# Map-based Public Awareness Building System for Disaster Prevention

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**Summary**
This paper presents a map-based system in which local residents can supply and share disaster prevention information. Producing a disaster prevention map with public participation is very useful as learning and awareness building for natural disasters. Our system's unique feature introduces a card-image data structure, which makes it easy for users to add new information, such as information about shelters, to a map and makes it possible for the system to arrange the collected information. In addition, it is a feature of the system that users can use the latest maps of areas prone to disasters, because they can add such maps so easily. Therefore, users can appropriately understand the town's readiness for disaster prevention. To evaluate our system, we conducted experiments in Handa City, Aichi Prefecture, Japan in which ten individuals participated. After using our system, participants provided many favorable comments. From the results of the experiment, we found that our system was effective for disaster prevention activities in a local community.

***Key words:***
*Disaster Prevention, Public awareness building, Map-based system, Cards and maps association, Web*

## 1. Introduction

It is important to educate local residents to develop knowledge and skills for disaster prevention and to acquire the capacity for them to cope with a disaster on their own. Also, when local communities prepare for disasters, it is important for local residents to actively and voluntarily cooperate with municipal government officials [1]. Producing a disaster prevention map with public participation is very useful as community learning and public awareness building for natural disasters [2].

On the other hand, Web-GIS, which is a Web-based geographic information system, is expected to be the system for mutual information sharing. Based on this expectation, a number of systems in which users (assumed to be local residents) can register and search for local information on a map have been developed [3]. However, no studies have tried to structure a system to produce a disaster prevention map by collecting local information on disaster prevention that local residents already know—such information is difficult for municipal government officials to grasp. The characteristics of disaster prevention information differ from those of other local information, such as restaurant guide or event schedule. Therefore, it is necessary to develop a system that can properly deal with user-supplied disaster prevention information. This paper presents a map-based system in which local residents can supply and share disaster prevention information.

Generally in the field of disaster prevention, Web-GIS is used by municipal government officials to provide hazard and disaster prevention maps to local residents (see, [4], [5]). Systems which do promptly the disaster correspondence has been developed [6] [7]. Unlike our system, in which local residents share disaster prevention information, in their system, the disaster prevention authorities share damage information on the map. Systems have also been studied that support risk communication between local residents and experts for disaster prevention. In this system, Web-GIS is used by users for attaching maps to their opinions on bulletin board systems [8]. Our system manages disaster prevention information on a map. Existing systems which manage user-supplied information on a map don't provide an easy environment for information updates, manage and search, because they don't relate these information mutually and use only a single map [9] [10]. Our system is characterized by using several maps and associating cards with the maps. Local residents can input disaster prevention information on the map using a card and register a new map including the area subject to disaster.

This paper is organized as follows. In section 2, we propose a map-based awareness building system for disaster prevention. In section 3, we discuss the result of evaluation of our prototype system.

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## 2. Development of Map-based Public Awareness Building System for Disaster Prevention

### 2.1 Requirements for the System

To discuss the requirements of our system, we interviewed the municipal government officials of the Disaster Prevention Division and others who engage in such disaster prevention activities. Through our interviews with them, we learned the characteristics of disaster prevention information, the problems of such activities, and determined the requirements of the system.

First, disaster prevention information has the following characteristics:

- The urgency of information differs between during normal and disaster times, it is extremely high during a disaster.
- Disaster prevention information has regional characteristics or little regional characteristics.
- There is information that all of the local residents should know and some that only some people should know.
- The reliability and accuracy of information are very important.

Next, individuals who engage in disaster prevention activities in local communities experience the following problems:

- Although they would like to distribute the various disaster prevention information obtained through their activities to local residents, they are concerned about the improper use of this information.
- During normal times, they need to know what is useful within the town during disasters and its conditions.
- They need to prepare for disasters with a full understanding of the town's weaknesses.
- Although provided with an inventory of disaster prevention warehouses from municipal government officials, they sometimes face shortages or inadequately stocked warehouses. Checking inventories is time-consuming.
- Because they do not know how an emergency evacuation area (shelter) is reinforced against earthquakes, they do not know whether it is safe.
- They need information from the viewpoints of the disabled and children.

Based on the above characteristics and problems, we determined the following requirements for our system:

- Users can learn and understand a town's preparedness for disaster prevention.
- They can easily understand the reliability and accuracy of information provided by the system.
- They can register and get updated information.
- They can restrict access to specific information.

The following sections present a system that meets these requirements.

