

Development of Mobile Application for Disaster Prevention

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Abstract:--- *In recent years, many damage has been caused by earthquakes in Japan. Most recently, there is Hokkaido Eastern Iburi Earthquake on September 6, 2018. The damage was 790 casualties. Blackout occurred in Hokkaido Island as a whole. Earthquake countermeasures in Japan have been accumulated every time the historically experienced earthquake disaster occurred. However, countermeasures by such accumulation are insufficient, and it is urgent to develop concrete measures and tools. When an earthquake occurs, send support for supplies (such as food and clothing) to the afflicted area. Victims can receive them. Thus, in the event of an earthquake, a support system from the administrative side to victims have already been constructed. However, the victims have not sufficiently constructed a demand system for requesting support from the administrative side. In particular, there is insufficient support for persons with handicaps called "disaster vulnerable populations", ie, disabled people, mobility impairment, foreigners, baby, elderly, and so on. For that purpose, using information technology, we conducted research to develop a support system reflecting the demand for supplies of disaster vulnerable populations. As a method, we proposed and developed a mobile application to make it easier for disaster vulnerable populations to deliver supplies requests. This contribute to the reduction of the handicap of vulnerable populations. This study outlines our system development and shows the evaluation result of interface development. In addition, in this study, as a tool development, we will organize and present the current situation of the mobile application development contest and contribute to the connection to the international community on disaster prevention.*

Index Terms: *Administrative services, Earthquake, Mobile app, Vulnerable populations.*

I. INTRODUCTION

In recent years, many damage has been caused by earthquakes in Japan. Most recently, the Hokkaido Ballistic Eastern Earthquake that occurred in 2018 can be mentioned. Damage situation, casualties 790 people, is a residential damaged 10,000 buildings more, black out the whole area of Hokkaido is a power failure all at once has occurred. In

Japan, large-scale earthquakes have occurred so far, with lessons learned each time, maintenance against earthquakes has been done. However, R & D is still necessary for research and development of concrete tools. In particular, there is insufficient support for people with handicaps, called "disaster vulnerable people", foreigners, elderly households and others.

Japan is one of the countries where smartphones are popular. Contests for developing mobile applications are also held at each level such as country, prefecture, and university and so on [1][3]. The application development contest for disaster prevention is being held by the Ministry of Land, Infrastructure and Transport. It is still 5 years since the first conference. Therefore, it is hard to say that it is widely perceived. This research is meaningful for organizing the efforts and connecting to international activities, thereby expanding further activities. In this study, from these viewpoints, we will organize the contents of mobile application development and consider the utility of its development. It also describes some of the applications we are developing. Section 2 describes the purpose and method of this research. In Section 3, we will organize the laws and policies developed by Japan's disaster countermeasures. In Section 4, the application development contest is described on the national level and the prefecture level, and the current situation of disaster prevention related applications is organized. Section 5 concretely describes the present state of application development we are proposing. Section 6 discusses the utility of application development and summarizes it in Section 7.

II. RESEARCH PURPOSE AND RESEARCH METHOD

The objectives of this research are the following two points. Regarding the mobile application development contest, contributing to the development of disaster prevention tools by organizing the current state of contest cases at national and prefectural levels, encouraging dissemination to the international community and considering the utility concerning its development. The second point is to describe our mobile application under development and to gather knowledge necessary for improvement.

III. CURRENT SITUATION OF DISASTER COUNTERMEASURE IN JAPAN

According to disaster measures in Japan, the law for evacuation action requiring supporters has been developed in the following way [2][4]. Measures have been taken in

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IV. CASE STUDY DISASTER-RELATED APPLICATIONS

two major divisions concerning (a) evacuation behavior maintenance and (b) life maintenance in evacuation centers.

(a) Measures for Support to Disaster-Affected People

Measures for Residents in Need of Assistance in Evacuation In 2006 the Cabinet Office released and has disseminated the Guidelines for Evacuation Support of People Requiring Assistance during a Disaster to municipalities. A survey resulted in high mortality rates for age and disabled groups in the Great East Japan Earthquake in 2011, while there was a sacrifice on a broad scale for those who provided support such as firefighters and social workers. With these lessons, the Disaster Countermeasures Basic Act was amended in 2013 to stipulate that head of each municipality be assigned with the responsibilities of establishing a list of residents who need assistance in evacuation at the time of disaster, and upon revision of the Basic Act, the above-mentioned Guidelines were revised in its entirety into the guidelines which incorporated specific procedures for establishing a list of residents in need of assistance at the time of evacuation.

