PROPOSAL OF AN IMMEDIATE ACTION SUPPORT SYSTEM TO OPERATE IN REAL TIME DURING DISASTER

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***ABSTRACT*:** In recent years, a great number of disasters such as floods and earthquakes were occurred in various parts of the world. From previous disaster reports, we are obtained that there are some problems in the wide area disasters. Especially, we are well-known that it is hard to grasp the disaster situation when the heavy damage occurs in the wide area. We have established an immediate action support system, based on the Geographic Information System (GIS) to operate in real time, during disaster. The purpose of this system is to get the accurate information on the disaster situations and to display the appropriate measures for the immediate action. This system consists of two parts. One is a gathering information support system and the other is an action support system. The former has a search function of the blank information area. When there are any blank information zones in gathering information, this system can research the inhabitants and the construction companies which belong to that zone, from proposed database. The latter has a search function of the dangerous area estimated from the information. This system display the dangerous information such as inundation area, closed to vehicular traffic and so on. From the dangerous information, we think that this system gives the instructions of an appropriate action in real time. This system can convey those instructions to local disaster prevention organizations and local construction companies. We are also developing the system to gather disaster information in times of disaster.

KEYWORDS: disaster information, GIS, immediate action support

1. INTRODUCTION

In recent years, a great number of disasters such as floods and earthquakes were occurred in various parts of the world. The scenes, for instance, Niigata-Fukushima heavy rain disaster, Niigata -chuetsu earthquake in October 2004 (K.Konagai et al., 2004) and the catastrophic hurricane Katrina in August 2005 (H.Hayashi et al., 2005), are fresh in our memory. From previous disaster reports, we are obtained that there are some problems in the wide area disasters. Especially, we are well-known that it is hard to grasp the disaster situation when the heavy damage occurs in the wide area. Because these disasters were heavy rainfall of an assumption outside, the correspondence of administrative bodies were delayed. The delay of the correspondence was connected with the extension of the damage. The main reason is that the grasp of information regarding disaster situation was imperfect. It is important to grasp the accurate information quickly and to share the information

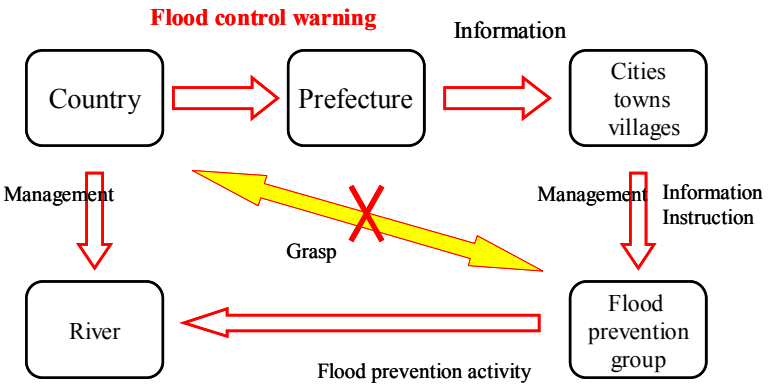

Figure 1: The arrangement of the problem

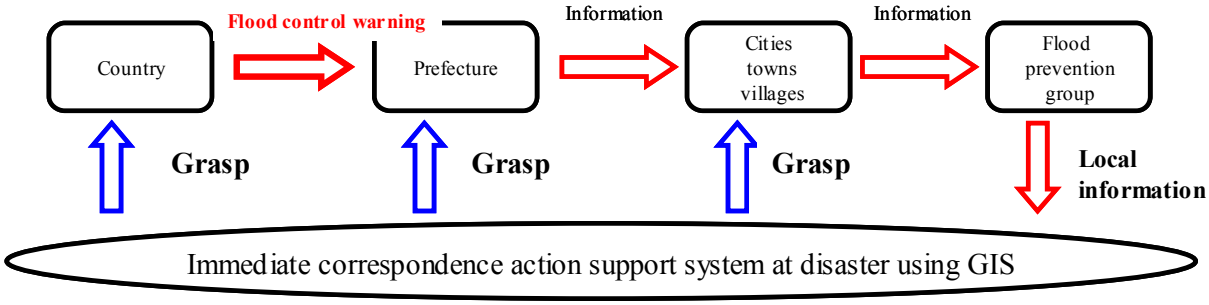

Figure 2: Advantage of this system

among administrators in times of disaster. Also, adequate information makes it possible to reduce damage in times of disaster or of impending disaster.

