A PRACTICAL METHOD FOR DISASTER MONITORING

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ABSTRACT: during last 2 years, very severe natural disasters have occurred such like tsunami by Indian Ocean Earthquake, Niigata Earthquake and Katrina which is category 5 Hurricane. The disaster taught us that the fast data acquisition is important to reduce the damages. Satellite images and aerial photographs are often used to extract damages in a rough scale. Field survey is required to monitor damage in a detail scale. This study focused on the proposal of a practical data acquisition method for field survey using a handheld GPS camera and WebGIS. The evaluation of the proposed method was carried out by comparing data acquisition using a paper map. The result of evaluation shows the proposed method is 1.5 times faster than data acquisition using a paper map. The proposed method reduced data acquisition time and processing time. The third generation cellular phone which equipped a digital camera and GPS become the standard in 2007. Therefore the proposed method will take important role in the near future.

KEYWORDS: GIS, Data acquisition method

1. INTRODUCTION

Severe damage occurred in every year due to weather such like deadly strong typhoons, floods, snowy weather or wind in Japan. Table 1 shows the statistics of damage by bad weather. Totally the damage by bad weather reached 4692.5 billion yen.

Table 1. **Statistics of damage by weather in 2004, Japan**

Type of damage	Total
Death (person)	326
Number of damaged building	97791
Number of Flooded building	170654
Agricultural damage (billion yen)	2874.8
Forestry damage (billion yen)	1231.1
Damage by flood (billion yen)	586.6.3
Total (billion yen)	4692.5

Category 5 Hurricane, Katrina badly damaged states of Louisiana, Alabama, and Mississippi. Almost 50,0000 people of New Orleans left the city. More than 20,0000 refugees moved to neighboring states.

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 is 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 fast and practical data acquisition method is required to monitor damage accurately and to make fast decisions. The objective of this study is developing

and evaluating a practical method for disaster monitoring using a handheld GPS camera.

2. DATA ACQUISITION MEDTHODS BY REMOTE SENSING

Remote sensing is widely used for monitoring damages by disasters. Table 2 shows the advantages and disadvantages of each disaster monitoring method by remote sensing: Very high resolution satellite images provide very detail spatial information, however they are expensive, acquired good contents depend on recurrent time and weather condition. Aerial surveying less influence by cloudy weather, aerial photos present more detail spatial information than very high resolution satellite image. Radar sensing can be carried without disturbance by cloudy weather. 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 various reasons.

3. A PRACTICAL DATA ACQUSITION 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 data acquisition method that reduces acquisition time and labor work was developed using a handheld GPS camera and a WebGIS.

Figure 1 shows the flow of the proposed data acquisition method for field surveying. Firstly, a surveyor takes a GPS camera to a damaged site by nature disaster, then he takes some pictures. Figure 2 shows a digital camera with a GPS.

The pictures 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.

Table2. The advantage and disadvantage of disaster monitoring method by remote sensing

Platform	Sensor type	Influence by weather	Influence by recurrent time	Cost	Spatial detail
satellite	Optical	yes	yes	expensive	fair
airplane		yes	no	expensive	fair
remote control helicopter		no	no	expensive	fair
satellite	Radar	no	yes	cheap	poor
airplane		no	no	expensive	fair

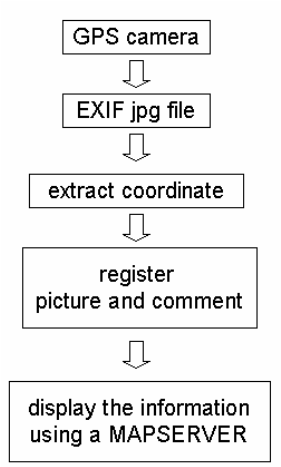

Figure 1. The proposed data acquisition method for field surveying

Figure2. GPS camera

After surveying, the file and comments are uploaded in a computer server through the internet using a file upload interface shown in the figure 3.

Figure 3. File upload interface to register pictures taken by a GPS camera.

Figure 4 shows the result of upload. PHP which is a serverside web program extract coordinate from the uploaded file.

Figure 4. 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 WebGIS displays the position and the uploaded picture using the shape file.

In this study, MAPSERVER is used as a WebGIS. MAPSERVER is an open source GIS server which is developed by University of Minnesota. In Figure 5, A MAPSERVER shows the position of the site in the picture with the link of the comments.

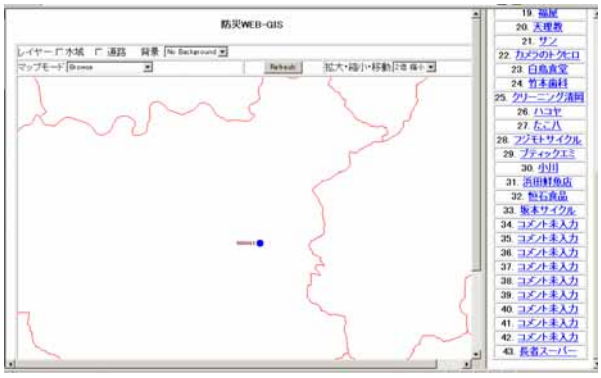

Figure 5. MAPSERVER display the registered picture's position and comments.

4. EVLUATION 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 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 3 shows consumed time for data acquisition and processing using the proposed method. Table 4 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.

Table 3. 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 4. 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

5. CONCLUSIONS

In this study, a practical data acquisition and processing system 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 allowed anonymous users to report damaged information. In this case, reliance of the reported information can become problems. However picture itself guarantees the reliance by the coordinate recorded by a GPS.

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.

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