The Method of Emergency Message Retransmission for the Disaster Vulnerable People

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***Abstract*— In the event of a disaster, obtaining information about the disaster quickly and accurately is an important matter that not only reduces the associated economic damage, but also leads to survival. We suggest the method to more efficiently utilize emergency messages transmitted to smartphones through telecommunication networks. The method we propose is to process the emergency message received by the smartphone according to the emergency level and send it back to the smart watch and earphone connected via Bluetooth. This enables the disaster vulnerable people, such as the elderly, children, foreigners, and visually impaired people, to quickly receive disaster information.**

Keywords—emergency messages, CBS, Cell Broadcasting Service, disaster information

I. INTRODUCTION

In 2020, an infectious disease that had only been imagined in the movies swept the world, and various disasters such as cold waves, heavy snow, and hurricanes occurred all over the world. Disasters that have occurred in recent years are becoming stronger, worse, and more various than those that have occurred in the past. In addition, disasters that were localized due to the centralization of cities and globalization along with the abnormal climate are spreading easily.

Moreover, along with the emergence of various media, fake news and misinformation on disasters are overflowing. Now, the need and movement of the state to deliver disaster information quickly and accurately to the public are occurring. In Republic of Korea(South Korea), disaster information has been delivered to the public through various media such as broadcasting networks, mobile communication networks, and warning systems installed in dangerous areas. In particular, after 2020, it has been shown that among various media, people prefer emergency message using telecommunication network(including 2G, 4G, and 5G) CBS most. Although the government uses various methods and media to deliver disaster information public, there are still disaster vulnerable people who do not properly recognize disaster information. Disaster vulnerable persons mentioned in this paper include the visually impaired, the hearing impaired, the elderly, the children and foreigners who are not familiar with Korean.

In this paper, we propose a method of retransmitting emergency messages which include disaster information received through mobile communication networks in consideration of the vulnerable. Chapter 2 deals with the definition of emergency messages(CBS)s and use cases of domestic and overseas, Chapter 3 explains the implementation and test results for the proposed method, and Chapter 4 concludes.

II. THE DEFINITION AND USE CASES OF EMERGENCY MESSAGES

A. *The Definition of Emergency messages*

Emergency message is a technology that broadcasts to all mobile phones connected to the selected base station at once by using the control channel of the mobile communication network. Emergency message used CBS(Cell Broadcast Service) technology and Cell Broadcast (CB) is a method of sending messages to multiple mobile telephone users in a defined area at the same time. It is defined by the ETSI's GSM committee and 3GPP and is part of the 2G, 3G, 4G LTE (telecommunication) and 5G standards[1].

South Korea is the first country in the world to start sending emergency messages to the whole country. During Covid-19, central governments and local governments provided and still provides a lot of information through emergency messages and used it as a channel to communicate with the public. In South Korea, emergency messages including disaster information are operated in three levels: urgency, emergency, and safety guidance. Disaster information should be provided as a universal service that is delivered fairly to the public. The following Fig 1. is shown in the results of a survey on broadcasting media by the Korea Communications Commission, an agency under the Ministry of Science and ICT in 2020. According to the survey results, smartphones received higher preference than TV or radio as an essential medium in disaster situations. It can be seen that many people are acquiring disaster-related information depending on the emergency messages they receive through their mobile phones.

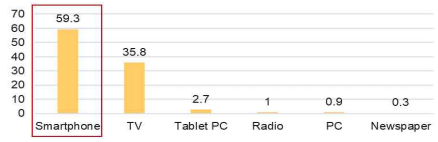

Fig. 1. Essential media in disaster situations by 2020 Use-behavior research for media (ref. KCC, ISSN 2005-498X)

B. *The Use cases of Emergency messages in other countries*

As shown in Fig. 2, the number of countries that use a emergency message service that delivers information about

disasters using telecommunication's CBS technology is increasing. A red dot means countries in using CBS for the national public warning system and yellow dot means Countries in the process of implementing CBS for the national public warning system

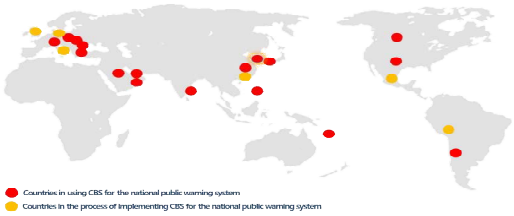

Fig. 2. Worldwide implementation of CBS

- **The United States**(USA) has developed a system that communicates disaster situations throughout the United States through the EAS(Emergency Alert System), which can replace the existing EBS(Emergency Broadcast System). Emergency messages are providing services not only in English but also in Spanish, and a geo-targeting method is in progress to subdivide the areas where disaster information was initially issued by county. 3GPP TS 22.268 defines the relevant standard as CMAS(Commercial Mobile Alert System) [2], [3].
- **Japan**, where earthquakes and tsunamis occur frequently due to regional characteristics, has been developing the system for transmitting emergency disaster messages through CBS for a long time. It is defined as ETWS(Earthquake and Tsunami Warning System) in 3GPP TS 22.268, and is characterized by separating and transmitting primary and secondary information, and including detailed disaster information such as images and videos in secondary[4].
- The **EU** is complying with the 3GPP CMAS standard, and the countries in Europe are increasingly building systems to transmit disaster information to the public as it suffers from Covid-19. In particular, **Germany** is applying a mobile application that provides federal risk information and news called NINA(Mit der Notfall Informations und Nachrichtem App des Bundes).