As described above, although legal maintenance has been done, it is urgent to research the development of useful concrete methods and tools that support them. Also, the living environment at the evacuation shelter is being maintained due to the following circumstances.

(b) Securing good living environment at the evacuation centers

In the Great East Japan Earthquake, there were many problems arising during the disaster: affected people suffered health problems; aged people were forced to stay home because they could not adapt themselves to the evacuation shelters in some cases, relief supplies were not provided sufficiently to home evacuees in many cases; and there were reported problems for provision of information, relief supplies, and services for wide area evacuees who evacuated to other prefectures or municipalities. In order to address these challenges, the Disaster Countermeasures Basic Act was revised in 2013, adding provisions to oblige administration to make efforts to improve living environment of the evacuees at the evacuation center, including food supplies, clothes, medicines, and other basic living needs and health and medical services. Also, with the said revision of the Act, guidelines were formulated and published for securing good living environment at the evacuation centers, directed mainly to municipalities.

In this way, improvements have been made to secure the living environment of evacuation centers for vulnerable people. Utilization of mobile applications is being studied as a useful tool for these measures. For mobile applications, prerequisites are satisfied if research and development of sanitary technology and battery technology progresses as the communication network is maintained, power can be secured, smart devices are prevalent, and prerequisites are met. At some point in the world there are countries that can not deal with these assumptions. However, based on these conditions, it will be useful to develop tools to realize disaster prevention.

Contests for developing mobile applications are being held at the national, prefectural and university level. In this section, we will organize Japan's efforts to develop mobile applications.

A. Mobile App Development Initiatives

(1) Country-level initiatives

To prepare for disasters such as earthquakes, various applications are being developed. There are many useful things in the event of a disaster, some of which can be used even in daily life. Disaster prevention application review committee hosted by the Ministry of Land, Infrastructure and Transport awards these excellent disaster prevention applications to the award. For example, the following applications are available.

The first is an application called "Hazard Checker". The function is a notification application that notifies weather disaster prevention information on the current location or designated point and the presence or absence of disaster hazard. It is compatible with multiple languages, and text and color display are designed to be easy to understand. The presence or absence of hazard information of the place you want to know is immediately displayed as "dangerousness confirmation result" in an easy-to-understand manner, so that you can easily know the dangers of the place. This is a convenient application and has been awarded the Grand Prize of disaster prevention application.

The second is an application called "local disaster prevention map creation support system". As a function, there is an application that makes it easy for kids to create and share disaster prevention maps of the area. It is a web application that supports information awareness of disaster prevention by overlaying hazard maps and terrain information with information such as dangerous parts and evacuation routes entered by children and has been awarded disaster prevention application award.

Thirdly, there is an application called "Disaster Education Education Guide Application: Coco-dake Timeline". As a function, it is an application to learn about disaster prevention that timeline information on large scale water disaster, disaster risk degree, evacuation information guide. Prior to landing of the typhoon, we conduct preliminary learning with inundation simulation etc. After the landing of the typhoon, it will encourage access to disaster prevention information according to the timeline (time axis) and support improvement of disaster prevention awareness. This application, like the above, has been awarded the disaster prevention application award. In addition, there are various apps such as inundation simulation, difficulty guide, application for medical staff who shares health information of evacuees, disaster message board application and so on.

The Ministry of Internal Affairs and Communications holds a contest called App Koshien. The screening criteria can be roughly divided into planning ability and technical ability, and creativity or novelty, consumer support,



implementation capability, technical challenge, UI and UX will be judged. The content of the application is not limited to disaster prevention, and there are things that can be used everyday. This contest has been held since 2011. From junior high school students to high school students are eligible, recruitment of primary school students is also possible. Elementary school students' application has also been seen in recent years.

The Ministry of Internal Affairs and Communications and the National Institute of Information and Communications Technology (NICT) hold "Entrepreneurs Koshien - Entrepreneurs World Expo". In an effort to create ICT start-ups from regions with innovative technologies and services, it is an attempt to unearth students who are aiming for entrepreneurship and promising young entrepreneurs from across the country. Through mentoring and brush-up of business plans, they are launching a "national accelerator program" that supports commercialization.

