Development of Integrated Management System based on Mobile and Cloud service for preventing various dangerous situations

Ryu HyunKi, Moon ChangSoo, Yeo ChangSub, and Lee HaengSuk

***Abstract*—**In this paper, to take advantage of personalized black box service, we did design and implement a combination service using a user terminal and smart phone application, cloud server. This proposed system is to collect and analyze the individual's status information, it is possible to recognize a dangerous situation for users to inform the guardian or decided particular government department. To recognize dangerous situations, we are using various electronic sensors like magnetic gyro, GPS, short circuit sensor. Also, to predict future risk situations, we use a face detection method that based on digital image processing. So, it can be guaranteed to be secure before the crime incident.

***Keywords*—** Dangerous situation, Personalized black box, Mobile, Cloud server.

I. Introduction

With the development of digital technology, the desire of users to record their lives has recently increased. Life logging devices and related technologies are developing as a result. Along with such trend, studies on services to improve safety and life quality in addition to simple logging are actively underway. [1] Among them, personalized black box life logging service can be applied in various fields that require personalized services such as crime prevention and ubiquitous computing environment. It can also be used for management of seniors demanding special care such as dementia patients and children, learning assistance in the field of education, and analysis of diseases using personal bio-information log.

In this paper, a system was designed and embodied so that daily activities of individuals can be recorded and traced using an exclusive device, recognizing information about what was said and done by the user, when and where to determine dangerous situations and informing such situations to a guardian or designated institution for crime prevention, accident monitoring and protection of the socially disadvantaged. For this purpose, a device based on 4G network (LTE) is manufactured and images obtained using the device are transmitted to a cloud server for analysis. Analyzed images are informed to a guardian or designated institution to avoid dangerous situations.

Composition of this paper is as follows. Chapter 2 examines related studies and Chapter 3 explains the mobile system proposed in this study to recognize dangerous situations based on cloud server. Chapter 4 explains details on the embodiment of the proposed system, and Chapter 5 is a conclusion.

II. Related Studies

The aim of MyLifeBus [3] project of Microsoft is to construct a system that digitalizes and saves all of the information related to life of individuals, allowing users to easily search and browse information on the system. The main purpose of this project is to record information so it can be accessed when people want, which helps replace human memory. Another example of studies on life log is Stuff I`ve Seen (SIS) [4]. This system was developed for the goal of recording and reusing personal information. It records and doing index information about actions that occurs in desktop applications. It focuses on indexing and inquiry of saved information.

Systems that recognize situations are being studied with a technology that determines the environment based on given context information, as well as a technology that transfers data using mobile devices at any place and time. Multi-modal interface can be regarded as a representative technology. [5],[6] In addition, Context-Aware Middleware for URC Systems (CAMUS) by the Electronics and Telecommunications Research Institute (ETRI) is a study on context awareness conducted in Korea [7]. CAMUS is a standard platform that helps robots recognize content, and it plays the role of a context recognition engine that analyzes and saves information collected by sensors and sends out work instruction by creating events.

Our system is a system that transfers daily records collected by a user device to a cloud server through wireless network on a real-time basis. The server saves and analyzes large volume of information collected and informs a guardian or designated institution about dangerous situations recognized.

Ryu HyunKi, Moon ChangSoo, Yeo ChangSub and Lee HaengSuk[1] is with the GyeongBuk Research Institute of Vehicle Embedded Technology, Kyungpook, Korea (corresponding author's phone: +82-54-339-0031; e-mail: hkryu@givet.re.kr).

III. Design of Mobile System based on Cloud Server that Recognizes Dangerous Situations

This paper designed a structure in which camera attached to the user device is used to transmit image and voice data to the cloud server on a real-time basis, and dangerous areas and persons detected are informed to a guardian or designated institution. Fig. 1 shows the mobile system architecture based on cloud server that can recognize dangerous situations proposed in this paper.