C. Standards Issues

In 3GPP, a private standardization organization that establishes international standards for telecommunication technologies such as 5G and LTE, discussions on Cell Broadcast Service(CBS) and Public Warning System(PWS) are taking place. In particular, research on emoji for disasters and plans to include emoji in emergency messages are underway. The 3GPP CT1(Core Network and Terminals1) group sent inquiries about the definition of the Unicode symbol for disaster by sending a liaison document to the ISO/IEC JTC1/SC2 group, which enacts the international character code set standard in February 2020.

In addition, the Unicode Consortium defines and uses emoji-based Unicode for fires, typhoons (hurricanes, cyclones), and volcanic eruptions.

III. Implementation and Test Results

Our proposed application targets emergency messages on smartphones, the media most widely used for distributing disaster information in South Korea. We developed two applications developed in order to support the received emergency messages delivery most efficiently and quickly.

One is the way to quickly check received emergency messages when using widely used Bluetooth earphones. Assuming that music and video are running, when an emergency messages is received, our app that can stop the currently running app and read the emergency messages TTS was developed. This can be usefully utilized not only for the general public but also for the visually impaired. The other is a method of retransmitting an emergency message to a wearable device in consideration of a situation where it is difficult to check immediately on a smartphone. We developed and tested the app by targeting a smartwatch among various wearable devices.

A. Development environment

TABLE I shows the development environment of smartphones and smart watches for retransmission of the proposed disaster information using emergency messages.

TABLE I. Development environment of smartphone(left) and smartwatch(right)

Android Studio development environment	
Android Gradle Plugin Version	3.4.1
Gradle Version	5.1.1
Android Version	9.0(Pie)
API level	28
compileSDKVersion	28
buildToolsVersion	28.0.3
API Library	AndroidX

Tizen development environment	
Tizen Studio (IDE)	3.3
API Version	2.3.2 (wearable)
Eclipse	2019-03
java	Jdk-12
Framework	samsung_sap

Fig. 3 shows the block diagram of the module processed by the smartphone to retransmit the received disaster message [5].

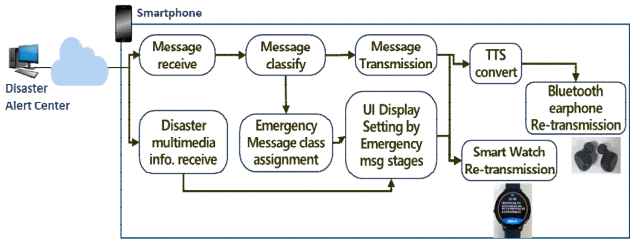

Fig. 3. Worldwide implementation of CBS

B. Implementation for the bluetooth earphone

A smartphone receiving the emergency messages classifies the emergency message level, modifies the setting value to match the corresponding level. After this, the existing running app is stopped on the Bluetooth earphone, and the emergency disaster text voice file converted to TTS is executed, and the

smart watch is retransmitted including multimedia information about the disaster.

C. Implementation for the smartwatch

As mentioned in 2.1, in South Korea, emergency messages transmitted through mobile communication networks are classified into urgency, emergency, and safety information. In addition to the message, color (Red, Orange, Yellow), alarm sound, vibration, and disaster symbol (Located in the center of top at smartwatch) were also considered.

TABLE II. EMERGENCY MESSAGES LEVELS [6]

Channel	Name	Display setting	Alarm sound	Alarm type	Rejection
4370, 4383	urgency	On	Over 60dBSPL @1m	Siren	Possible
4371, 4384	emergency	On	Over 40dBSPL @1m	Siren	Impossible
4372, 4385	safety information	Off	General text reception setting value		Impossible

In Fig. 4, 5, and 6, the left is a simulation of the government's system that generates and sends emergency messages to public, and the middle is reprocessed multimedia information such as the location of the disaster, links, related videos, and shelter information with a smartphone that received the emergency message. On the right is a smart watch that has received an emergency message.

The disaster symbols that were designed and applied by ourselves are heat wave, typhoon and air raid and were developed and tested with an emphasis on what is displayed on the smart watch. This can be freely changed by applying an image that is being discussed internationally in the future.

Fig. 4. Emergency Message of safety guidance level about Heat Wave

Fig. 5. Emergency Message of emergency level about Typoon

Fig. 6. Emergency Message of urgency level about Air raid alarm

If you touch the blue color at the bottom of the smart watch, disaster contents are displayed in the same way as the smart watch.

Fig. 7. Results of smartwatch content selection(disaster location, link, related video, selter information

IV. CONCLUSION AND FUTURE WORKS

In this paper, a method of retransmitting emergency messages(CBS) using a telecommunication network, which is a medium for the government to deliver disaster information to the public in the most efficient and quickly, was proposed. The proposed method can help the disaster vulnerable, visually impaired, and people in a specific situation to recognize quickly by retransmitting the received emergency messages to the wearable device. Ultimately, proposed method provides the effect of reducing human and economic risk by supporting rapid evacuation in the event of a disaster.

In the future, we plan to conduct continuous research on a method of predicting the risk of disaster by analyzing the history of emergency messages, and how to improve the service of current emergency messages in the next-generation mobile communication network.

ACKNOWLEDGMENT

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