### 2.2 System Overview

The outline of our system is shown in Figure 1. It is based on the Web and consists of three functions and a disaster prevention information database. We classified users into three groups: 1) individuals who engage in disaster prevention activities in the town called "leaders"; 2) those who support the "leaders", such as a member of welfare organization, called "supporters"; 3) and all the remaining local residents. With the registration function, "leaders" and "supporters" can add disaster prevention information to the database. With the editing function, "leaders" can also delete or modify the information. Only "leaders" can use this editing function. With the display function, all users can browse the information, but some information only "leaders" can browse.

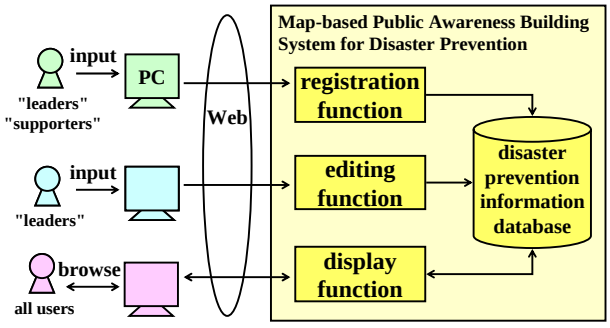


Fig. 1 Outline of Our System

Our system is characterized as follows.

- Introducing a card-image data structure: Users can easily add new information, such as information about

shelters, to a map and the system can arrange the collected information.

- Handling many kinds of maps: Users can use the latest maps of areas prone to disasters, because they

