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Practical Evaluation of ICT-based Self-made Regional Safety Map through Residents' Workshop in a Historical Local Town

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Abstract: This paper describes a practical evaluation of our ICT-based regional safety map for a historical local town. In this kind of towns, it is required to make daily potential dangers visible and share them as basic information for regional safety. Our system supports local residents to post dangerous points in their living areas and share. We created and revised a local safety map under the cooperation of voluntary disaster prevention members. From the observation of the workshop and questionnaire survey, we found that (1) our system contributes to collect and share distinctive local danger information for the safety map, (2) the map provided by our system leads to awareness of safety by reaffirming nearby danger, and (3) the map is also useful for reviewing danger information and improving reliability through meeting.

Keywords: regional disaster prevention, safety map, voluntary disaster prevention, historical local town, community participation

1. Introduction

In Japan, which has suffered many damage due to natural disasters (Disaster Management, Cabinet Office, 2015), research and various efforts to minimize such damage have being done (Geospatial Information Authority of Japan (GSI),2017; Mitsuhara, H. et al., 2015; Nakai, F. et al., 2014; Nonomura, A. et al., 2016; Sakuma, A. et.al., 2015). Under these circumstances, there are areas where town development is progressing against disasters. However, local towns with historical streets (hereinafter referred to as historical local towns) are vulnerable to disasters due to regional problems (Okazaki, Y., et al., 2016). Historical local towns have traditional landscapes such as post towns or castle towns (Japan Guide.com, 2012). In order to preserve such traditional landscape, it is difficult to improve the infrastructure such as earthquake resistance of building and road construction. Also, as young people flow out to urban areas, the population has been declining and aging in historical local towns. The number of elderly people who can receive support from young people at the time of disasters is limited. People living in these historical local towns need to consider disaster risk in advance and prepare for disasters in such harsh conditions of spatial or human restrictions (Mishima, N., et al., 2014).

Since the Great East Japan Earthquake, hazard maps have been drawing attention as disaster countermeasures. However, the usual hazard map does not consider detailed regional characteristics. In historical local tows with old townscapes, there are many distinctive problems, such as narrow roads and small waterways, where there is no emerging standard when creating hazard maps. Moreover, anxiety that residents feel in their daily lives is often issues that they do not notice unless they actually live in the area. It is necessary to highlight these issues from the perspective of local residents. By reviewing conventional disaster prevention maps from the stage of creation and collecting information by local residents themselves, it becomes possible to create original regional safety maps that posted information on the residents' perspective.

We have been developing and researching a regional safety map creation support system based on the characteristics of the town in utilizing ICT (Kozaki, S. et al., 2017; Okazaki, Y., et al., 2017;

Okazaki, Y., et al., 2018). In this system, while actually walking around the district using the tablet terminal, the residents register the information (kind of danger, picture, comment, position) of the points that can be danger. By integrating the collected information and displaying the information on the map, a local safety map is created. By residents participating, we are expecting recognition of local dangers by collecting and sharing detailed information on the area and raising awareness of disaster prevention for residents.

In this study, we evaluate the local safety map we created using our regional safety map creation support system at Hizen Hamajuku which we selected as model area. This region has remained old city from the Edo era and has been designated as nationally important traditional buildings preservation districts (Agency for Cultural Affairs, 2017; Saga Trip Genius, 2014). We asked representatives of the local residents to consider evacuation plans assuming disasters. At that time, they actually used the tablet terminal in using the regional safety map created by previous activities. Through these activities, we evaluated our maps from the viewpoint of the usefulness as a disaster prevention map and the validity of information, the readability of the information being posted, and the ease of use as a safety map.

The rest of the paper is organized as follows. Section 2 presents how to create a local safety map. Section 3 describes results and discussion of the evaluation through the workshop. Section 4 gives summary of the paper.

2. Collection and Review of Danger Information by Town Walking

2.1 Collection of Danger information by Town Walking

On September 29, 2017, 11 local residents and 8 our members took a walk using our system and gathered information (Okazaki, Y., et al., 2018). 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”, “Minamifunatsu”, “Kitafunatsu”, “Nakamachi”, “Hashuku” and “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 danger information. The time to walk around town was around 1 hour including the round trip to the starting point.

