DISASTER INFORMATION-GATHERING SYSTEM USING CELLULAR PHONES WITH A GLOBAL POSITIONING SYSTEM

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***ABSTRACT*:** The authors propose a means of gathering disaster information by using cellular phones equipped with a Global Positioning System (GPS). When a disaster occurs, adequate information is a necessity and we believe that this system will improve both information gathering capacity and ability to react to the situation. Currently fax and telephones are the main tools used to collect and disseminate data but it takes a long time to send a message. Also further operations are required to share the information among administrations. We have developed two tools for the disaster information gathering system. One is an input support system using Java Programming and the other is an information reception mail-server that automatically generates a disaster information database. The electronic data recorded includes informant, position, time and comment on the disaster. The significant attributes of this system are that an electronic database is automatically generated from a GPS locator equipped cellular phone and that the database can display by using Geographic Information System (GIS). We confirmed the feasibility of our system by test demonstration. We are also developing a system to support immediate communication under disaster conditions.

KEYWORDS: disaster information, GPS, GIS

1. INTRODUCTION

In recent years, the importance of improving disaster prevention and mitigation capacity in local regions has increased because disasters have exceeded the scale predicted by the disaster management authorities. A number of countries suffer many disasters such as floods and earthquakes. For instance the scenes, of the Niigata-chuetsu earthquake in October 2004 (K.Konagai et al., 2004) and the catastrophic hurricane Rita in September 2005 (H.Hayashi et al., 2005), are fresh in our memory. There are some problems in the case of heavy rain disasters. Especially, the timeliness of an administrative action is as important as action in times of disaster. It is important to grasp accurate information quickly and to share the information among administrators. Also, adequate information makes it possible to reduce damage in times of disaster or of impending disaster. Currently fax and telephones are the main tools for collecting and disseminating data but it takes a long time to send a

message. Also further operations are required to share the information among the various administrative bodies.

In this study, the authors propose a new information gathering system using GPS-locator -equipped-cellular phones and an information reception mail-server (M.Ohya et al., 2005). We call this system the JAM System (Joho Automatic Mapping System). We have developed two tools for this disaster information gathering system. We believe that it will improve both information gathering capacity and ability to react to the situation. We are also developing a system to support immediate communication under disaster conditions (J.Asada et al., 2005).

2. JAM SYSTEM SCHEMA

The JAM System uses a cellular phone equipped with a GPS locator and communicates by E-mail. This system utilizes two tools; one is an input support system using Java and the other is an information reception mail-server that automatically generates a disaster information database. The significant attributes of this system are that an electronic data base is automatically generated from the GPS locator equipped cellular phone and that the database is able to display by using GIS. The system is shown in Figure 1.

2.1 Cellular Phone Positioning Method

There are three methods relevant to positioning in the GPS locator equipped cellular phone. The first method is independent positioning. However, atmospheric conditions must be good. The second method of positioning combines GPS reception data with information from base stations. The third method is positioning using only base stations.

The JAM system uses the first method because the positioning accuracy is better than that of the others. However, the positioning is not possible outside the limits at the communication area, since the calculation of the basic line analysis and so on, are done in the base station server of the GPS locator equipped cellular phone.