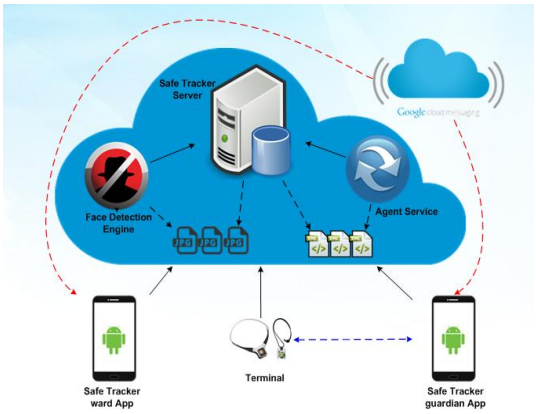

Fig. 1 Mobile system architecture based on cloud server that can detect dangerous situations

Image and data are generated on the user convenience device and meta information including temporal and spatial information (GPS) of the image is transmitted to the cloud server, and the cloud server stores the collected image / voice data and position values in the optimal format. In addition, stored data are analyzed to detect dangerous areas and persons based on position information and inform the situation to a guardian or designated institution.

A. User Convenience Terminal Device Module

The device module includes a communication function for real-time transmission of data obtained by different sensors to the cloud server. The system power circuit was designed with consideration on stable output voltage, and the structure for measurement and dissipation of heat was enhanced. The memory interface circuit embodied an SDRAM interface for program data processing, and the camera interface circuit was designed to remove image signal noise. Fig. 2 shows the development range of hardware.

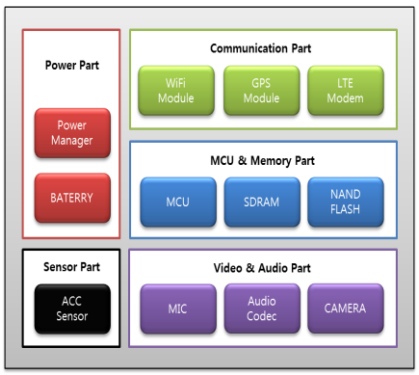

Fig. 2 Development range of device hardware

Software of the device used RTOS porting by modifying memory, IO, communication device and clock frequency according to hardware. Device driver preparation, analysis and control of communication protocol (Wi-Fi, LTE Modem), sensor and power controller, file system porting, TCP/IP stack porting and device API configuration were done. The main task was prepared by creating image and voice processing task frame. Fig. 3 shows hardware configuration of the device.

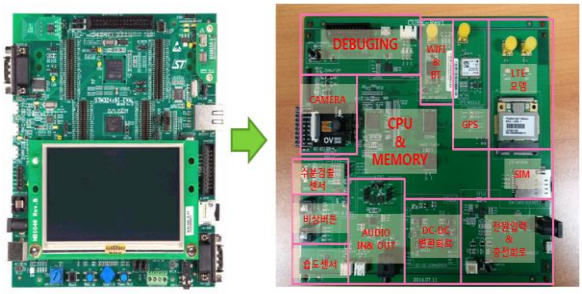

Fig. 3 H/W configuration of the device

B. Smart phone application

Important functions of the app include device setting, notice of dangerous situations, emergency call, situation monitoring, reception of position information, setting of dangerous areas, registration/authentication processing, and guardian registration. Fig. 4, Fig. 5 shows software architecture of the smart phone app and application design configuration.

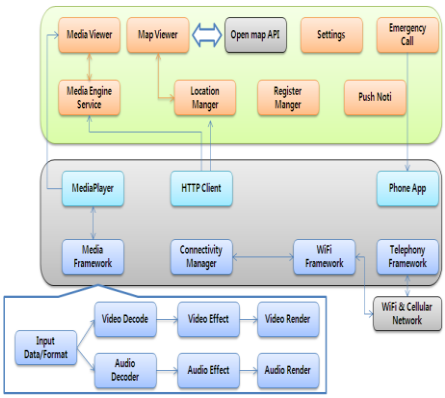

Fig. 4 Software architecture of smart phone app

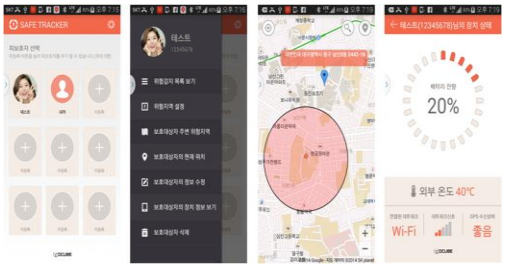

Fig. 5 Smart phone app design configuration

C. Cloud Server System for Data Saving and Transmission

Image / voice data and position values received by the server are saved as XML documents. When an event requesting META information is received, XML file stored in the storage is loaded and parsed to convert it into JSON format using JSON maker module, sending data out as open API response. The app analyzes JSON data included in the response to bring URL list of media files stored in the server and sequentially calls files according to time information to play media files through HTTP. Fig. 6 shows the configuration of the cloud server and app.