Figure 1 shows the safety map created in this activity. A total of 50 regional danger 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. Figure 2 shows information posted in 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 including the town specific. We believe that we could create a safety map reflecting the characteristics of the district by walking around and registering information in using our system.

2.2 Review Meeting for Posted Danger Information

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.

In this review meeting, there were opinions that it would be better not only to have specific points, but also to have danger information on roads, certain areas, or information useful in case of a disaster (AED(Automated External Defibrillator), fire hydrant, evacuation center). Therefore, we improved the system so that such information can be provided. We also changed the crime icon from a suspicious person to a police officer.

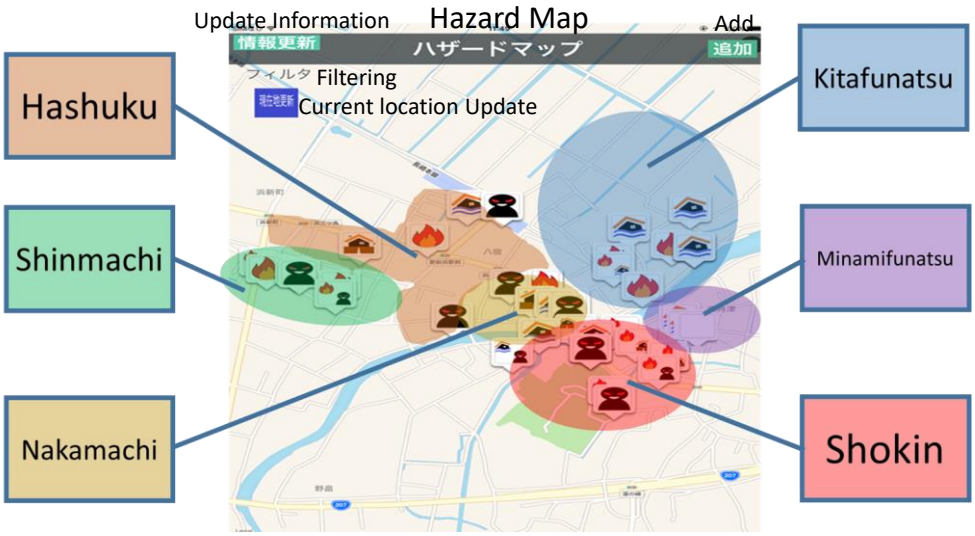

Figure 1. The created safety map.

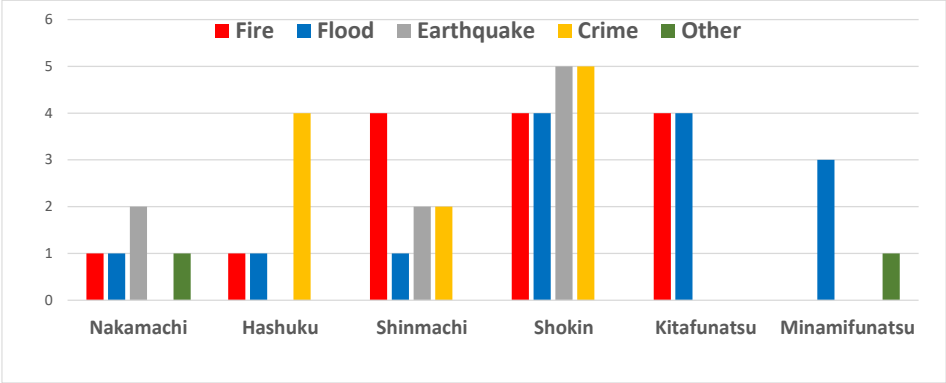

Figure 2. Danger information posted in each district.

2.3 Additional Danger Information Collection

On October 4, 2018, 5 local residents, one Kashima city official staff and 3 our members gathered at Hama public hall and collected additional area information described in section 2.2. This time, instead of actually walking around the towns, we used a customized Zenrin Map. A total of 29 information is added. Many of them are information on narrow roads where fire truck cannot pass and low land where water flows. We made the safety map reflecting such information.

3. Evaluation of Safety Map through Regional Safety Workshop

3.1 Outline of the Workshop

In this workshop, we evaluate whether disaster prevention map created using this system have practical roles and objectives expected by the residents. Local volunteers who actually use the disaster prevention map examined evacuation plans assuming disasters in using the regional disaster prevention maps created by our system. The viewpoint of evaluation is the practicality of the disaster prevention map, characteristics and validity of information, easiness of viewing and ease of operation.