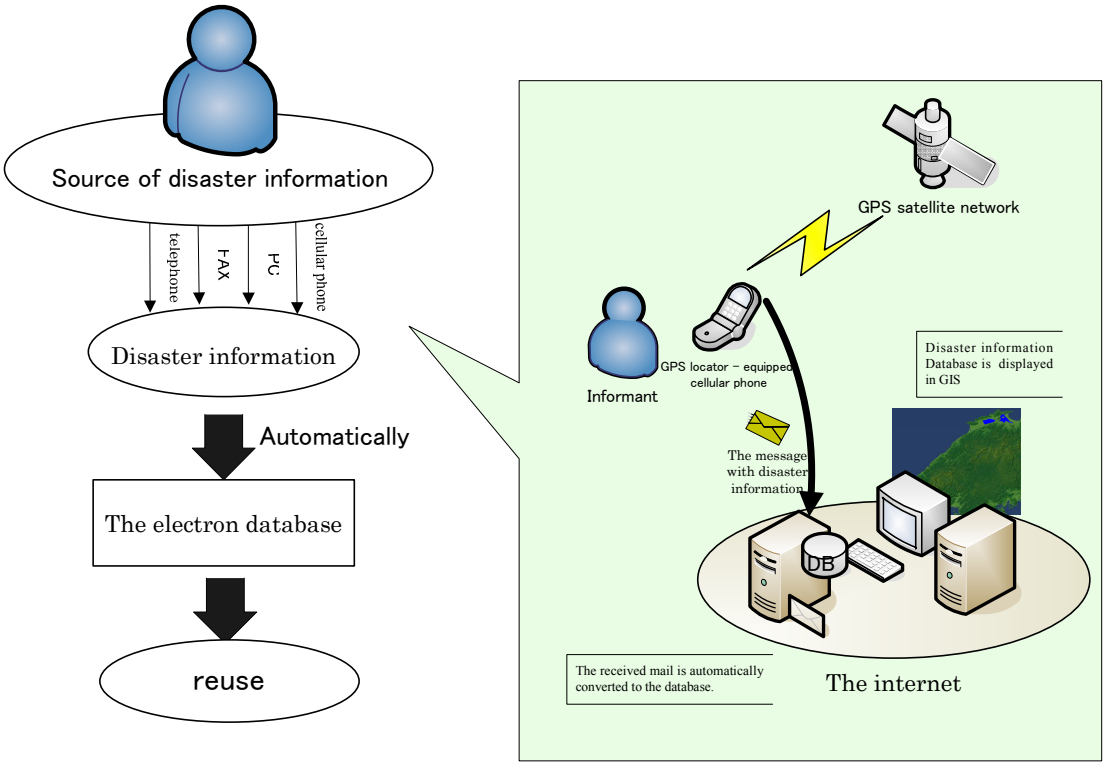

Figure 1 JAM System Image

2.2 Method for Acquiring Position Information

There are three general methods for getting position information.

(1) The mail message including the positional information.

(2) The positional information by using URL including CGI.

(3) The positional information and accompanying information by using Java programming or Brew programming.

In this exercise we adopted Java programming in consideration of the development of the input support application. The third method is adopted in this system.

2.3 Disaster Information

In this system, position, photographic images and reports on disaster conditions are treated as disaster information. The input support application was developed for cellular phones to enable input of supplementary information because correct judgments may be difficult to make, based only on image information. The input method adopted for comment on disaster conditions is to choose an item from a pre- registered list of menus with options to cover a wide range of physical and other conditions. After inputting the disaster information, the informant pushes the send-key in the application and the standard mailer of the cellular phone comes into operation. The disaster information selected by the application is written to the mail message and includes position information. The informer sends the message and attached photographic image to the disaster information server by E-mail (see Figure 1). The mail is automatically diverted to the disaster information database in the mail-server by the program developed by the authors (M.Ohkubo, 1999). This program starts as soon as the mail-server receives the mail. The disaster information is stored in text form, and the decoded image file is stored as a JPEG file in the specified folder. Stored data is available as GIS data. By utilizing GIS, the disaster situation can be easily assimilated on the map when a disaster covers a wide area.

Features of this system are that it automatically creates data which can be utilized on GIS and, that it can display the disaster situation with the image photograph and the position on the map. An example of the GIS display is given in Figure 2.

