INTEGRATING DISASTER INFORMATION ON A WEB BASED GIS

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Abstract: Local governments, research institutes, universities and disaster consultant companies have established disaster information in various formats and coordinate systems. In this study, we established a web based GIS system using the MAPSERVER. The disaster information was converted to a standard format and coordinate system to be integrated on the system, then the information is opened to the public through the internet. Additionally, a function was added to the system which enables users to report disaster information using a GPS camera. The system extracts the coordinate of damaged site from a picture, and displays the position on the web with the picture. This system assists decision makers and users to understand the damage situation in a short time, and reduce the time for disaster site investigation. Therefore this system will take important role for disseminating disaster information.

1. INTRODUCTION

Severe damage occurred in every year due to weather such like deadly strong typhoons, floods, snowy weather or wind in Japan. Totally the damage by bad weather reached 4692.5 billion yen.

Earthquake is one of main disasters in Japan. In 2004, Magnitude 6.8 Earthquake occurred in Niigata prefecture, the Earthquake continued until September 2005. Many buildings and roads were collapsed and cracked. The first Earthquake was occurred at early evening, so the surveying of damage was delayed. Therefore the damage by the Earthquake became worse.

Huge tsunami by Indian Ocean Earthquake occurred on December 2004. The magnitude of the earthquake reached from 9.0 to 9.3. Due to late rescue and subsidy distribution, the tsunami killed more than 28,3100 people.

From the experience of the disasters, we learned that data integration of disaster information for the analysis of damage situation and a practical disaster site investigation method for fast monitoring damage site are required. A powerful Earthquake called Nankai earthquake will occur around Shikoku Island Japan within 30 years. To prepare the disaster situation, a disaster information system is required. We set the Shikoku Island as the test area for this study.

The objective of this study are integrating disaster information on a web based GIS, opening the information through the internet and developing a practical disaster site investigation method for disaster monitoring using a handheld GPS camera.

2. INTEGERATION OF DISASTER INFORMATION USING A MAPSERVER

Figure 1 shows the concept of disaster information integration. The data integrated in this study is divided into data preparation before disaster and data acquisition after disaster.
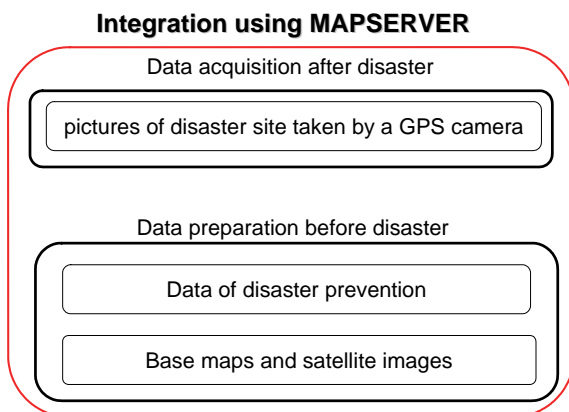

Figure 1 The concept of disaster information integration

2.1 Data preparation before disaster

2.1.1 Base maps and satellite images
Maps and satellite image are used as background data. Those data take very important role to help faster interpretation of location of disaster site.

1) Digitized maps and satellite images
1:25000 scale digital maps which contain various spatial information was prepared

(Figure3). Mosaiced Landsat images which cover Shikoku island Japan, SPOT and ASTER images were prepared as satellite images.

Figure 3 1:2500 scale digital map

2) Map digitizing by image processing
In this study, we prepared spatial data for landcover change evaluation: time series data are required for landcover change, however there are few data for the landcover change evaluation. Map elements such like road, rice field were extracted from a 1:25000 scale paper map. Figure2 shows the extracted map elements from the map produced in 1984 and 2003, and how the landcover changed.

Figure 2 data for landcover change evaluation

3) Map digitizing by topographic analysis of DEM

50m resolution DEM which enhanced by its elevation was prepared (Figure 4). Map of landform pattern analysis was carried out using the DEM.