On December 20, 2018, we held a meeting at Hama public hall in Hizen Hamajuku about 2 hours from 10:00 am. Participants were 8 local residents, one Kashima city official staff, and 5 Saga University officials (1 professor, 4 students). Of the 8eight local residents, five were participating in both town walking and review meeting , and one was participating in town walking. Two people and the city staff participated only in this workshop. Figure 3 shows two photos of the workshop. The procedure is as follows. We organized four groups of two local residents and one student. A city office staff joined

Figure 3. Snapshots of the workshop

one of them. For about 20 minutes, students used the actual equipment to explain disaster map viewpoints and operations to local residents. After that, each group took about 70 minutes to check the information that was posted and to examine the evacuation plan. In order to examine the evacuation plan, we distributed maps of paper that printed Hizen Hamajuku area and self-made evacuation plan examination sheet. They confirmed the danger in their daily life and evacuation route. Finally, we conducted a questionnaire survey on the system and disaster prevention map for about 10 minutes. The record of this workshop is only photographs and memos in consideration of participants who are reluctant to record (video and audio recording). Workshop analysis by protocol analysis is a topic for the future.

3.2 Items and Methods in Evaluation

The questionnaire has 13 items in all. Question 2 to Question 11 are five-point scale selective question. Evaluation items of the questionnaire were practicality of safety map (Questions 8 and 9), characteristics and validity of information (Questions 5 to 7), ease of viewing, ease of operation (Question 2 To 4, 10 to 13), and the experiences of electronic devices (Question 1).

3.3 Results and Discussion

3.3.1 Practicality of the Map

Figure 4 shows the answer to the question No.8 (whether this safety map is effective for each role or purpose). Since we were able to obtain positive evaluation, we believe that we were able to achieve role and purpose of the map in general. Although we did not compare with official hazard maps, the conversation among the residents at the workshop showed that they were able to know information on their own risks not listed in the safety map, and also provided a good opportunity to think about disaster prevention.

The answers that it is moderately effective were also high percentage. This indicates that the map has room for improvement. There were requests such as adding information and improving the degree of danger to Question 13 (Improvement points and functions / information you would like added). Improvement proposals include establishing standards of danger levels and visualizing them, making it possible to register not only the cause items of the disaster but also damage prediction, and making it possible to register more than one photo.

There were many positive answers to the questions of "Improvement of disaster prevention awareness by using on a daily basis" and "Documents for use in discussion and disaster prevention workshops". We think this is because the review of the evacuation plan in this workshop was useful. Several improvement points were pointed out on the map, but we believe that the workshop was meaningful and successful.

Although there were many positive answers about improving disaster prevention awareness, it is not easy to show it as objective data by using the map. It is a future task to conduct this evaluation after examining concrete evaluation methods.