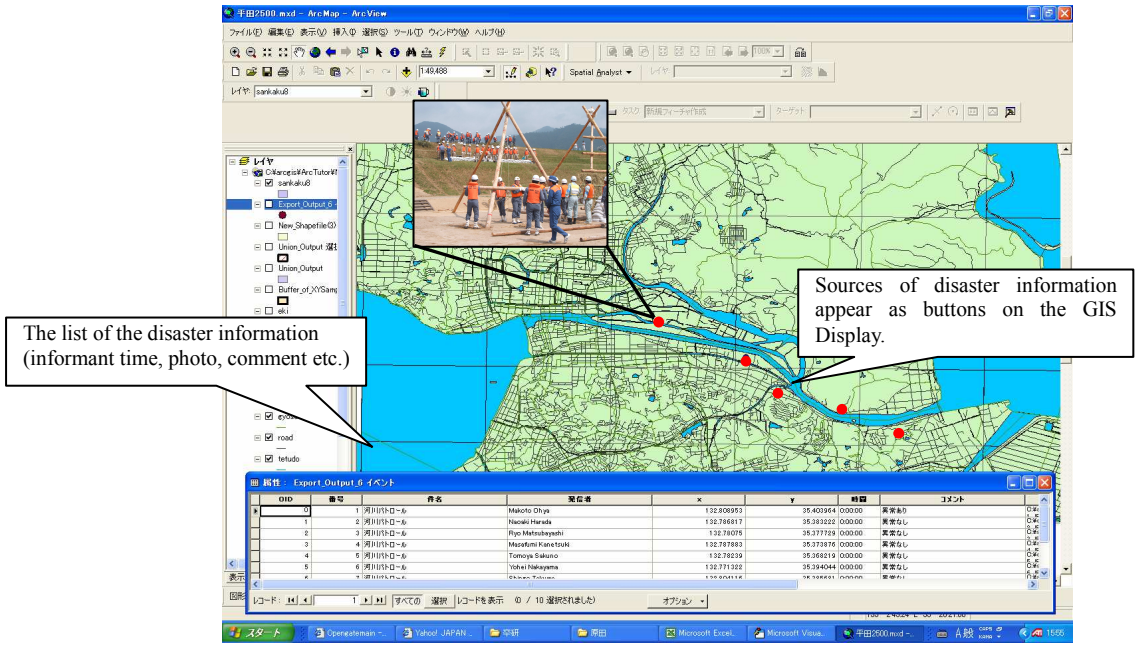

Figure 2 Example of the Disaster Information Display on GIS

3. INPUT SUPPORT APPLICATION

River management authorities would utilize the input support application. The authors also consider that the informants should be leaders of local disaster prevent organizations or employees of local general construction companies act as informants in the event of a wide area disaster (J.Asada et al., 2003). The input support application was developed using Java to allow easy input of disaster information. In this application, the method adopted is to choose to input disaster information by selecting a pre-registered item. The informants must download this application to each individual cellular phone beforehand.

As an example of the activity report, a patrol report and a levee protection activity report are assumed as shown in Figure 3. In addition, the disaster information transmission flow by emulator is also shown. The GPS locator is automatically activated after the input of disaster information, and the standard mailer gets started.

