Prototype Modeling of Information Sharing System of Evacuation Support for Vulnerable Citizens in Disasters

Hajime KAWAMUKAI, Haruhiko NISHIMURA and Isao SHIRAKAWA

Abstract: In order to escort vulnerable people in disasters to safe evacuation sites effectively, we need to accumulate information concerning risk factors on the evacuation routes, including detailed information on and location coordinates of the risk factors. In this paper, we explain our development effort for a prototype modeling in order to share the information on risk factors on the evacuation routes with ordinary computers only with an internet connection. In order to improve accessibilities for information sharing on the risk factors, we have modified our user interface for sharing information on risk factors, from GIS based system to one of the web based mapping systems, which enables to share information more easily with those who have concerns in these risk factors, like vulnerable people themselves, possible escorting persons, local disaster management officers and so on.

Keywords: assistance for vulnerable people in disasters, evacuation assistance, location based service, information sharing

1. Introduction

We have been experiencing many disaster victims, mostly due to the heavy rains, flooding, landslides, strong winds, and earthquake, in Japan. To add this, the population of the vulnerable people in disasters has been increasing and the number of victims among these vulnerable people has increased in the past decade, partially due to the social demographical changes toward aged society in Japan. In order to avoid the victimization of those vulnerable people, we should escort those vulnerable people in disasters to safe evacuation sites before a disaster occurs. For the realization of the safe escorts of the vulnerable people in disasters, it has been discussed to utilize the personal information for the vulnerable people in disasters. Recent study of information usage for disaster mitigation focused on the utilization of the personal information on those who may have difficulties in disaster evacuation. However, as pointed out by the Cabinet Office (2006) and Yamasaki et al. (2007), the sensitive personal information should be protected severely, even in disasters, reflecting on the wide social attention to the protection of personal information.

On the other hand, detailed information on risk factors on the evacuation routes is strongly required in examining suitable safe evacuation routes. Even a small gap or a small damage on the road surface might create

KAWAMUKAI, Hajime
1-3-3, Higashi Kawasaki Chuo, Kobe JAPAN 650-0044
Faculty of Applied Informatics, University of Hyogo,
Phone: +81-78-367-8622
E-mail: kawamukai@ai.u-hyogo.ac.jp

troubles in escorting vulnerable people in disasters. These minor risk factors for healthy and active people are not well recognized by themselves. Therefore, the detailed information on risk factors detected by the vulnerable people, including locations and types of risk factors, should be accumulated before disasters and shared among related people in order to design and examine suitable escorting routes to evacuation sites.

To accumulate and share the detailed information for risk factors on evacuation routes, we have devoted our efforts to develop a prototype model. In this paper, we explain our brief development concept of our information sharing system for risk factors on evacuation routes.

2. Overview of our system

2.1 Issues on our former approach

Our survey data entry system was developed on a mapping system, which runs on PDAs with GPS function, and has already been shown in Kawamukai et al (2009). In the former system, all data concerning risk factors on the evacuation routes are stored and used on the GIS based system. As our research went on, we found that many people have troubles with using GIS based system, due to ordinary people do not get used to GIS. The former system requires an additional software installation, even for information sharing.

As the web mapping services, like Google maps and Yahoo maps and so on, are getting so common in our daily life and the users of the web based mapping services have been increasing, we decided to develop our information sharing interface based on one of the more user friendly web mapping services.

2.2 Concepts of our modified system

Figure 1 shows the conceptual image of our system. Field surveyors collect information on risk factors in the survey field stored in PDA based GIS system. First, the collected data are imported into the PC with ArcGIS. Second, our data transformation system accesses the database managed by ArcGIS and creates web pages for detailed information on risk factors and a map presentation web page, which represent geographical data on a web mapping services. These created web pages are sent to one of our web servers. Users are asked to access the map presentation web page in order to share the information about risk factors on evacuation routes. Users are allowed to share the information, but not allowed to modify data represented on our web mapping service based website.

By changing our user interface of information sharing to the web mapping service based system, users are asked to prepare an ordinary PC with an internet connection and a common web browser.

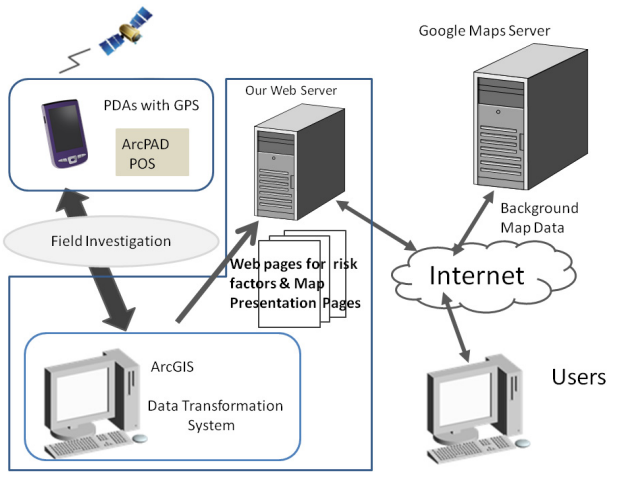

Fig. 1. Conceptual Image of Our Location-based Service System

2.3 Data Architecture of our system

Figure 2 indicates the data architecture implemented in our system. The database fields are as follows: "possible difficulty", "possible endangerment", "level of difficulty" and "level of endangerment", and the properties of fields are also shown in Figure 2.