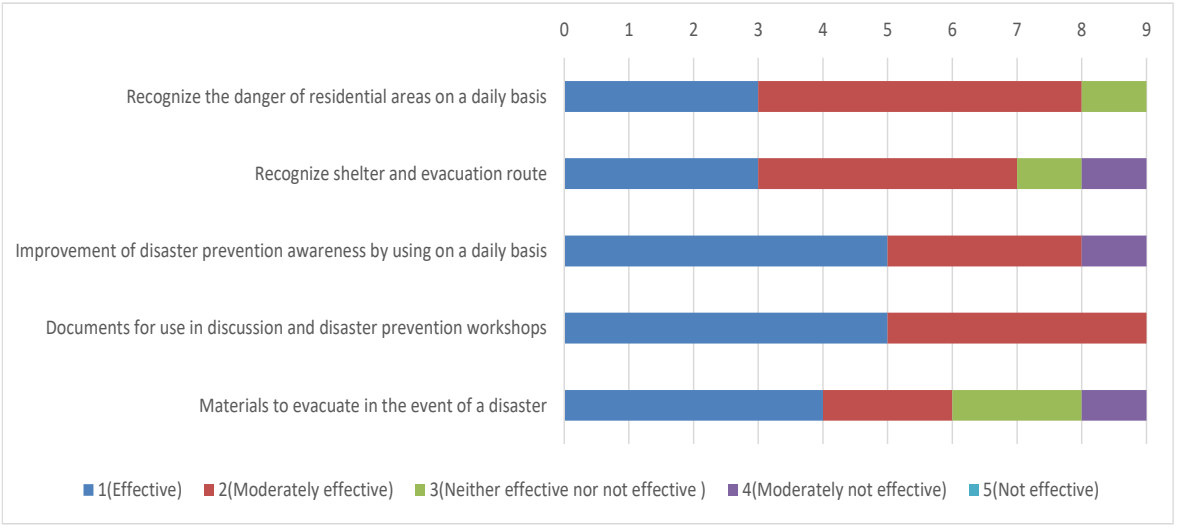

Figure 4. Answers to Question No.8 (Practicality of the map)

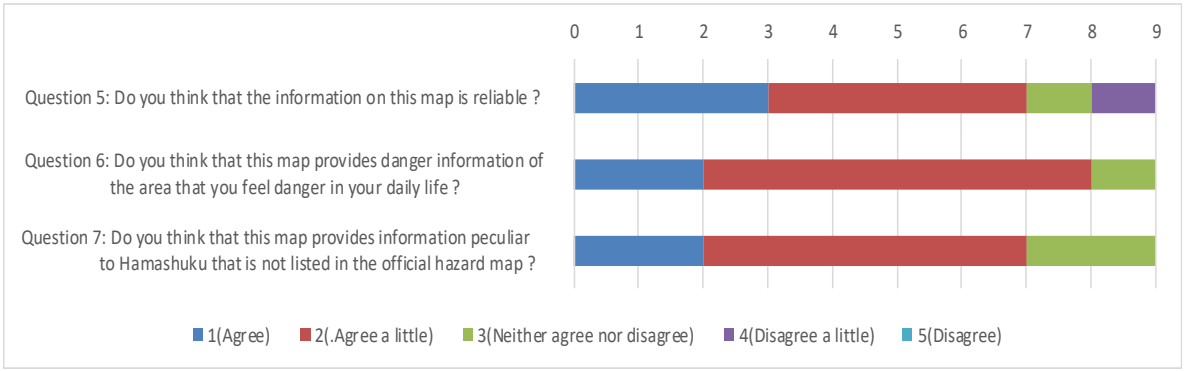

Figure 5. Answers to Question No.5-No.7(Characteristics and validity of information)

Two questions, "Recognize shelter and evacuation route" and "Materials to evacuate in the event of a disaster", were somewhat sluggish with good evaluation. Both of them are questions about evacuation. The reason for this may be that the system is designed to use before disaster occurrence. We think that it will become possible to use the system even when evacuating by additionally installing the function to register evacuation route.

From these results, we can say that our safety map makes it possible to recognize the danger of the area on a daily basis and it is effective as a material for local disaster prevention activities. We believe that it is useful to use this safety map when deepening the understanding of regional dangers as part of disaster prevention activities by local residents.

In this type of system, maintaining and updating information is necessary. In this area, voluntary disaster prevention member gathers every year to exchange information. Our system is expected to supply updated information. However, some members are worried about using electronic devices. Therefore, at this point, it would be best to examine with paper map and reflect the result tothe system.

3.3.2 Characteristics and Validity of Information

We show the answers to the question about characteristics and validity of information (No.5 to No.7) in Figure 5. The answer to Question 5 ("Do you think that the information on this safety map is reliable?") was generally positive. The following two reasons can be considered. The first is that the information was collected by residents walking around their districts. The last is they have a review meeting on the information they have collected so far.

For questions No.6 ("Do you think that this safety map provides danger information of the area that you feel danger in your daily life ?") and No.7(" Do you think that this safety map provides danger information peculiar to Hizen Hamashuku that is not listed in the safety map distributed by the administrative organs?"), there was no negative answer. There was no direct comparison with the official hazard map at this workshop. We had the participants compare with the hazard map which had been distributed. The official hazard map shows the classified areas expected to be flooded. By comparing with the self-made regional safety map, residents were able to compare with their own recognition and confirm the danger again for flood damage. Other disaster forecasts are not included in the official hazard map and cannot be compared. These results indicate that detailed local information on areas that are not listed in the official hazard maps can be posted on our safety map.

