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Review of Hazard Mapping Information Collected for Local Disaster Prevention by Residents in a Historical Local Town

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역사적인 지역 주민들의 지역 재해 예방을 위해 수집 된 위험지도 정보의 검토

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Abstract We are developing a hazard map creation support system for historical local towns. Our system aims at collecting the unique information received from residents and raising resident's consciousness to disasters by recording hazardous locations where residents feel danger in case of disasters. In this paper, we examine the hazard information of the area collected by the residents themselves in using the system. While exchanging opinions, the residents review the validity and completeness of the information gathered by walking around the area. We also consider how to integrate and share it throughout the region.
We found that it was possible to gather regional hazard information from the viewpoint of residents in addition to high coverage for each district. Also, by sharing information at the review meeting, the residents were able to newly know the hazard information of other districts that they did not know before. This shows the usefulness of residents to share the dangerous information while examining each cause across the different districts.

Key Words : Hazard mapping, Regional disaster prevention, Hazard information, Historical local town, Local residents

요 약 우리는 역사적인 지역 마을을 위한 위험지도 작성 지원 시스템을 개발 중입니다. 우리 시스템은 재해 발생 시 주민이 위험한 장소를 기록함으로써 주민들로부터 받은 고유 한 정보를 수집하고 재해에 대한 의식을 높이는 것을 목적으로 합니다. 본 논문에서는 주민들이 수집 한 지역의 위해 정보를 시스템을 이용하여 조사한다. 의견을 교환하는 동안 거주자는 주변을 걷는 데 수집 된 정보의 유효성과 완전성을 검토합니다. 또한 지역 전체에 통합하고 공유하는 방법을 고려합니다. 우리는 각 지역에 대한 높은 보상 범위 외에도 거주자의 관점에서 지역 위험 정보를 수집 할 수 있음을 발견했습니다. 또한 재검토 회의에서 정보를 공유함으로써 이전에 알지 못했던 다른 지구의 위험 정보를 새로 알 수있었습니다. 이는 각 지역의 각 원인을 조사하면서 주민들이 위험한 정보를 공유하는 유용성을 보여줍니다.

주제어 : 위험지도, 지역 방재, 위험 정보, 역사적인 지역 마을, 지역 주민

1. Introduction

Japan, which is a disaster-prone country, faces the threat of various natural disasters, such as earthquakes, typhoons, and volcanic eruptions [1-3]. A variety of disaster prevention measures and trainings have been

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studying[4-6].

Our approach in this paper is small-start ICT-based disaster prevention, which is rooted in the region and based on the characteristics of a historical local town[7-10]. We have been developing a hazard map creation support system for a historical local town with old Japanese scenery[11]. These towns are vulnerable to disaster because of depopulation, aging and preservation of the traditional landscape[12]. We selected Hizen-Hamashuku in Kashima City of Saga Prefecture in Japan as a model areas of historical local towns. This region has remained old city from the Edo era and has been designated as nationally important traditional buildings preservation districts[13].

Our system supports to make regional hazard map in the following procedure : (1) Residents walk around the area and find dangerous location. (2) He/she posts the information on a tablet device (a position, a photo, a disaster type, a risk level and comments). (3) The posted information is stored in the database of the server. (4) Each terminal acquires information from the database on the server. (5) The terminal can show all posted information. The continuous resident participation and posting design are core concept for our community-based approach.

We expect that local residents can collect detailed information and also expect that disaster prevention awareness of residents can be improved by participation activities. Utilizing this system, we have collected the hazard information of each district by local residents themselves walking around the districts by themselves[14].

In this paper, we conduct mutual evaluation of the collected information through exchange of opinions by local residents. The viewpoint of evaluation is as follows : Our system is able to support (1) collecting hazard information of residents' perspective, (2) collecting exhaustive information, and (3) the validity of posted information. We also discuss how to integrate and share these information for regional safety.

2. Collection of Hazard Information by Town Walking

We On September 29, 2017, 11 local residents and 8 our members took a walk using our system and gathered information. About 15 minutes, we explained the way of using the system to the residents.

After that, we assigned persons in charge of the six districts in the target area. They are "Shokin", "Minami-Funatsu", "Kita-Funatsu", "Nakamachi", "Hasshyuku" and "Hama-Shinmachi". The person in charge of each district is a group of 2 to 4 people including the local residents of the district and our student members. Each group searched for each district and registered district hazard information. The time to walk around town was around 1 hour including the round trip to the starting point.

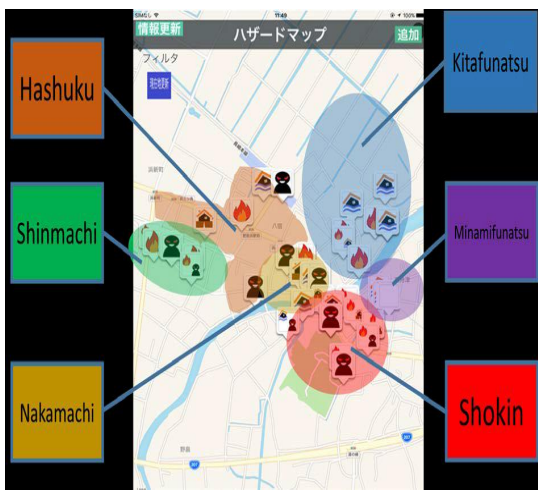

Fig. 1. The created hazard map.

Fig.1. shows the hazard map created in this activity. A total of 50 regional hazard information was registered. We asked local residents to input information. Most of the information was input by the residents themselves, but our members (students) entered information on the support of uneasy people and the information they found themselves.

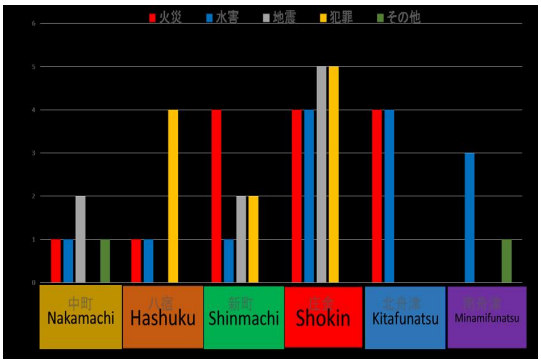

Fig. 2. Hazard information registered for each district.

Fig.2. shows information registered for each district. The type and number of registered information are different for each district. Moreover, these differences reflect the anxiety of each district against these disasters. We believe that we could create a hazard map reflecting the characteristics of the district by walking around and registering information in using our system.

3. Posted Hazard Information Review Meeting

3.1 Outline of the Review

The review meeting was held at Hama public hall, which is a community hall in target area, on April 19, 2018. There were 9 participants, who are 5 local residents, one Kashima city official staff and 3 our members (one professor and two graduate students). The residents are representative for voluntary disaster prevention activities from each district in the target area. The city official belongs to the City Construction Division which administer the target area. We held the meeting for about 2 hours from 10 AM.

3.2 The Meeting Process

We prepared a large-scale ZENRIN map of 1/250 scale. It shows the target area by A0 size paper. The reasons why we applied not tablet devices but a paper map are (1) it is suitable for exchanging opinions while sharing information, (2) it is easy to operate on information such as pasting or writing on a map, and (3) it is easy to grasp activities of other participants.

We examined 23 regional hazard information, which is judged risk levels 3 (the most dangerous) or level 2 out of 50 pieces of hazard information collected by walking around the target area. The area is divided into 6 districts as we described above. They are “Shokin”, “Minami-Funatsu”, “Kita-Funatsu”, “Nakamachi”, “Hasshyuku” and “Hama-Shinmachi”. We have given ID number for identification to all information beforehand. We printed 23 sheets of hazard information and distributed them to participants. Each sheet expresses hazard information at each point (Fig. 3).

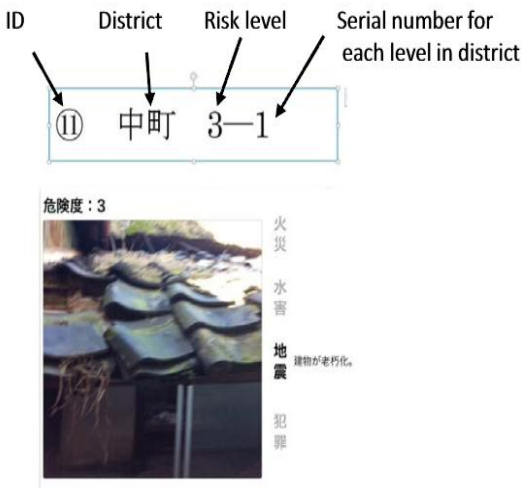

Fig. 3. An example of distributed hazard information sheet.

By attaching a numeral seal to the position on the map corresponding to each information ID number, we prepared the location confirmation. All the participants checked each position, a photo, and hazard information in turn, and exchanged opinions.

3.3 Results and Discussion

Fig. 4 shows the results of answers to the question of whether they knew the each hazard information

from before.

We can see that about 80% of hazard information knew from before. This result shows that the residents were able to gather hazard information of the district from the residents' perspective by using our system. The 20% hazard information recognized for the first time at this review meeting was information on districts other than their own district. In the existing method with ad hoc message exchange, sharing of hazard information of beyond the district is insufficient. This shows the usefulness of information sharing by our system.

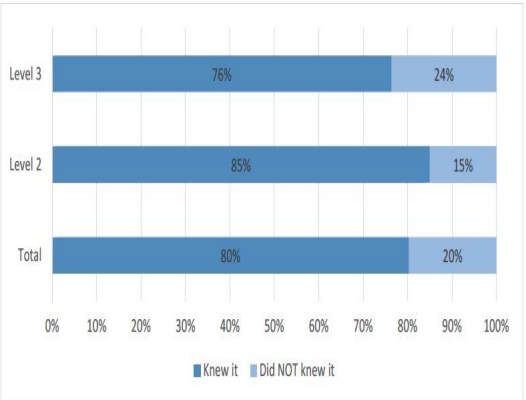

Fig. 4. An example of distributed hazard information sheet.