In addition, the Cabinet Office Regional Creation Promotion Office holds application contests useful every year since 2017 for analysis of regional economies and excavation of local attractions. We are recruiting application ideas using analysis created using RESAS-API or applications created using RESAS-API.

(2) Prefecture-level application development contest

Even at the prefecture level, similar to the national level, an application contest is being held. The "Tokyo Public Transport Open Data Challenge" by the Association for Open Data of Public Transportation and the Tokyo Metropolitan Government has made the data on major public transportation in the metropolitan area more fulfilling than ever before. Data such as station premises map, facility information, walking space network and Bluetooth Low Energy beacon location installed in public space are also released. This is a contest for the preparation of the Tokyo Olympic and Paralympic Games in 2020. They are looking for applications and ideas to realize "Tokyo", which allows visitors of various attributes who came to the metropolitan area for the first time to travel to their destination smoothly by public transportation. In this way, contests linked with large-scale events to be held in the future are also being implemented.

In Ibaraki Prefecture, a contest called "Ibaraki Digital Content Software Award" is being held. In this prefecture, they are raising interest in contents and IT by setting opportunities for planning, producing, recruiting, etc. of digital contents and software (applications). They are aiming to revitalize the region through training of human resources and cooperation with related industries.

Kanagawa Prefecture Information Service Industry Association is a general incorporated association established for the purpose of IT industry in Kanagawa prefecture gathering, to develop industries and contribute to the local community, activities similar to the above are being developed. Shinshu Future Apps Contest Zero is held in Nagano Prefecture. This contest is targeted at elementary school students to young people under 30 years old and provides opportunities to cultivate the education and sensitivity of ICT utilization. In order to nurture advanced ICT human resources, they are looking for their own applications and systems that operate on smart phones,

tablet terminals, personal computers, etc., and recognize outstanding works. Other similar contests are held in prefectures such as Hokkaido and Tokushima Prefecture.

(3) City and university application contest

There are contests led by Yokohama National University circle at the university. The "E-zuka smartphone application contest" is held by Iizuka-shi, Fukuoka prefecture with various support. It is a development contest for applications for smartphones and tablet terminals. The first contest was held in 2012 and is continuing. In addition, there is an application development contest leading companies. These are trying to boost the app development. However, these contests are not limited to disaster prevention applications, and it is difficult to say that they are fully recognized.

B. Consideration on the current state of application development

In this section we have described the current state of the application development contest. Especially for applications relating to disaster prevention, both disaster victims and those not affected by disasters can be used, but it was not enough as a countermeasure against disasters. For example, as far as we surveyed, there were no apps that support the supply of goods. Also, at the Web site, there are sites involved in the supply of goods, but there was no assistance that victims were able to directly request goods.

In other words, receiving the victims' voices (requirements of goods required by the victims), there are currently no apps for goods support on the victims side. Although the mechanism of transportation of administrative-related goods has been established to a certain extent, it is undeniable that current and state-of-the-art goods support applications for individuals and one disaster-affected person are not considered sufficiently.

If you have such an app, you can see at a glance what kind of supplies are not enough for victims, and the supporter can send the necessary supplies for the victims. There is a possibility that detailed measures can be realized for supply of goods, depending on the time and the season. It is also possible for such optimal material support simulation to know how much stock is stored. Therefore, in this study, we decided to design and develop disaster supplies transport support application. Details are described in Section 5. It is thought that there is significance in having them further expanded by arranging these and connecting to international activities.

V. APPLICATION DEVELOPMENT FOR DISASTER VULNERABLE PEOPLE

When an earthquake occurs, disaster relief supplies are sent to the afflicted areas and distributed to victims. In the event of an earthquake, disaster supply systems for the victims from the administrative side have already been constructed. However, demand systems that request victims' disaster supplies assistance to the government etc. are not sufficiently constructed in Japan. In particular, there is insufficient support for people with handicaps, called

"disaster vulnerable people", the elderly, disabled, seriously ill, infants, pregnant women and foreigners among others [5][6].

In order to describe the function of the development application in another paper, this research focuses on the interface design part of the application examined at the time of development.