This series of activities demonstrates that the residents themselves can create an original regional safety map with gathering information on dangerous points by walking around the area and examining information by review meeting. By creating a safety map in using our system, it is possible to reflect issues that do not emerge as standards of creating normal safety maps, such as narrow roads and small waterways, and anxiety that local residents feel in their lives. Based on past experiences of disaster, it is also possible to register in the system what they learned from actual damage situation. We believe that these are meaningful when creating safety maps, such as in historical local towns with regions-specific issues.

3.3.3 Ease of Viewing and Operation

Figure 6 shows the results of questionnaire on usual usage of electronic equipment, and Figure 7 shows the results of questionnaire on ease of viewing and operation of safety map. Three participants in the experiment had never used smart phones or tablet terminals. We checked the answer of these three people to the question No.10 ("Do you think that this safety map is easy to operate?"). Two people had a positive evaluation as "Agree" (One person missed entry). This is because students instructed participants on how to use, so that even participants who have hardly used electronic devices can get

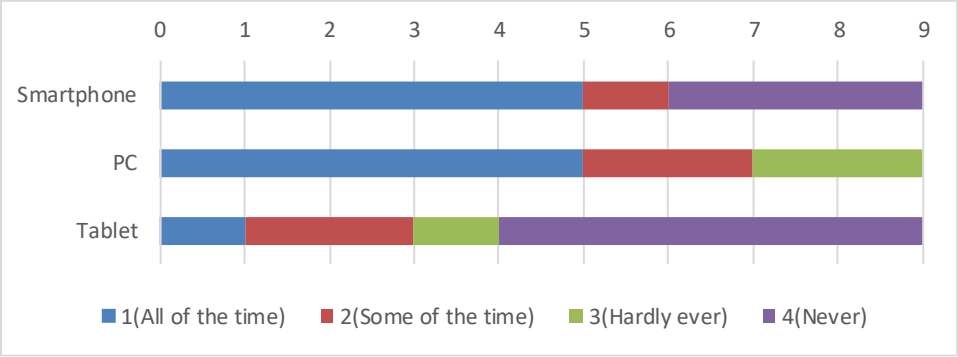

Figure 6. Answers to Question No.1(Usual usage of electronic equipment)

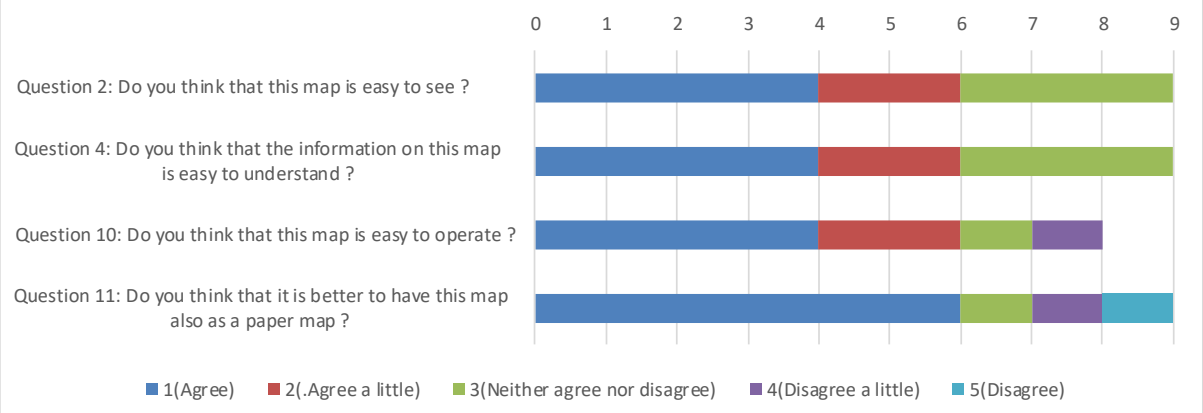

Figure 7. Answers to Question No.2, No.4, No.10 and No.11(Ease of viewing and operation)