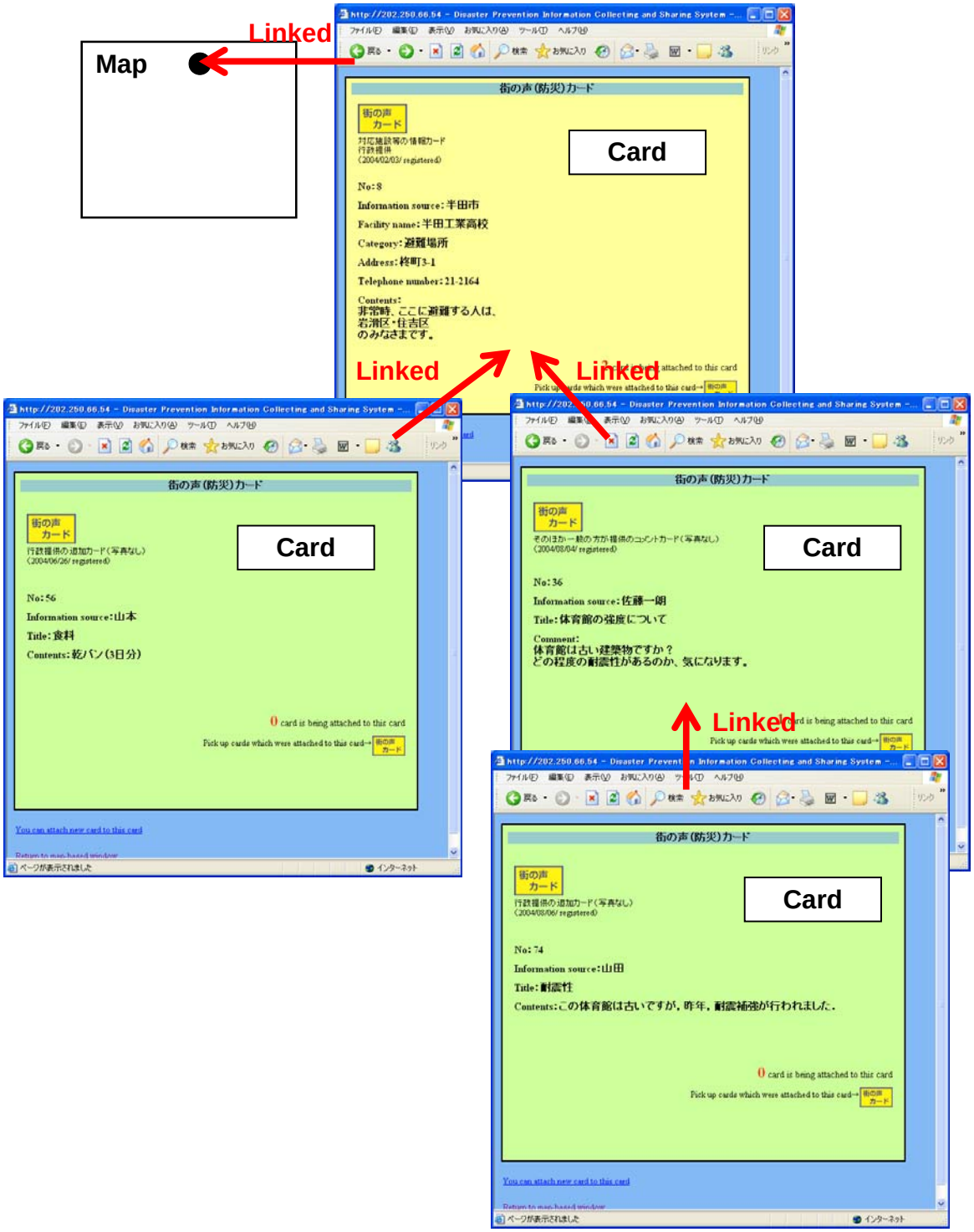


Fig. 2 Connection among the attached cards

can add such maps so easily.

- Representing the reliability and accuracy of the information: Our system displays an icon on the map according to the information source or whether he or she checked the accuracy of the stored information in the field.

## 2.3 System Functions

**(1) Registration Function**

It is important for public awareness building that local residents learn and understand a town's readiness for disaster prevention during normal times. To do so, information is available about hazardous places during a disaster, such as a block wall that might collapse, and facilities that support people during a disaster. In our system, users can register such information by attaching a card associated with a map. They can also add updated information or comments to those stored in the same manner.

Figure 2 shows the connection among the attached cards. When users attach a new card to a map, the new card is linked to a position on the map. On the other hand, when they attach a new card to stored one, the new card is linked to it.

On the other hand, there is also disaster prevention information that is not shown by a point on a map, such as flood or landslide hazard areas. In our system, they can also register a map of such areas prone to disasters. The system can display a card on user-supplied maps.

**(2) Editing Function**

Because accurate information is crucial in the field of disaster prevention, we equipped the system with the following functions: delete information, modify information, and add information to indicate that one of "leaders" checked the accuracy of the stored data. They can use these functions on a window that displays a card or disaster prevention information, as shown Figure 3. However, the information that he or she checked might have no use as time passes. Therefore, after a specified period of time has elapsed from when he or she added such information, the system automatically deletes this added information to indicate that no one checked it yet.

**(3) Display Function**

As shown in Figure 4, the main window of our system consists of two parts: a map on the right side and a menu on the left side. Users can browse a card by clicking an image of a card (icon) on the map to operate the map display by selecting the group of a user or kind of map from the menu. And then, they can browse the attached cards from a card on the map one after another by traversing the connection among the cards (Figure 2).

To represent the reliability and accuracy of the information, we classified the icons on the map according to the information source. These were offered by municipal government officials, "leaders", and "supporters". Even when a "leader" adds information whose accuracy he or she checked, our system changes the kind of corresponding icon.

In addition, because users can switch to a map on which an icon is displayed only by selecting a map from the menu, they can easily browse for areas prone to disasters and gather disaster prevention information around the area. For example, Figures 4 and 5 show that a user selected "flood hazard area" and "landslide hazard area", respectively. This enables users to understand the town's disaster prevention readiness.

Moreover, since users can specify that only "leaders" can browse when registering information, when a user other than a "leader" uses our system, it does not display the icons on a map. On the other hand, "leaders" can switch all information, information of only "leaders", and information other than only "leaders" by selecting user group from the menu. For example, Figures 4 and 5 also show that a user selected "all information" and "only leaders" respectively. It is important to restrict access to specific information.

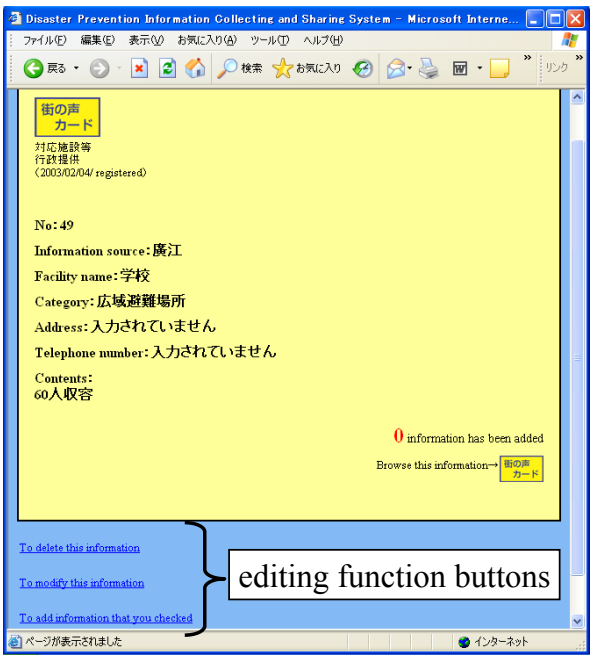


Fig. 3 Window Displaying Disaster Prevention Information (Participant Registration in Experiment)