2.1.2 Data of disaster prevention

Disaster prevention data which developed by local government of Kochi prefecture and Kochi university of technology was integrated.

As disaster prevention data, tsunami simulation data, a map of landslide area and map of blockade area were integrated in the web GIS.

1) Data preparation by conversion

The local government of Kochi prefecture prepared the data to predict the wave elevation by the earthquake. However the data is in special data format and coordinate system. Therefore the data could not be overlaid on other data in standard data format and coordinate system. The data was converted to grid format and standard Japanese coordinate system (JGD 2000). Figure 5 shows the converted tsunami simulation data.

2) Data preparation by digitizing

There are many landslide areas in Shikoku Island. The landslide area was digitized. Figure 6 shows the map of landslide area and the polygons in the figure are landslide areas.

3) Data preparation by spatial analysis using GIS

A Map of blockade area was established by using a DSM and road data. To detect blockade

area, shadow simulation and landcover classification were carried out: 8 shadow data according to the sun's location on the south, west, east, north, southeast, southwest, northeast and northwest were established. Then the 8 shadow data overlaid. In this study, we set the blockade area when shadow data overlaid more than 7 times. Figure 7 shows the map of blockade area and dangerous path to pass when the earthquake occurred.
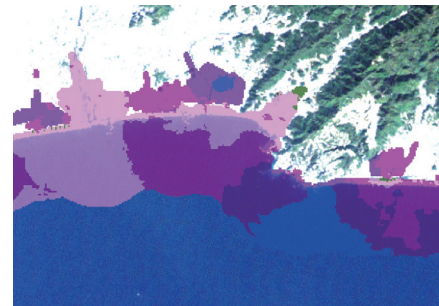

Figure 4 50m resolution DEM

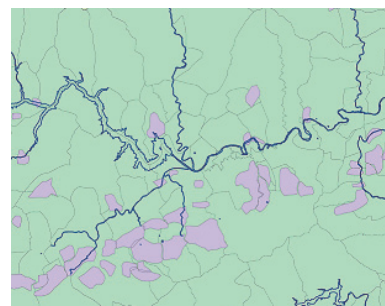**Figure 5 Tsunami simulation data**

Figure 6 A map of landslide area

The data described in this section unified in the data format and coordinate system, then open to the public using MAPSERVER.

Figure 7 A map of blockade area

The data can be seen at the web site http://www.infra.kochi.ech.ac.jp/takalab/.

2.2 Data acquisition after disaster

Remote sensing is widely used for monitoring damages by disasters. However there are advantages and disadvantages of each disaster in using remote sensing for disaster monitoring: Very high resolution satellite images provide very detail spatial information, however they are expensive and acquired contents depend on recurrent time and weather condition. Aerial surveying is less influenced by cloudy weather, aerial photos present more detail spatial information than very high resolution satellite image. To use aerial photos, data processing time of them is required. Radar sensing can be carried without disturbance by cloudy weather. However, most radar data have low resolution and no color information. One of advanced remote sensing platforms is radio control helicopter, it can acquired detail information from a low height, is not affected by cloudy weather. Remote sensing using radio control helicopter is still experimental and expensive.

The damage information acquisition using remote sensing has limitations for the various reasons.

1) A practical data acquisition method for field surveying

To cover the limitation of data acquisition by remote sensing, field surveying is required. Field surveying is not much influenced by weather condition, however much time and labor work is required to monitor wide area.

In this study, a practical disaster site investigation method that reduces acquisition time and labor work was developed using a handheld GPS camera and a web GIS.

Figure 8 shows the flow of the proposed data acquisition method for field surveying. Firstly, a surveyor brings a GPS camera to a damaged site by nature disaster, then he takes some pictures. Figure 9 shows a digital camera with a GPS.