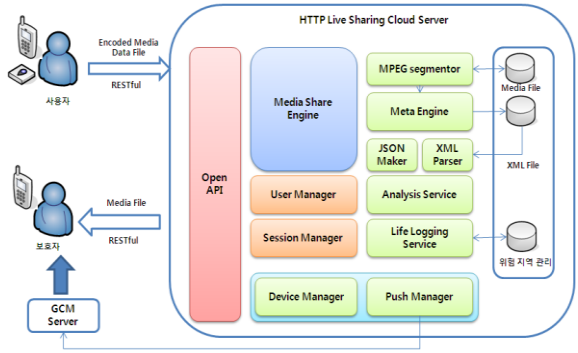

Fig. 6 Architecture of the cloud server and application

D. Detection of Dangerous Persons using Face Recognition

The objective of this system is to register the DB on dangerous persons provided by the government as a library on the cloud server and to use face recognition technique for detection of risk factors and prevention of crimes. Also, block matching algorithm is used to correct images, and image stabilization technique based on bit plane matching shaking can be used to correct images that are shaken during daily activities. The Ada-boost algorithm was used as an algorithm for face classification. After sequentially generating classifiers, analysis data used observation values extracted from the performance of the previous classifier. Fig. 7 is the conceptual diagram used for face classification. The PCA method was used for face recognition, and its stepwise application method is illustrated in Fig. 8.

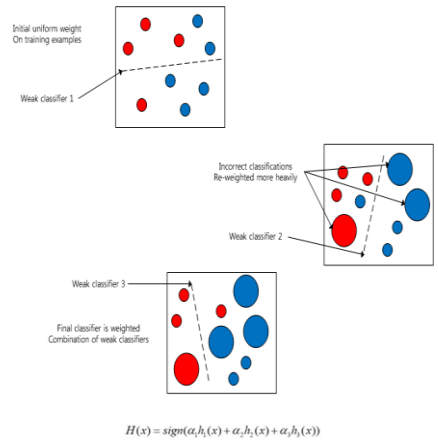

Fig. 7 Conceptual diagram of face classification

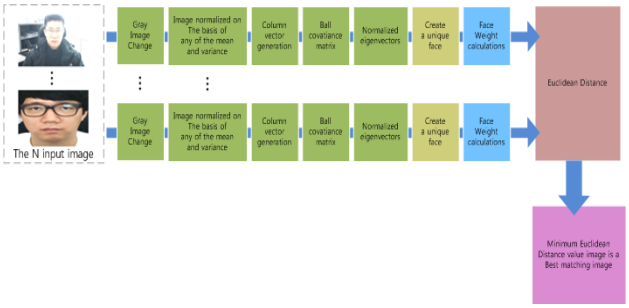

Fig. 8 Flowchart of the PCA algorithm

Fig. 9 shows the test results for the face recognition algorithm created based on the methods presented above.

Fig. 9 Test results for the face recognition algorithm

IV. Implement of Mobile System based on Cloud Server that Recognizes Dangerous Situations

A. Implement Environment

The device developed in this paper was manufactured using EVM board (STM32429I-EVAL), and the app was developed for Android OS. In addition, the cloud server was embodied to save and record image / voice and position data as XML files.

B. Implement Result

Data collected by camera on the device are transmitted to the cloud server through wireless network on a real-time basis.

Segments of image / voice and position values of the user are processed by restful open API call for optimal storage and management in the cloud server. The cloud server provides an external open API interface to analyze data and operate service module.

The cloud server manages image / voice information of the user for different situations as XML. When image / voice segments of the user are registered, the server receives the event by callback through the push manager and automatically links the guardian to the corresponding image. Fig. 10 shows the inter-device scenario between the device and cloud server.

