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Using GIS Technology in Disaster Management and Control in urban

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ABSTRACT: Disaster management is a process in which we should summon all plans, organizations, and control groups to encounter a hard moment and offer the results to managers for decision making based on the current situation. The aim of this research is to estimate the environment of disaster management from the vision of information technology (IT), geospatial information services, and geospatial data management systems. To achieve this goal, four phases of disaster management, namely mitigation, preparedness, response, and recovery are discussed. Moreover, the specifications of a constructive information system are mentioned. Also, the needful data to implement a GIS for disaster management is argued. In the end, the results obtained from this study indicated that there is an urgent need for governmental agencies to being in contact more and more in order to employ geospatial information services in managing a disaster as much as possible.

Keywords: GIS, Management of Technology, T-GIS, Disaster Management, Database

ORIGINAL ARTICLE

INTRODUCTION

Alluvial and bedrock river channels are usually considered to be fundamentally different, with alluvial channels being shaped principally by flow and sediment transport processes, and bedrock channels principally by lithological and structural controls [1]. The formation of discontinuous floodplain pockets demarcates a transition zone along longitudinal profiles between confined and alluvial river variants [2].

Every year natural disasters cause uncounted damages and fatalities in the world wide. There are ten types of disasters, among forty-three known global disasters, which take place with entire energy locally, nationally, and globally. These ten disasters are earthquake, flood, tornado, eruption, tsunami, sea waves, snow break, famine, volcano, and landslide [1].

Among these disasters which mentioned above, earthquake is the dangerous one that generally causes a huge amount of costs and deaths due to unawareness of civilizations. The first act to control and come across each catastrophe is to gather needed data from the area that is suffered from disaster and to notify people at the right time. These data (either spatial or attribute) can be listed as the location of damaged place, the condition of access ways, number of residence, capacity of the nearest health centers (hospital, clinic, etc.), food resources, safe places, and so on. Obviously, a map with up-to-date information on it plays a main role in case of decision making and discharging safety groups to the injured places. In other words, spatial data of disaster place and a well- defined database linked into them are the preliminary tools in order to overcome with the problem better and better. Based on the latest evaluations, 60 – 80 percent of manager's decisions are related to the geographical environment and spatial data which can use GIS technology to control and manage circumstances. But more generally, geographic information and the technologies that acquire, interpret, and disseminate such information (GIS, remote sensing, GPS, etc.) are clearly essential in all aspects of disaster, from preparedness, prevention, and protection through detection to response and eventual recovery.

Geographic Information and Technology (GI&T) provide the basis for estimating and mapping risk, for planning evacuation routes and shelters, for determining areas where human populations are most likely to have been impacted following a disaster, and for assigning resources during recovery, among many other vital and important tasks [5]. The other applications of GIS technology in rescue operations can be listed as positioning of temporal camps, positioning of permanent camps, positioning of land fields, designing a database for injured people to create reports, charts, and graphs, designing maps as well as snapshots of inured places to summarize the current situation, and many others.

Four Phases of Disaster Management

Generally, there are four phases in managing a disaster and making decision in tough situations as showing in Table1:

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Table1. Phases of Managing a Disaster [7]

No	Phase	Procedure
1	Mitigation	Minimizing the effects of disaster through planning, analysis, assessment, and public education.
2	Preparedness	Planning how to respond through preparedness planning, conducting emergency exercises and training, implementing warning systems, and public education.
3	Response	Efforts to minimize the hazards created by a disaster through search and rescue, disaster relief/aid, and other response efforts implemented or coordinated as a result of planning, public education, emergency exercises and training, and other response efforts.
4	Recovery	Returning the community to a sense of normalcy. Some communities may not be restored to the way they were before a disaster but a sense of normalcy can be restored through mitigation, preparedness, and effective response.

Specifications of a Constructive GIS in Disaster Management

Data and Database: The effectiveness of a constructive information system is based on the quality and availability of relevant data in a well-defined database. Databases play a key role in value of the output in information systems, especially in geoinformation systems. GIS technology utilizes an RDBMS (Relational database management system) that comprises of spatial and attribute data and the relationships that exist between them [5]. In a GIS database the vector or the geometries such as point, line, and polygon is linked to its attributes. Similarly the raster data formats stores attribute information of each pixel. The feature and the attribute data work together as an integrated system using rules, relationships, and topological associations allowing the user to create a complex data model for representing the earth and its process.