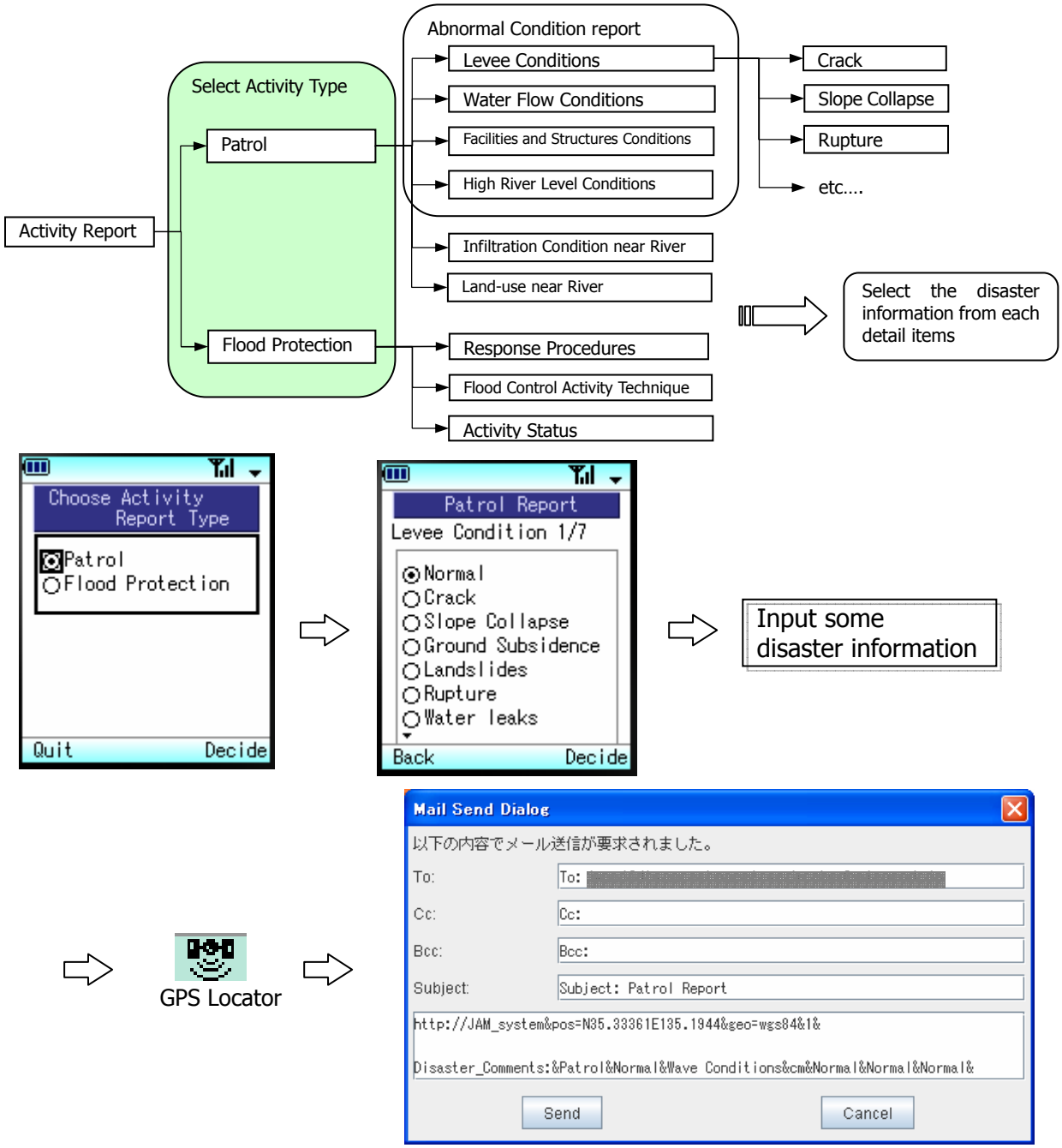

Figure 3 Input Support Application written by Java Programming

Thanks to the cooperation of the Izumo Office of River Chugoku Regional Development Bureau, Ministry of Land, Infrastructure and Transport, we were able to select key words for disaster information that were extracted from actual patrol reports during previous levee protection activities.

4. JAM SYSTEM FLOW

The flow diagram of the proposed JAM System is shown in Figure 4. The system is composed of three parts; prior preparation, operation of the GPS locator equipped cellular phone and mail-server.

Firstly, it is necessary to train likely informants and have them practice using the system. The informants must also register with the JAM System.. This ensures the reliability of the disaster information on the database. Prior preparation is completed when the application is downloaded from the Web-server onto the cellular phone.

The disaster informant starts providing information in response to a request from the disaster countermeasure headquarters or by a procedure discussed and agreed in advance of a disaster occurring.

The operating procedure for the cellular phone is briefly explained as follows. Initially, the Java application is activated and the type of activity report is selected, for example a patrol activity report or flood protection activity report. The informant then chooses the appropriate information items and pushes the send button. The standard mailer in the cellular phone comes into operation after the position is identified by the GPS locator. The position and disaster information are written to the mail message. Finally, the informant sends the E-mail with attached photograph to the mail server attached to this system.

The mail server we established automatically extracts the disaster information and attached