A. Overview of the proposed application

(1) Disaster vulnerable people

Disaster vulnerable people are also called "Necessary assistants in disasters". They are "people who need assistance in taking a series of disaster-prevention actions such as evacuating to safe places to protect themselves from disasters". They can not do crisis avoidance behaviors and evacuation behaviors like ordinary people. Therefore, they need assistance by others in evacuation life, reconstruction of living, restoration activities. Their obstacles are diverse, and the necessary support depends on the phase and timing of the disaster. For that reason, careful measures are required for assistance to them.

Specifically, it is understood that people with physical and mental disabilities (physically handicapped, intellectually handicapped, internally handicapped, visually / hearing impaired), dementia and physically weak elderly, routinely healthy people understand Infants who are poor in power and judgment, foreigners who do not understand Japanese well, pregnant women who suffer temporary behavior problems, injured or sick and others. In addition, travelers and tourists who are not geographically sometimes included.

(2) Types of trouble and examples

The disadvantages that vulnerable people encounter in disasters are different. The main obstacles can be categorized into the following six. They are "information trouble" in which information is difficult to communicate and understand, "crisis avoidance behavior trouble" to get rid of the disaster, "move behavior disorder" including "evacuation behavior trouble" due to the damage of daily moving space, , "Living behavior hindrance" (including evacuation shelters etc) where the behavior of daily living is narrowed by the affliction, "adaptive hindrance" which can not correspond psychologically and mentally to the change of sudden living environment, furthermore from the living environment aspect, "Economic trouble" for rebuilding the living with "structural trouble" such as building structure (Table 1). Table 1 also shows what types of disaster vulnerable subjects are assumed for these obstacle classifications. As shown in Table 1, it can be seen that the disaster vulnerable subjects correspond to the plural obstacle classifications. For example, it is assumed that infants and handicapped persons fall under all obstacle classifications, and surrounding supporters should support with consideration for the contents of obstacles expected to be encountered by vulnerable people in disasters.

Table 1 Disadvantages encountered by disaster vulnerable people in case of disaster

Classification of trouble	Contents	Subject: Major disaster vulnerable
Information trouble	Information transmission and understanding is not easy.	Infant, disabled, foreigner, elderly
Crisis avoidance behavior trouble	It lacks instantaneous power, acts in a panic, can not protect yourself, it is easy to kill and injure.	Infant, disabled, elderly, pregnant women, injured or sick
Moving gait trouble	There are problems of evacuation and movement due to insufficient physical strength, damaged houses, roads, etc.	Infant, disabled, foreigner, elderly, pregnant woman, victim
Living behavior trouble	Without medical equipment / instruments it is difficult to maintain life and living. Also, preparation and maintenance of welfare evacuation centers is inadequate.	Infant, disabled, elderly, pregnant women, injured or sick
Adaptive hindrance	Action impossible due to psychological upset. Also difficulties in communal living at evacuation centers with disabled people and foreigners due to unrelated.	Infant, disabled, foreigner, pregnant woman
Structural trouble / economic trouble	Casualties at the time of earthquake due to housing structure problems. Delay in rescue and recovery due to delay in relief and economic troubles.	Infant, disabled, elderly, foreigner, pregnant woman, victim



The difficulty that vulnerable people suffer in disasters at the time of disasters varies depending not only on the type of disaster but also on the time course of the disaster period ("emergency period", "evacuation and relief period", "recovery period"). Vulnerable people with disasters are likely to suffer these obstacles in duplication and in some cases the potential hindrances are amplified due to the disaster. Compared to the general public, it is more vulnerable to damage, and recovery and living reconstruction are likely to be delayed. In addition, not only the disaster vulnerable side but also the deficiency in the structure of the evacuation center and the support system, etc. may be hindered by insufficient understanding of the surrounding people. Therefore, it is necessary to promote understanding of these by awareness raising activities.

(3) Current situation of vulnerable people

With reference to "evacuation support guidelines for disaster assistants," the government has requested local governments to formulate policies to plan the priorities of requiring assistants to evacuate. The government urges local governments to formulate an overall plan, an individual plan, and a list of persons who need assistance during disasters. However, the number of organizations that formulated an "individual plan" that specifically specifies who should evacuate to individual assistant supporters remained at 28.8% (501/1742) (2012 firefighting Investigation by the agency).

Also, in the event of a disaster, the existence of "welfare evacuation shelter" is also important. The evacuation center needs to be equipped with assistant staff, a space of a certain size is secured, and barrier-free is required. However, only 41.8% of the municipalities that designate one or more welfare evacuation centers (according to the Ministry of Health, Labor and Welfare). In order to minimize the damage, it is important to enhance advance notice for disasters and to create a support system. Preparation of nursing care products and auxiliary instruments, etc. are necessary for both individuals and administrative agencies.

B. Outline of development application

The developed application has the function of delivering the voices of vulnerable people in the disaster area to the side that supports it. In other words, it is an application for communicating the aid items desired by vulnerable people to the supporter side. The types of goods obtained through the application are various. Clothes, meals, and fine-grained correspondence about living are desired. In this development, 6 items of clothing, diapers, meals, cane, medicine, and transportation days are provided in the application. Attributes of each item are set more finely. The selected attributes are described below.

For clothing, there are attributes such as size, gender, thick or thin selection, baby clothes, number of sheets, and the like. For diapers, there are attributes such as number, size, and selection of tape type or pants type. Regarding meals, weaning foods and selection of allergies are available. For wand, you can choose whether it is for injured persons or for people with weak legs. Regarding marketing medicines, there are attributes such as cold medicine, antiseptic solution, bandage, gauze and so on. We set items

of urgency such as whether the number of days to be transported should be around 4 to 5 days from ordinary time or whether it is necessary to arrive in about 1 to 2 days on an urgent basis. In addition, considering weak eyesight, it was designed with dark colors and easy-to-see colors.

A questionnaire survey was conducted to examine the interface suitable for selecting these items and attributes. About the application interface, prepare three illustrations of a drop box, a button, and a text input and set up a question with the purpose of "what kind of input format do you think is good when using it in a disaster" and a free form comment field, and conducted a questionnaire survey. The answer got 3 choice options and free description comments. For preliminary survey, we prioritized to answer quickly and conveniently, and we conducted a questionnaire collection with a one-week response period by utilizing the group LINE of 30 researcher colleagues including students. In the questionnaire survey, there were about half of answers, drop list form was popular, so we adopted the drop list form.

VI. GENERAL CONSIDERATION

TV interviews were the main medium for the means to convey the demand of goods to many people from victims. Even if they respond to the interview, the goods as requested are not always delivered. Also, there has been a lapse of time since the requested time, and the supporter could not provide sufficient support. The prototype of the developed application can improve this situation as much as possible. However, with the interface, it turned out that the scroll was long and the work was tough. It also turned out to be deficient as an item of a person with poor eyesight or actually needed in a disaster area. Originally, human beings were helpless against natural disasters. However, as discussed in this research, application development, which can directly deliver victims' voices to supporters using information technology, solves the current problem and makes society better.

Several utilities are considered for holding the application development contest. One is the enlightenment of disaster prevention activities, which is an effect that leads to raising awareness of disaster prevention. Holding such a contest is one advertisement. The second one is considered to be an opportunity to appeal the activities of each group. Depending on the role of the organization, although the purpose of the application development contest is different, it is suggested that as a part common to development, it leads to improvement of the technical capability of the application to be developed. In addition, the idea's planning ability is also necessary. This leads to extending the skills of application developers about two major aspects such as implementation skill and planning ability. In addition, contests focused on the development of disaster prevention applications will also need the ability to investigate the current state of disaster prevention. In this way, the utility of application development is large in many ways.



For future problems and restrictions, there are few people who can develop applications. Therefore, there is a possibility that various ideas are difficult to occur. However, the Ministry of Education, Culture, Sports, Science and Technology has decided to implement programming education for primary school students in Japan from 2020, and improvement is expected.

VII. CONCLUSION

In this study, we summarized the laws and policies that are being developed about disaster countermeasures in Japan, and categorized development examples of mobile applications in terms of country, prefecture, city etc. Among them, we examined the current state of disaster prevention application. In addition, we discussed the present situation of the application which we are developing concretely and considered the utility. Through these, we contributed to the promotion of disaster prevention tool development and accumulated useful knowledge on improvement of mobile application under development. From now on, we plan to make improvements on the improvements, and to develop development aiming for practical application.

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