When our data transformation system is activated, firstly, the detailed information for risk factors, stored in the ArcGIS, is transformed into a suitable web page format. Next, our data transformation system also creates a map presentation web page, which enables to share the risk factors on a web mapping service. Properties for risk factors are represented by several icons with different colors, and the level of properties are represented by the size of icons, as shown in Fig. 3.

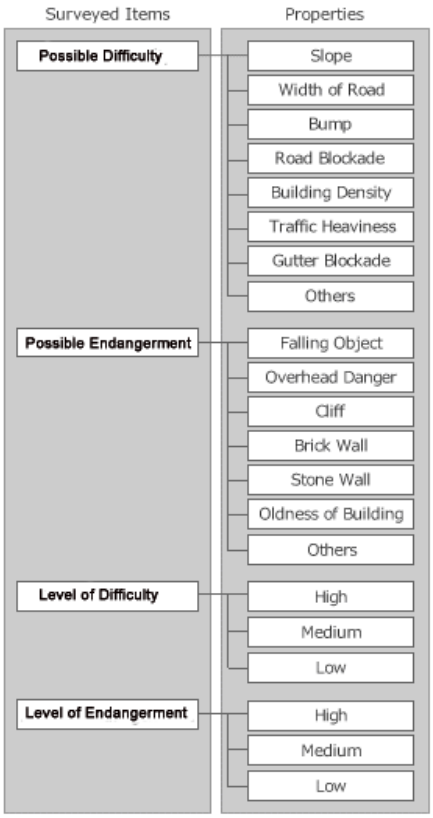

Fig. 2. Data Architecture of Our Proposed System

Table 1. Data transformed into the map presentation web page

Field	Data Type	Description
DATE	Text	Date of investigation
LONG	Real	Longitude of the access location
LAT	Real	Latitude of the access location
ID	Long Int	ID numbers for the risk factors
CLSF	Text	Classification for the risk factors
PROPT	Text	Property for the risk factors
LVL	Text	Property levels for the risk factors
SITEADR	Text	Website addresses of the risk factors with detailed descriptions

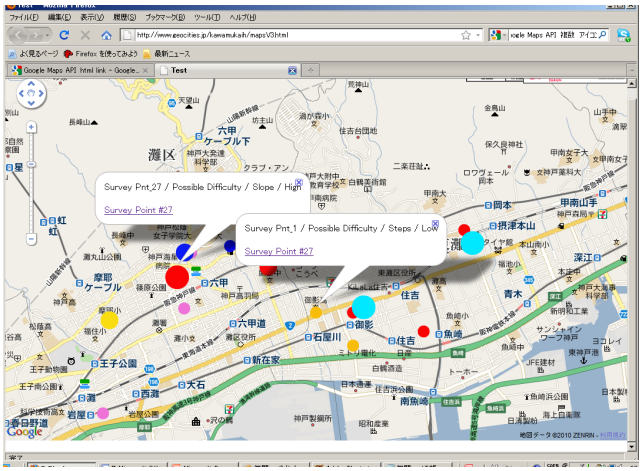

Fig. 3. A sample presentation of risk factors

Table 1 shows the detailed information items retrieved from a database table managed by ArcGIS, in order to create a map presentation web page.

Users can easily find the locations of risk factors on a more user friendly web mapping services and can be guided to access the detailed information on risk factors by a simple click operation on the linked texts shown in balloons.

2.4 Selection of the Web mapping services

Our past GIS based system for information sharing is too unfamiliar to ordinary people. It requires some basic knowledge of computer applications and geographic information. Users were asked to engage some tedious map preparation tasks on our past GIS based system. By developing our interface on a web mapping service, users are released from burdens of beforehand operations in order to share information on risk factors on evacuation routes.

We had compared several web mapping services in order to decide on which we were going to develop our user interface for risk factors. After several discussions, we decided to use the Google Maps service, as the base web-based mapping system, which has good advantages in terms of the openness of application interfaces and information availability for our development.

3. Conclusions and further research orientations

We have drastically improved users' accessibilities for sharing information concerning risk factors on the evacuation routes, by developing data transformation system, which allows to change our user interfaces on the web mapping system. We are now trying to confirm the change in usability by interviewing with potential users.

Our data entry system, however, requests the further modification and improvement in usability. The handling PDAs with GPS and GIS based software on PDAs is not easy task for ordinary people. Using these devices as a data entry system requires tedious preparation and a lot of supporting efforts and guidance for users. Considering the popularization of the cell phone with GPS function, one of the alternative devices for data entry is the cell phones with GPS, as indicated in Guan et al. (2006).

The other research orientation of our research is improvements of web presentation web page creations. We are now considering to develop more efficient and sophisticated web page creation methods or applying more advanced recent technological development of GIS software.

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