Connection request on the device can only be made on Android app, and registration and setting of the device are done after connection. Completion of device registration is informed when unique device value is returned. Once device registration is complete, sendEventFile is used to transmit a danger detection event with an image to the server and sendEvent is used to transmit a danger detection event without an image to the server. In addition, the device regularly sends image files to the server for face detection, as well as position information whenever position of the user is changed.

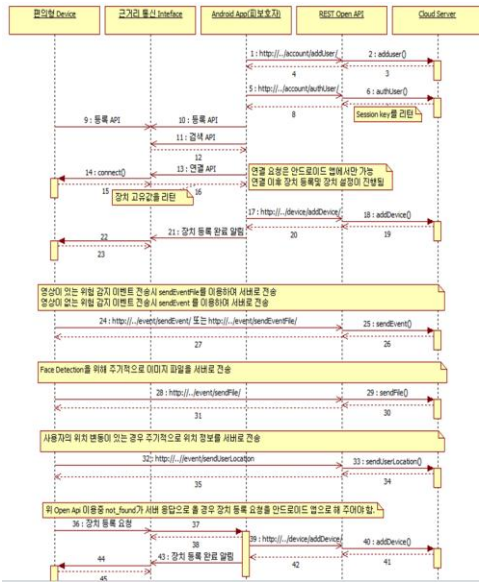

Fig. 10 Inter-device scenario

The Android app can largely be divided into guardian mode and ward mode. Guardian mode can register one or more wards to be protected and includes functions such as list of dangers detected, setting of dangerous areas, current position of wards, and emergency call. Fig. 11 shows the screen in guardian mode.

Fig. 11 APP screen of guardian mode

As shown in Fig. 12, ward mode has a function that informs the user of danger through push message when the user enters a dangerous area. Also, the ward mode can check battery status of the device and inform to user's guardian.

Fig. 12 APP screen of ward mode

V. Conclusion

This system proposed in our paper transmits data from a personal device to a cloud server through wireless network on a real-time basis. The server analyzes and processes data to detect dangerous situations or persons and inform them to a guardian or designated institution.

Primarily, the proposed system can prevent the user from exposure to dangerous areas and situations, and inform exposure to dangerous areas and situations to a guardian and designated institution for safety. The proposed system can additionally provide a monitoring function in various fields of application such as crime prevention, accident monitoring and protection of the socially disadvantaged.

Acknowledgment

This research was supported by the MSIP(minister of

science, ICT and future planning), Korea, under the mobile convergence tech center building project program supervised by the NIPA(National IT industry Promotion Agency), IITP(Institute for Information & communications Technology Promotion). (10048107).

REFERENCES

[1] Sooyoun Park and SungIn Kim, "Usability Evaluation of Lifelogging Application on Mobile - Focused on Dayone Application and Momento Application," *Korea Digital Design Council journal*, vol.14, No.1, pp. 117–127, Jan 2014.

[2] Gong KiHyun, et, al., "A Lifelog System based on Context information," *Journal of Computing Science and Engineering*, Vol.36, No.1. 2009

[3] Jim Gemmel, Gordon Bell, and Roger Lueder, "MyLifeBits: A personal Database for Everything", *Communications of the ACM*, Vol. 49, No. 1, January 2006. http://dx.doi.org/10.1145/1107458.1107460

[4] Susan Dumais, et, al., "Stuff I've Seen: A system for Personal Information Retrieval and Re-Use", SIGIR, 2003

[5] Bok-Man Jang, et, al., "U-healthcare Context-Awareness Security Framework Using Multi-modal Interaction Agent," *Journal of Security Engineering*, Vol. 6, No. 5,pp.337-349, Oct 2009.

[6] AWARENESS Service Infrastructure D2.1-Architectural specification of the service infrastructure, 2004, http://doc.telin.nl/dscgi/ds.py/Get/File-49225/D2.1_-_Awareness _Service_Infrastructure.pdf)

[7] H. Kim, et, al.,"CAMUS – A Middleware Supporting Context-aware Services for Network-based Robots," IEEE Workshop on Advanced Robotics and Its Social Impacts, pp. 237-242, 2005.