The pictures taken by a GPS camera are stored in JPG format, and the coordinates of the positions are stored as EXIF (EXchangeable Image file Format). EXIF is widely accepted format to store various information such like time, date, focal length and coordinate derived from a GPS.

After surveying, the file and comments are uploaded to a computer server through the Internet using a file upload interface shown in the figure 10.

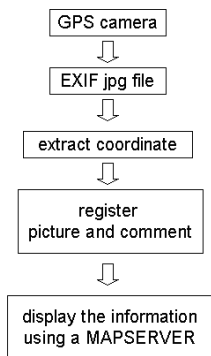Figure 11 shows the result of upload. The coordinate of disaster site was extracted by a program in PHP.

Figure 8 The proposed data acquisition method for field surveying

Figure 9 GPS camera

Figure 10 File upload interface to register pictures taken by a GPS camera.

Figure 11 After uploading a file, the interface shows the picture uploaded, file name and coordinate system.

The coordinate information is stored in shape file format which is developed by ESRI, then the web GIS displays the position and the uploaded picture using the shape file.

In this study, MAPSERVER is used as a web GIS. MAPSERVER is an open source GIS server which is developed by University of Minnesota. In Figure 12, A MAPSERVER shows the position of the site in the picture with the link of the comments.
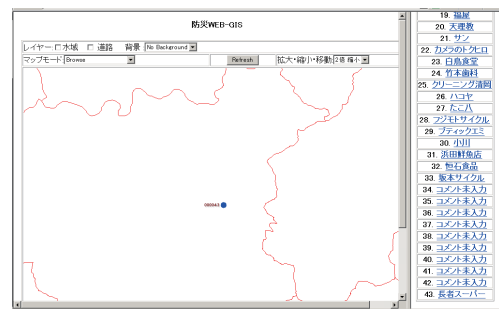

Figure 12 MAPSERVER display the registered picture's position and comments

2) Evaluation of the data acquisition method

In this study, empirical evaluation of the proposed method was carried out. Data acquisition time using a GPS digital camera (proposed method) compared with data acquisition time using a paper map (manual method). We measured the time taken from data acquisition to presentation in a GIS. In data acquisition, the information of buildings along downtown, national road route 195 and Akebono street was acquired using handheld GPS camera and a paper map.

Table 1 shows consumed time for data acquisition and processing using the proposed method. Table 2 shows consumed time of data acquisition and processing using a paper map. As increasing the number of buildings the gap of consumed time between the two methods become bigger and bigger. In comparison of the two methods, the proposed method is 1.5 times faster than the manual method.

3. CONCLUSIONS

In this study, various disaster data in various format and coordinate systems was integrated by image processing and spatial analysis on a web based GIS and the data was opened to the public through the Internet. Additionally, a practical disaster site investigation method was developed, then the evaluation of the proposed method was carried out.

The proposed method shortens data acquisition time comparing with the data acquisition using a paper map.

Although this system was developed for wireless and online environment, the system can be used in offline environment.

This system has much potential, because the third generation cellular phone which equipped a digital camera and GPS will become standard in 2007. Therefore this system can take important role to make fast data acquisition for disaster monitoring in near feature.

REFERENCES

1.Report on weather change monitoring in 2004, http://www.data.kishou.go.jp/climate/cpdinfo/ monitor/2004/2_2.htm

Table 1 Consumed time for data acquisition and processing using the proposed method

	Downtown	R 195	Akebono str.
Number of buildings	154	125	20
Consumed time for taking pictures (minutes)	200	160	30
Consumed time for establishing GIS data (minutes)	95	85	14
Total (minutes)	295	245	44

Table 2 Consumed time for data acquisition and processing time using the manual method

	Downtown	R 195	Akebono str.
Number of buildings	154	125	20
Consumed time for recording the information of buildings (minutes)	300	250	30
Consumed time for establishing GIS data (minutes)	130	105	30
Total (minutes)	430	355	60