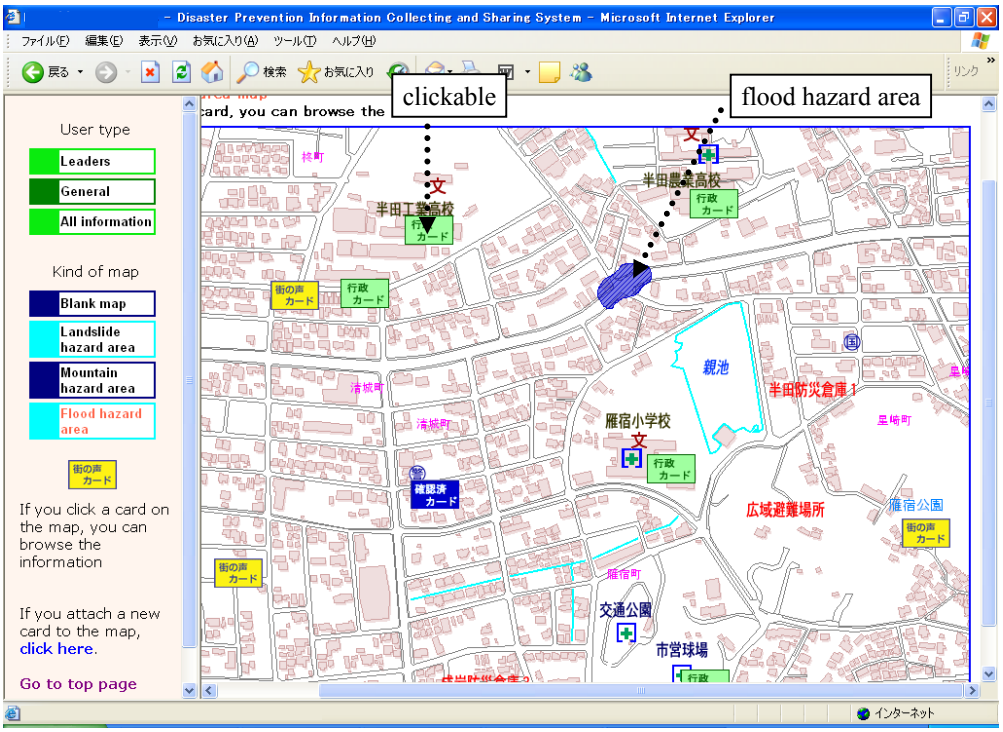


Fig. 4 Main Window of System (Displaying All Information on Flood Hazard Area Map)

## 3. Experiment

### 3.1 Outline of the Experiment

We conducted experiments in Handa City, Aichi Prefecture, Japan in which ten individuals participated. These people are members of a volunteer group and engage in disaster prevention activities to develop and spread knowledge and skills about disaster prevention in the area. After using our prototype system, they commented on it. In the experiment, we registered in advance forty-five elements of disaster prevention information, such as information about shelters, and four maps (one is blank) of areas prone to disasters, such as flood hazard areas.

### 3.2 Results

**(1) Usage of the system**

Experiment participants could register and browse disaster prevention information without much difficulty. For example, Figure 3 shows registration information and information about evacuation center. In addition, they could also add their comments to information that we had registered in advance. For example, the following comment was added to information about a shelter: "When I browse a map of areas prone to disasters, I worry about routes that can safely take residents to shelters." This comment shows that he or she understood disaster prevention information around the area prone to disasters by switching to a map.

**(2) Comments on the system**

After using our system, participants provided the following favorable comments:

- This system is effective as a disaster prevention information system for municipal government officials and local residents to share updated information before disasters occur.
- Even though the authorization to input information is limited to municipal government officials and us "leaders", and it is limited to official information, this system is effective because of regular information updates.