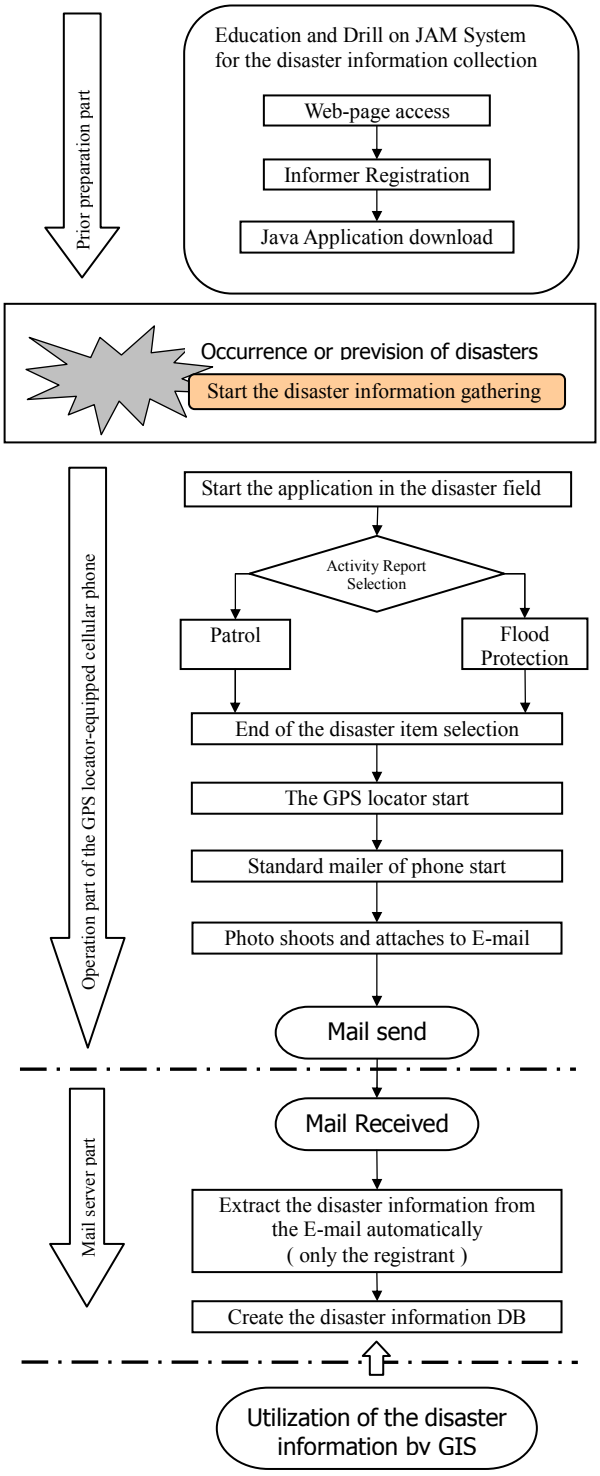

Figure 4 JAM System Flow

photograph from the body of the E-mail and creates the disaster information database. This server will only accept E-mail from cellular phones registered in the system.

5. CONCLUSIONS

In this paper, we have proposed a disaster information-gathering system that uses a cellular phone equipped with a GPS locator. The feasibility of the present system was confirmed by test demonstration. The conclusions drawn from this research are as follows.

1. The present system is able to create a disaster information database automatically, and that the database is available in GIS over a network.
2. Through test trials, we have confirmed the potential of the proposed JAM System but there is still room for improvements.
3. By using the information collected here, we propose the development of a system which supports immediate communication during a disaster is carried out simultaneously.
4. A natural disaster strikes when peoples' memories of the previous one have faded. So the disaster information system must be a system utilized not only in times of disaster but also be available on a regular basis.

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REFERENCES

H. Hayashi et al. : 2005. Mini Special Topics, Publication Civil Engineering, JSCE, Vol.90, No.11, pp.33-56 (in Japanese)

J. Asada, M. Ohya, R. Takata and T. Katada : An Examination on the Efficiency of the Disaster Information Network by the Local General Constructors, *Journal of the Disaster Information*, No.1, pp.70-77, 2003 (in Japanese)

J. Asada and M. Ohya et al. : An immediate action support system to operate in real time duaring disasters, The proceedings of the 60th JSCE Annual Meeting (CD-ROMS), CS9-006, 2005 (in Japanese)

K. Konagai et al. : 2004. Mini Special Topics I, II, Publication Civil Engineering, JSCE, Vol.89, No.12, pp.3-46 (in Japanese)

M. Ohkubo, 1999. *E-Mail utilization method in the generation of cellular phone*, UNIX USER, Vol.8, No.6, Soft Bank Publishing, pp.27-48 (in Japanese)

M. Ohya and J. Asada et al. : Development of the Automatic Database System for the Disaster Information, The proceedings of the 60th JSCE Annual Meeting (CD-ROMS), CS9-007, 2005 (in Japanese)