It is also supported from the residents own words "We don't know the detailed information of other districts. It is very useful to share the hazard information gathered for each district together in considering district disaster prevention.".

After the review, we asked the participants if they walked around again, they could find new hazard information. Their answer was negative. We consider that the collected hazard information has covered almost everything because voluntary disaster prevention members in each district actually walked around his/her district and entered the information.

Fig. 5 shows the results of answers to the question of whether the information the residents judged risk level 3 and level 2 (Level 3 is the most dangerous) is really dangerous. There is no clear criteria of the risk level to be given at the time of posting information. It is left to the subjectivity of the poster. Opinions for criteria have been asked by local residents so far. About 84 % of the information judged as risk level 3 is recognized as dangerous. About 66 % of risk level 2 is the same. Approximately, 15% and 33% of the information judged level 3 and level 2, respectively, revealed that the danger could not be recognized. This result shows the limits of judgment of the degree of danger by subjective evaluation of residents.

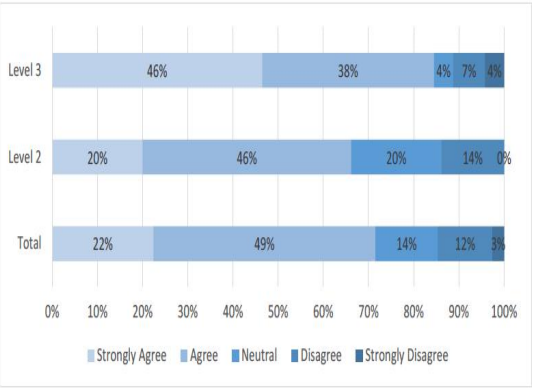

Fig. 5. Review of risk level based on subjective evaluation

Improvement is considered necessary from the viewpoint of the adequacy of risk level. On the other hand, it is meaningful to collect and share information on places where some residents feel dangerous in their daily life. Among the places where some residents thought it was dangerous, it was found that countermeasures were already taken and the danger was reduced. It was also revealed that disasters have occurred in the past even though they do not appear to be high in danger, and that this is not well known. Through this review meeting, it was beneficial that these cases above were become apparent and shared among residents. These findings indicate that it is desirable to create a mechanism to provide hazard information with some degree of reliability in sharing it among all residents. In order to realize this, it is

necessary to review the causes of each hazard information from multiple perspectives.

4. Discussion

In this section, we discuss the basic performance of our prototype system based on our trial test in the field. A total of ten people, five local people and five Saga University teachers and students. We explained a function and how to use the system for around 15 minutes to participants. We divided all into three groups and assigned the area to investigate. We all went around the area for 40-50 minutes and input the data of hazardous location. A total of 27 locations, 46 information was registered in just less than one hour.

4.1 Collection of Local Hazard Information

Information associated with flood hazards was registered in low-lying areas, whereas hazard information for fires and earthquakes was registered where houses are clustered. This indicates that it was possible to collect information about hazardous locations from local residents in a short time.

Our trial experiment shows that people in the region are most concerned about earthquake hazards. The next greatest concern is the risk from crime rather than from other natural disasters. This is because fire hydrants and river improvement work have reduced the risk from fire and flooding.

Originally, the targets of the hazard maps were natural disasters, such as earthquakes and floods. In this study, we considered crime from the perspective of the safety of local residents. Our field test revealed potential anxiety about local crime.

4.2 Operational Performance

Our system is designed to allow elderly people who are not used to digital terminals to input information by touching presented choices. The comments for each hazard are also prepared and easily selected by touch. In addition, a user can input original comments by using a keyboard. One user expressed the opinion “It was easy to use”. The user input worked smoothly and input took about one minute per entry. These results demonstrate that our system is a user-friendly iOS application.

4.3 Overlooked Information

We also identified the necessity of multiple viewpoints. Posting information from local residents makes it possible to register unique local information. However, residents may overlook hazards because they become familiar with and complacent about risks.

5. Conclusion and Future Work

In this paper, we examined the regional hazard information collected by the residents themselves in using our hazard map creation support system. The target area is historical local town in Saga, Japan, where the old good streets of the Edo period remain. While exchanging views surrounding the large-scale paper map of the area, the residents review the validity and completeness of the information gathered by walking around the area. We found that it was possible to gather regional hazard information from the viewpoint of residents in addition to high coverage for each district. Also, by sharing information at the review meeting, the residents were able to newly know the hazard information of other districts that they did not know before. This shows the usefulness of residents to share the dangerous information while examining each cause across the different districts. Meanwhile, for the labeling danger revel for each hazard information by subjective evaluation of residents, its limit was shown because it is not always possible to agree among residents.

In future research, we will create a mechanism to ensure the reliability of hazard information and create a regional hazard map for the area. We hope that our

research contributes to preparing for disasters by communicating the collected hazard information to all residents in an easy-to-understand manner.

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