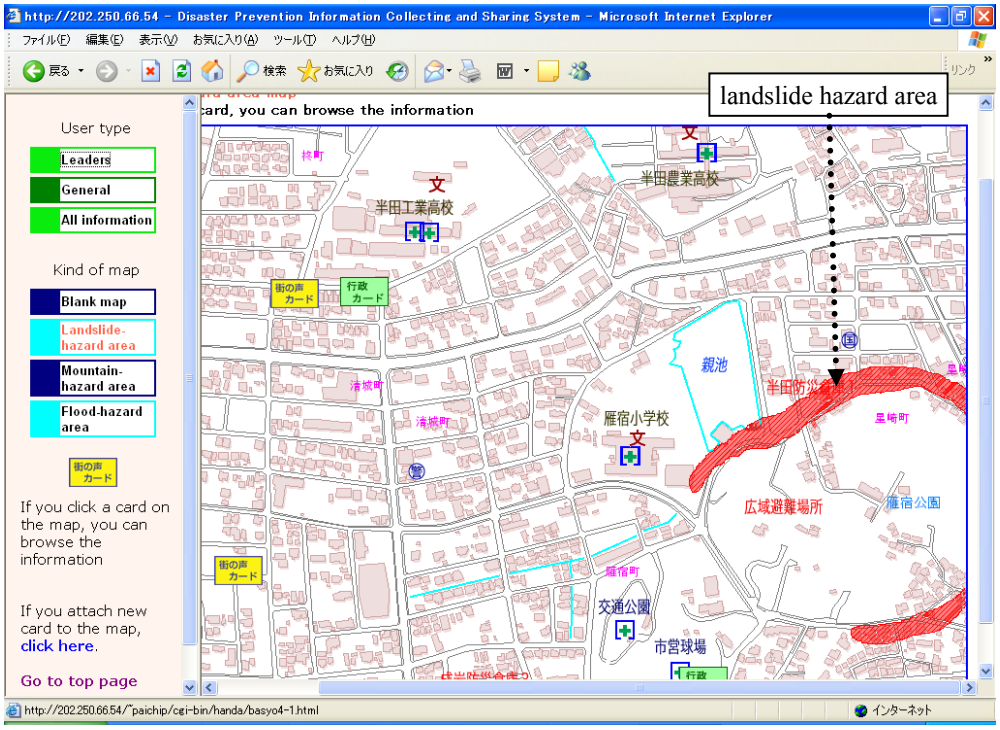


Fig. 5 Window Displaying Information for Only "Leaders" on Landslide Hazard Area Map

- Using a map is good because we can understand the information more specifically than in list form.
- Because we can learn about areas prone to disasters and gather disaster prevention information around the area by switching from one map to another, this switching map function is effective.

On the other hand, we also received the following suggestions:

- This system needs a function to scroll on maps.
- We would like to overlay several kinds of maps of areas prone to disasters.
- As for methods to input information about hazardous places or facilities, the manner selected by users from a list prepared in advance might be easier than this system.
- We have to check whether the user-supplied information is correct.

### 3.3 Discussion

**(1) Usefulness of the system**

The above positive comments clarify that our system is useful for learning and understanding a town's readiness for disaster prevention. In addition, these positive comments show that it is a promising system through which municipal government officials and local residents can effectively share updated information.

**(2) Issues of the system**

We need to incorporate such map operation functions as scrolling and overlaying to allow users to more appropriately and more efficiently learn and understand a town's readiness for disaster prevention. In addition, to input information efficiently, we need to extend the registration function, for example, to register a lot of information at a time. Furthermore, for practical use of the system, we need to thoroughly discuss the management of its information.

## 4. Conclusions

In this paper, we developed a map-based system in which local residents can supply and share disaster prevention information among themselves. To evaluate the system, we conducted an experiment in Handa City, Aichi Prefecture, Japan. Evaluations of the prototype system showed its usefulness for learning and understanding a town's readiness for disaster prevention. It was also promising as a system through which municipal

government officials and local residents can effectively share updated information. Thus we discovered that our system was effective for disaster prevention activities in a local community.

By the way, a team of consultants who have prepared a proposal to the Canadian is very interested to use our system in their project. The project is intended to use ICT (Information and Communication Technology) to provide more timely, accurate and relevant information to communities in the Caribbean that are vulnerable to hurricanes. If the project is put into action, we could evaluate our system based on the practical use. We will discuss the usefulness of the system in respect of public awareness building

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His current main research topics are as follows.
(1) Development of PC software for senior citizens:
(2) Development of education support software for network engineers:
(3) Development of basic and allocation technologies of Web-based 3D CG: