GIS With Mobile Communication For Countermeasure against Natural Disaster

by

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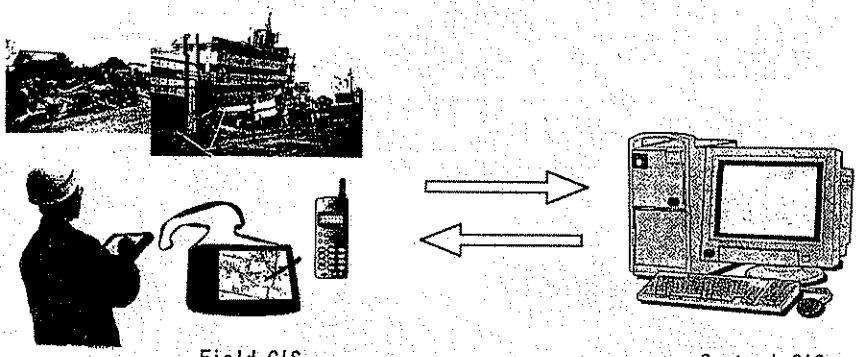

ABSTRACT

The Geographical Survey Institute(GSI), Ministry of Construction has made effort to fully produce of the Digital Maps on Japan and to enforce utilization of the Geographical Information System (GIS). It was recognized again that importance of utilizing the GIS through experiences with the Hyogo-ken-nanbu Earthquake.

This paper reports the mobile communication GIS developed for rescue operation and reconstructing activity by transmitting real-time information obtained on field investigations. On the field, this system can be easily operated to input obtained data by adopting menu-oriented interface. In the headquarters, this system can display same information as on the field, so that it is possible to carry out countermeasures certainly against with linking the other related information.

1. Introduction

The Hyogo-ken-nanbu Earthquake which occurred at 5:46 AM on 17 January 1995, was a terribly large epicentral earthquake which magnitude of 7.2. The earthquake killed more than 5,500 people and destroyed housings over 100,000, and it seemed that sufferers were over 320,000. Thus it was the worst miserable disaster in recent Japan

In respect to the information systems for social works and private enterprises activities, a lot of computers and telecommunication systems were destructed exhaustively. Also the region's economic infrastructures, including water and gas networks, telephone lines, power cables were crippled. Such destruction paralyzed business and social operations in Japan. As a result, it was recognized that importance for risk management, so that the Government, the local municipalities and researchers started to reexamine plans for countermeasures against natural disasters such as rescue operation and repair of social infrastructures.

Especially it is indispensable to realize the measures for obtaining and transmitting information, just after the outbreak of disaster.

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2. The outline of the study

For rescue operations and reconstructing activities just after the disaster, it was recognized that GIS played key roles in assembling information on real time, in linking the information with other related information such as public facilities, equipment for anti-disaster, geographic characteristics, social conditions, and realizing enforcement for prompt anti-disaster actions.

In this study, GSI developed the mobile GIS for smooth rescue and repair activities. Also GSI investigated the methods for efficient assembling and communicating information of damage, and providing information through computer networks such as Internet.

3. The outline of the system

3.1. Functions of the system

This system was integrated by customizing GIS software on the market. Main functions are as follows.

- Basic functions
  - Call out a map
  - Magnification, Reduction, Scroll
  - Display each layer, overlay of layers
  - Overlay raster image data and vector data
- Input
  - Input figures according to damage item (i.e. housing, public civil facility)
  - Input attributes according to damage item
  - Update damage information
  - Input by pen-operation
  - Measure (Distance between two points, Area of a polygon)
- Communication
  - Data transmission by portable phone (TCP/IP)
  - Auto dial
- Image management
  - Capture photo data, image data, Correction, Management
  - Retrieve and display

3.2 Damage Items

The damage items and their attributes which are able to assemble in this system are housing, public civil facility for road, river, railway and so on, and extent of liquefaction. Also figures such as point, line, polygon, which express location of damaged position, can be registered on the map viewed on the display, according to the damage item.

Table 1 shows the list of damage items.

3.3 Communication method

For rescue operation and reconstructing activity, it is necessary to grasp real and accurate situation in the damaged area. In this sense, we have to input the real-time information obtained by the field investigation, and put the information into the GIS in the headquarters by using mobile telecommunication media such as the portable phone.

However the telecommunication media or the public telephone lines may lose their function by the disaster, for example, overflow of the capacity or destruction of the local telephone exchange system.

There are some communications media, such as the public telephone, the portable phone, the personal handy-phone system, the satellite telephone system and the wireless phone system for anti-disaster, it is hardly to look out the system which is completely able to overcome the troubles stated above.

In this study, we adopted the digital portable phone as communication media because of its stability for data transmitting.

3.4 System components

- Headquarters
  - Desktop PC

- Modem
- Software
  - WindowsNT
  - GIS software
- Field system
  - Pen computer
  - Portable phone
  - Digital Camera
  - Modem
  - Software
    - Windows for PenComputing
    - FieldNotes

3.5 Effect for systematization

Thus far, when a disaster occurred, officials in charge of anti-disaster assembled information on the damaged area, and they brought it to the headquarters themselves, or reported it by using the public telephone or the wireless phone system for anti-disaster. In this case, so that the subjectivity of the officials could influence the quality of information, the reliability of information might be sometimes doubtful slightly.

If the mobile communication GIS for rescue operation and reconstructing activity is used, it is possible to transmit pictures of the damaged situation from the field promptly. The facts such as pictures are effective to grasp the damaged situation and to take countermeasures against the disaster.

On the other hand, to be shared common information by the headquarters and the field, is also effective for managing real time information and providing information to the related organizations.

3.6 Applicable fields of this system

In this study, it is considered the feasibility of the mobile communication GIS with a portable phone. As an application for the other field, it seems to be used for the support system on the field research.

The major applicable businesses are as follows.

- Update topographic map data
- Basic investigation for the City Planning (land use survey, research of housings)
- Confirmation of building houses (Field investigation for comparison)
- Investigation of fixed property, building site
- Investigation of possessions on the roads
- Welfare
- Marketing

4. Conclusion

In this study, the mobile communication GIS was developed in order to enforce smooth rescue operation and reconstructing activity at the disaster, through the experience from the Hyogo-ken-nanbu earthquake. This system was just developed as a prototype system, improvement of the functions will be needed for practical use. Also it is necessary to establish organizations and liaisons for utilizing the system.

On the other hand, it is prerequisite to settle the main computer at the headquarters. Hence it is also needed the risk management such as aseismatic structuring of the building of the headquarters, countermeasures for fire, prevention for falling down of the computers, and backup of the data.

Concerning to the risk management for computer systems, there are some manuals, for example, the security management guideline for the computer system, or the guideline for system inspection, and based on such guidelines many kinds of countermeasures have been taken. In spite of these measures, the unexpected damages of the computer system were recognized at the Hyogo-ken-nanbu earthquake. Thus the reexamine of the risk management is quite necessary. To avoid functional disorder of the computer aided anti-disaster system by hazardous earthquake, it is strongly expected that further strengthen the countermeasure for security, through researching, analyzing and investigating of the computer system in damaged situation.

ITEM	Symbol			CONTENT OF ATTRIBUTES (selecting on menu window)
	type	image	color	
House	point polygon		red	Situation :completely destroyed, partial destroyed, slightly destroyed, burned down, other
				Restoring condition : pulled down, rebuilding, repairing, other
				Comment
Road	point line polygon		gray	Place : roadway, sidewalk, median, slope, side ditch, bridge, tunnel, other institutions, other
				Situation : depression, upheaval, clack, collapse, other
				Quantities : meter, square meters
				Comment
River	point line polygon		blue	Place : levee, river course, water gate, barrage, pond, other
				Damage : collapse, flooding, ravage of institution, other
				Quantities : meter, square meters
				Comment
Railroad	point line		olive-green	Place : rail, overhead wire, station building, garage, railroad bridge, other
				Situation : depression, upheaval, collapse, cut off, other
				Quantities : meter, square meters
				Comment
Water pipe	point line		light blue	Comment
Sewer	point line		brown	Comment
Gas pipe	point line		purple	Comment
Electric power	point line		green	Place : electric light pole, overhead wire, underground interconnection system, other
				Comment
Telephone	point line		yellow	Damage : telephone pole, overhead wire, underground, other
				Comment
Liquefaction	polygon		navy-blue	Comment
Other	point line polygon		black	Comment
Place of photography	point line image		pink	Number of photograph (input by 10key)
				Comment
Note	image		black	

Table 1 The Item List of Collecting Damage Information