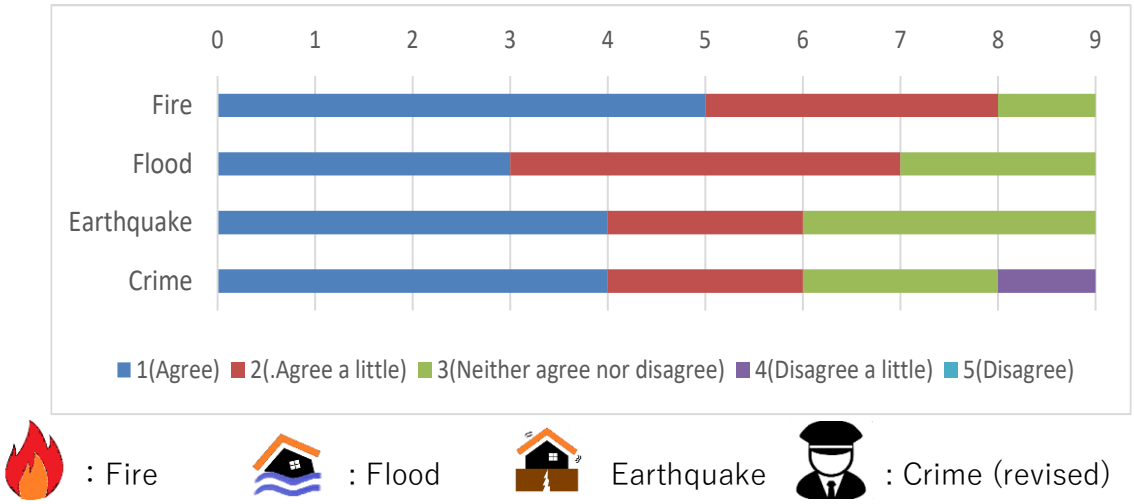

Figure 8. Answers to Question No.3(Evaluation on icons)

used to it soon and think that they were able to handle the system. This demonstrates that even elderly people with little experience handling electronic equipment can handle our system by instructing the operation method for a short time. All the participants were able to get guidance from the students this time. However, there was an opinion that I was worried about my own operation. When considering actual operation, preparation of operation manual is required.

The evaluation results of the icons are shown in Figure 8. The fire and flood icons got a good rating in general. On the other hand, in the icons of the earthquake and crime, three participants answered that they would be lost in judgment of good or bad, or slightly disagree. Icon design is considered to express the cause. Earthquake icons express the appearance of the earthquake by shaking the house with a wavy line around the house and cracking the ground. However, it seems that it was not clear what these lines express. For crime icons, three did not make a positive evaluation despite revision. Icon of crime expresses police with reference to crime hazard map. Since crime has many varieties, intuitive icon design is difficult. It is necessary to re-examine the crime icon.

The fact that the evaluation on Questions No.2 and No.4 is not very high indicates that there is room for improvement in the user interface of our system. There was an opinion that the photo and the characters were small. Also, there was an opinion that characters overlapped and they were hard to see at the case of information filtering. This indicates that it is necessary to reexamine the color and size of characters or background of the filtering screen. Question No.4 is an evaluation of the comprehensibility of the posted information. The reason why the evaluation of this item was not high can be ascribed to the difficulty in understanding icons and danger levels as described above. Based on these points, it is expected that the convenience of the system can be enhanced by improving the user interface for elderly persons and presenting the information being posted more intuitively.

4. Conclusion and Future Works

In this research, local residents evaluated the original regional safety map created in using tour safety map creation support system through workshop activities. As a model district, we selected Hizen Hamashuku, Kashima City in Saga Prefecture, where historical townscape remains. Our system supports local residents to post dangerous points in their living areas and share. Through review meeting and workshop activities, we evaluated our maps from the viewpoint of the usefulness as a safety map and the validity of information, the readability of the information being posted, and the ease of use as a safety map. Using the map as a material of the disaster prevention workshop, we demonstrated that (1) our system contributes to collect and share distinctive local danger information for the safety map, (2) the map provided by our system leads to awareness of safety by reaffirming nearby danger, and (3) the map is also useful for reviewing danger information and improving reliability through meeting.

Our activities, including this workshop, are part of the district's voluntary disaster prevention activities, and the staff of the City Planning Division of the city is always participating. In order to publish the information of our system, it is necessary to improve the reliability and understandability of the information and discuss with the city officials how to integrate the information of our system and the information of the official hazard map. So far, our system has been used only by the district's voluntary disaster prevention organization. Future challenges will include disaster prevention education and information gathering from the perspective of children by applying it to school education.

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