As a correspondence action in times of disaster, the levee protection activity is mentioned. One of the problems is that the administrative bodies can not grasp the situation of the levee protection activity. The flow of the information transfer in the levee protection activity is shown in Figure 1. We are considered that new disaster information flow is formed by utilizing the proposed system in the present paper and the disaster information-gathering system developed by the authors simultaneously, as shown in Figure 2. If all of the proposed system is established, the administrative bodies such as the river management will make it possible to easily grasp the disaster situations in the activity site.

In this paper, the authors propose a new action support system on the GIS to operate in real time during disaster. The significant attributes of this system are that the accurate information on the disaster situations can grasp in the wide area, and the appropriate measures for the immediate action are displayed on the GIS in real time.

2. OUTLINE OF PROPOSED SYSTEM

Whole proposed system image is shown in Figure 3. This support system consists of two parts; one is a gathering-information support system and the other is an action support system. The former has a search function of the blank information area. The latter has a search function of the dangerous area estimated from the information.

2.1 Gathering-Information Support System

When a disaster occurs, a lot of damage information is sent to the administrative body. However, it is not easy to classify that information because it has various attributes. The system developed by the

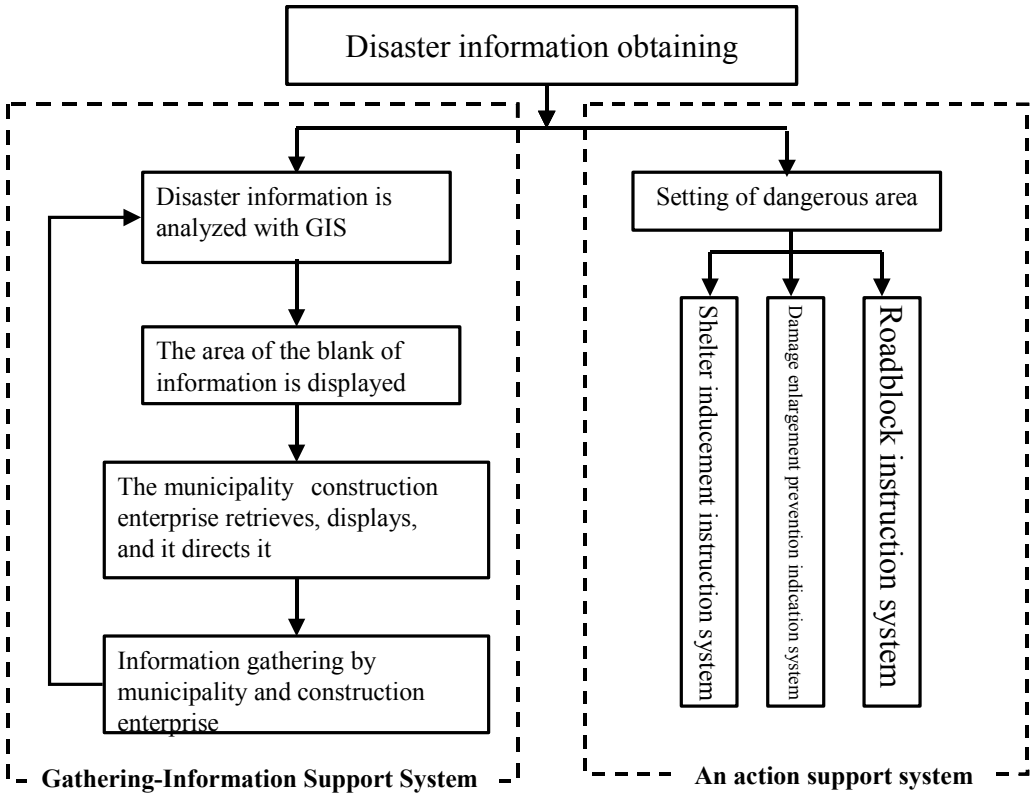

Figure 3: Flow chart of An Immediate Action Support System to Operate in Real Time during Disaster

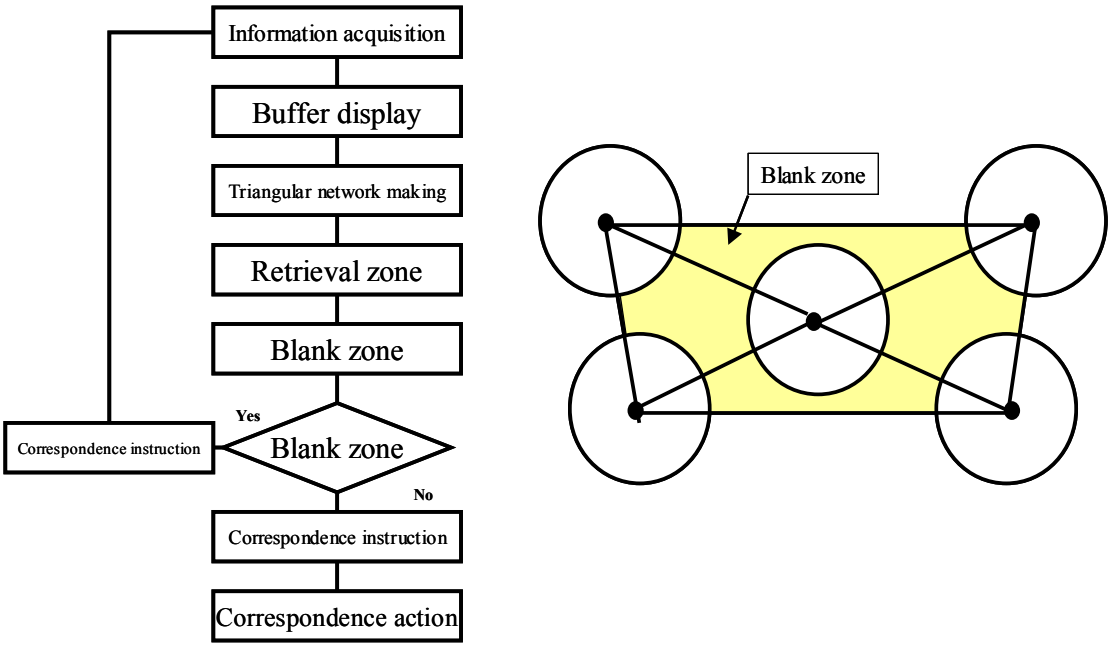

Figure 4: Flow chart of Gathering-Information Support System

present research is possible to solve such a problem. After this system analyzes gathered information, the blank information zone is set up. It is possible to visually help a situation grasp by displaying the blank information area on GISMap. The set procedure of blank information zone is described as follows, and is shown in Figure 4.

(1) Gathering information is plotted on GISMap.

(2) Circle buffers are draw at each information point. This circle buffer is drawn based on an informational effective radius. It is assumed that there is enough information within the range in this circle buffer.

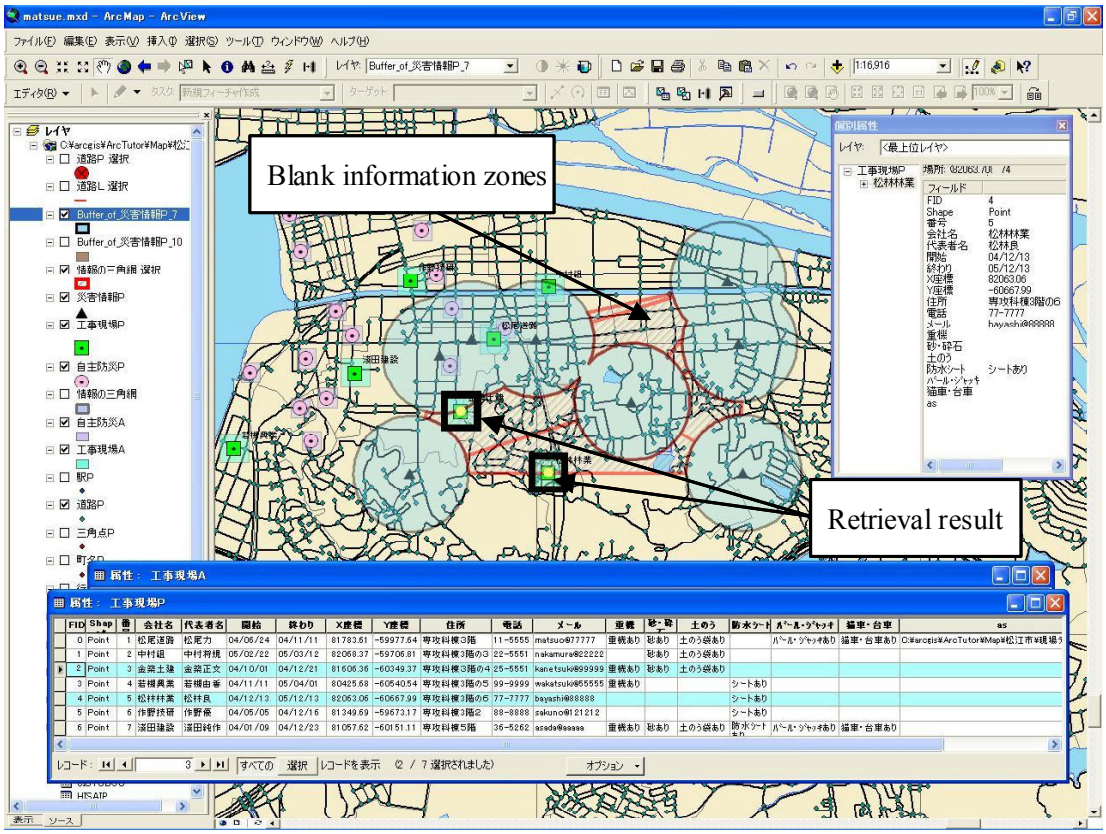

Figure 5: Example concerning execution of Gathering-Information Support System

(3) It draws a triangular networkthat makes each point, the apex. This triangular network is defined as the retrieval area of information.

(4) The part from where a triangular network of a circle buffer, was pulled, is retrieved. This retrieved area is defined as the blank information zones.

When the blank area exists, the construction companies and local community in the vicinity of the area are retrieved. The purport of the information gathering is directed to retrieved construction companies and local community with mail. When there are no blank information zones, suitable action is determined per disaster information. And, the construction companies and the local community are directed to execute the decided action with mail. This system considers the change of circumstances by the passage of time. At the disaster, the situation changes momentarily. Information collected to cope with this is classified by the interval, when information was acquired.

The situation is confirmed again for the time that time passes from collection to some degree. Figure 5 shows the example of executing the system.

2.2 An action support system

This system is a system that sets dangerous zones from collected disaster information, and puts out the instruction of the correspondence action to the construction companies and the local community. This system is executed by the following flows (Cf. Figure 6). The definition of dangerous zone in this system is "Zone dangerous at present. Or, the zone forecast it is dangerous in several hours." This system has a setting method of dangerous zones of two patterns. At first the dangerous zones are the area where a refuge advice was announced. Another is a method of setting dangerous zones from gathered disaster information.

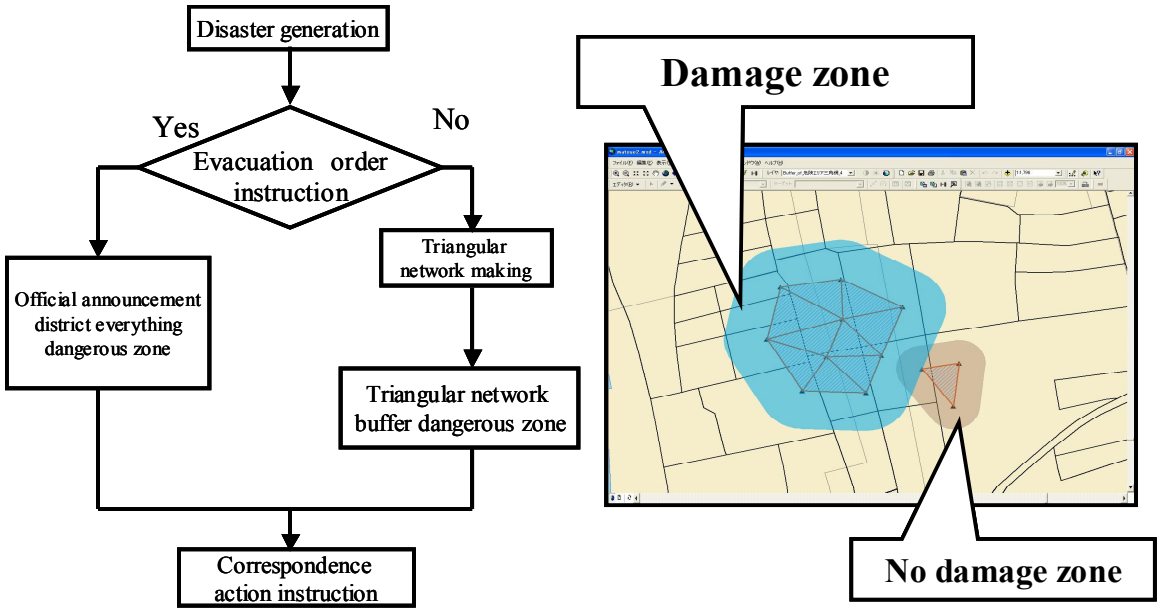

Figure 6: Flow chart of An action support system

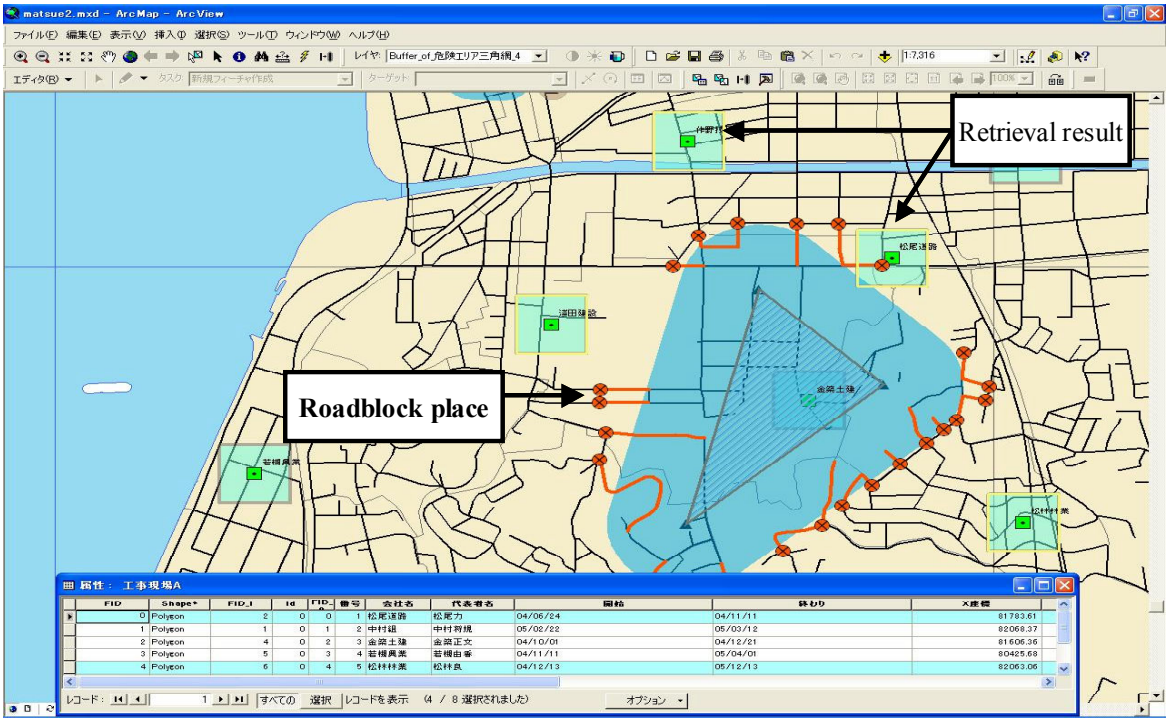

Figure 7: Example concerning execution of an action support system

The dangerous zones are the inside of an area surrounded in the point that there was the damage. The area is the triangular network which linked the point where information of the damage was sent to our systems. At this time, after damage information is classified by the damage level, it draws a triangular network. And, the radius of the buffer of the triangular network is decided, according to the damage level, and draws. Figure 6 shows the example of displaying a dangerous zone.

For instance, when a dangerous zone is set by information "Road flood", the "Dangerous zone" becomes the same meaning as "Road flood zone" because this system sets a dangerous zone at each damage level. By the way, it is necessary for an organization concerned to decide a classification

method of a class of the damage by discussing it beforehand. After a dangerous area is set, this system searches the construction companies and the flood prevention group managing the area. And this system directs a searched organization to act a necessary response at the time of a disaster.

In that case, the directed content is as follows.

(1) Putting of sandbags. Other flood control activity.
(2) Removal and movement of obstacles on roads.
(3) Prevent an inflow of a commoner to the dangerous zones

Figure 7 shows the example of executing a roadblock instruction system.

3 THE CHARACTERISTIC OF A DATABASE TO TREAT BY THIS RESEARCH

In this research, we construct an original data base. This database is going to consist of it by the construction companies and detailed information about the local communities. The reason is because a construction company has a construction machine and the staff who had professional knowledge. Therefore, it is thought that construction companies become a valuable war potential at the disaster occurred

3.1 Cooperation with local construction company

At the time of disaster outbreak, it is thought that the construction machine which a construction company has and the staff who had professional knowledge are helpful. Therefore, "The agreement about the disaster emergency-measures business of storm and flood damages and earthquake disaster" has been concluded between the prefectural office and the Shimane Prefecture construction industry Association in Shimane Prefecture. At the time of disaster outbreak, the prefectural office asks a construction company by this agreement to maintain a function of a river and a road. The construction companies which received the request execute patrol and traffic restriction measures, and the emergency measures of facilities. Therefore, it is necessary to decide the maintenance areas to head off flaps beforehand.

3.2 Cooperation with local communities

For this system, cooperation of the prefectural office and a local community is necessary to collect information. It is difficult for administration to confirm security of inhabitant's situation when the heavy damage occurs in the wide area. Therefore it is effective that administration asks a local community for the confirmation. For example, this system displays the situation of a shelter reported by inhabitants as follows. When a shelter does not yet open, this system displays it with blue, and this system displays it with yellow when a shelter opened, and this system displays it with red when inhabitants gathered to a shelter. Therefore, we are easy to come to grasp the situation of a refuge in a wide area disaster by this system.

4 POSSIBILITY OF AN APPLICATION TO A REGULAR BASIS OF THIS SYSTEM

If the user is not using the system for a long time, the user might not be able to use this system well in a time of disaster. Therefore, we aiming at the development of the system that can use on a regular basis.

4.1 For Local communities

The example of use to a local community in this system is as follows. We propose the execution of the disaster drill that uses our system.

In this training, the residents collects information on a dangerous part of the town with the GPS-locator-equipped-cellular phones. And, the

residents makes the disaster prevention map from collected information.

Other uses to a regional community of this system are to confirm the health condition of the elderly person with whom the leader of a regional community lives alone.

4.2 For River patrol

The example of use to a river patrol in this system is as follows. It is of use to the business of the everyday, to check the embankment and the illegal mooring boat managements.

As the utilization, information of the patrol is stored into a database on the GIS, using the GPS-locator-equipped-cellular phones. It is possible to make the river patrol business efficient, by this system.

5 CONCLUSIONS

An immediate action support system to operate in real time, during disasters was developed in this research. However, a lot of problems that should be improved for the practical use of this system remain.

To solve these problems, we keep first developing our system, and automate the system. A precondition that plural organizations share information is necessary to use this system effectively. Therefore, it is necessary to contain the construction companies society and the flood prevention group, and to establish a common organizations crisis-management system.

Finally, we have to conduct a proof experiment to confirm that this system is useful.

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