password settings for authorization processes are shown in Table 3. Figure 9 is cloud directory in Host, and Figure 10 is Figure from smartphone, which accessed Cloud Server via web.

Table 3. mysql Configuration

```
# mysql -u root -p
mysql> CREATE DATABASE cloud;
mysql> CREATE USER 'glory'@'localhost' IDENTIFIED BY 'embedded';
mysql> GRANT ALL PRIVILEGES ON cloud.* TO 'glory'@'localhost' IDENTIFIED BY 'embedded';
```

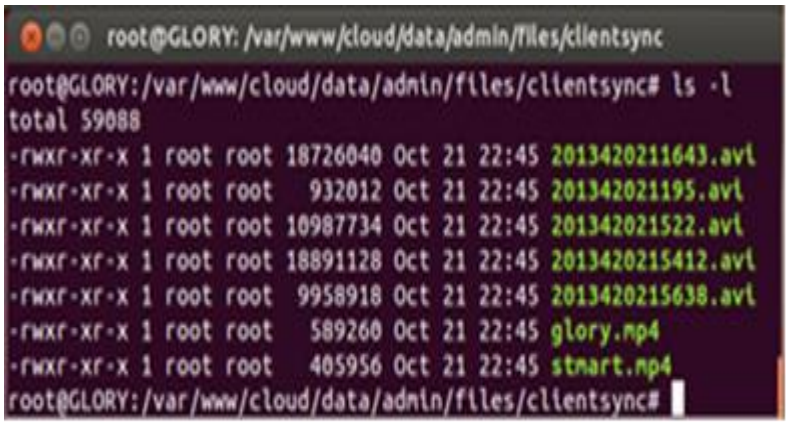

Figure 9. Cloud Directory on the Host

Figure 10. Cloud Web

If directory synchronization is used, a certificate is needed for it. In this thesis, certificate is created using SSL. And synchronization with smartphone is completed as in Figure 11.

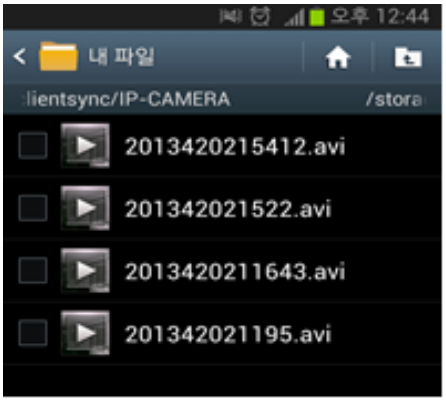

Figure 11. Cloud Sync

3.3. Android Application Implementation and Experimental

When smartphone's application for saving videos saves video information in designated directory, client sync application for cloud is installed for syncing video information with Host's Private Cloud Server.

To develop android video-saving application, JDK version 1.6 is used, android-sdk_r21.0.1-linux is used for android library and tool, and eclipse tool is used for development.

For android application source to save videos in the synced directory, which is synced with private cloud server, it is set as shown in Table 4. In this thesis, android platform version 4.0 (Jelly Bean) is used, and Figure 12 shows developed application program, which is taking video on android 4.0.

Table 4. mysql Configuration

```
recorder.setOutputFile("/sdcard/" + filename + ".mp4");
```

Figure 12. Smartphone Video Sync

Figure 13 shows the possibilities of the cooperation between employee in office and employee in business trip using exclusive application which syncs videos of meeting between smartphone's directory and Private Cloud Server's directory.

Figure 13. Real Time Monitoring

4. Conclusions

Nowadays, we record videos in emergency situations, or in meetings and seminars for evidences of crime or contracts. Hosts in previous video information system cannot retrieve video information without it being sent from camera to host. And for IP Camera there are problems regarding connections of multiple users simultaneously to host to retrieve video information, and has integration problem between multiple types of cameras.

In this thesis, application program designed for IP camera was developed, and it was found out that by only using IP camera's IP address, it can retrieve video information from host, and it is also found out that multiple users can gain access to video information simultaneously using web.

And in this thesis, designed application on smartphone was operated to save video information in designated directory, which was synced with Host's Private Cloud server, and it is found out that users can ubiquitously check whether video was saved using Private Cloud server. Also smartphone or IP Camera's video information is always stored on Private Cloud Servers, which can be used as evidences when crimes took place. Also, employees can save materials from meeting, and for corporations, it has possibilities for cooperation between employee in business trip and employee in the office using video information taken from meeting or conference synced real-time in corporation's Private Cloud Servers and monitor them.

In this thesis, it was found out that by using private cloud servers in each corporation and by using smartphone, individuals can store video information in emergency situation, and save meeting records ubiquitously and easily. And it was also found that files are not synced with private cloud server if it is not in complete form in the smartphone. And also in this thesis, video length was set as 10 seconds, so there was a delay of time about 10 seconds from the spot.

References

[1] J. Rivera, "Cloud Computing for Personal Use", The epoch times, **(2010)**.
[2] F. Nilsson, "Intelligent Network Video", CRC Press, **(2009)**.
[3] M. Kolon, "Delivering High Acailability Routed Networks", APRICOT2005, **(2005)**.
[4] G. L. Foresti and C. Micheloni, "Active video-based surveillance system", IEEE Signal Processing Magazine, **(2005)** March.
[5] Y. Hagiwara, T. Furuya, T. Sakurada and T. Saito, "Surveillance Camera System with a Wired and Wireless Network", Proceedings of IMSA2005, Hawaii, USA, **(2005)**.
[6] Cloud Security Alliance, "Top Threats To Cloud Computing V1.0", **(2010)**, March.

[7] I., O. and Hatayama, "Network camera system using new home network architecture with flexible scalability", International conference on ICCE2005, pp. 151-152, **(2005)** January 8.
[8] A. G. Greenberg, J. Hamilton, D. A. Maltz and P. Patel, "Cost of a Cloud: Research Problems in Data Center Networks", Computer Communication Review, vol. 39, no 1, **(2009)**, pp. 68-73.
[9] http://developer.android.com/sdk/index.html.

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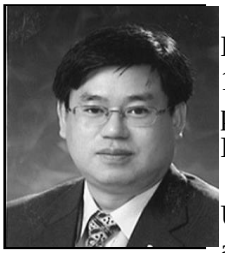

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