Relationship among Different Organizations

The key to an effective GIS based disaster management system is a free flowing interchange of data among organizations. Data relevant to disaster management is created and utilized by various organizations for their own specific purposes. Such data is scattered across the country often in non-compatible formats, available in paper forms, sometimes too small a scale for analysis, non-existing metadata and too often lying neglected, damaged, destroyed or lost. Data created or purchased by an organization for its own applications are often not shared with other organizations owing to lack of awareness or sometimes due to reluctance to share information. There is an urgent need to compile and collate time series large scale spatial and non-spatial data at a country wide level to know risks better and to do something about it. The National Spatial Data Infrastructure (NSDI) is a proactive move towards this direction [9, 3].

Computer Hardware and Software

To apply GIS in order to manage a disaster we need various equipments. These equipments involve communication networks, either local or global, computer hardware and software to generate paper maps and digital information for decision-makers, navigator gadgets to facilitate the rescue operation and so on. Commonly, communication networks are one of the most significant parts in each GIS procedure. The usage of networks can vary in term of cable or wireless networks. An optic fiber, for example, can send and receive data in a large amount in comparison with a dial-up network [9]. With all advances in computer science in hand also we can use geospatial services in our transportable tools such as, PDAs, laptops, and 4G (four-generation) cell phones. Beside above, the parts of a disaster management system cannot be completed without applicable computer software. In a disaster management system, computer software is a very complicated component and requires various capabilities such as, the ability to work in a network environment, the ability to input, store, manipulate, analyze, and summarize the different types of spatial and attribute data, the ability to work with satellite imagery, the ability to relate GIS with GPS and other navigator systems in order to establish a mobile system to navigate vehicles and forces in the operation environment, etc. [9]. In addition, the software component must have the ability to up-to-date the applications according to the usage.

Methods of Processing Data

Actually, the ability of processing spatial and attribute data simultaneously is one of the most important differences among GIS, drawing software (e.g. AutoCAD), and database software. Methods of processing data, in fact, are the correct ways to hire data due to achieve a specific goal in a GIS. There are several possible methods of processing data in a disaster management system which can be designed and implemented. Shortest path finding models, image processing models to find the dimension/ or boundary of disaster, spatial and attribute management data models, direction modeling, 3D (three-dimension) terrain modeling and other models which design based on the necessity are the most important models that process attribute and spatial data at the same time. Although, the processing of two common types of data (i.e. spatial and attribute) is a really require act, but, the data processing models necessary for disaster management are not just related to the processing of these data [11]. Perhaps, we need other models such as risk assessment models, evaluation models and management models during the processing phase. It is obvious that implementation and

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development of such these models in the framework of GIS is possible but needs to use a set of interface programs or languages to connect everything and it causes reducing of speed and efficiency of system. There must be a connectivity and relationship among components that mentioned above in a dynamic disaster management system. Organizing these different components, especially database, is one of the most difficult processes to create a GIS for disaster management. In the disaster time the executive of this system will be activated. In the next step the scenario of implementation and organization a disaster using information technology will be argued.

Managing a Disaster using Information and GIS Technologies

Proposed geospatial information system in order to manage a disaster consists of two parts, namely server and executive. The server part is planned with a set of wireless connected computers through a network. The internal linkage of these server computers is joined using a wireless network or a LAN network and they are in touch with the executive part via mobile networks. This system can operate as a Client-Server or PC Based and can be connected to other system via Bluetooth technology [8]. The executive part uses a PDA or a mobile device which equips with a GPS to receive the commands and massages from controlling and commanding team and find the supposed place. The position of executive groups sends to the controlling center automatically, so it is possible for controlling and commanding center to trace them frequently. As it mentioned earlier, database is one of the most important parts of a disaster management system. All of the spatial data such as road maps, urban maps, infrastructure maps, high risk areas maps, and other requirement data for managing a disaster are stored in the database of GIS precisely, therefore, this system plays a role to retrieve and convey stored data among users. A GIS must be multi-operational and be usable in different parts, especially in military and rescue maneuvers. The software part of this system consists of DBMS (Database Management System), operational and visual part, and appropriate models in order to disaster management data processing. Data processing models are the most important elements of the software in a system and these models are defined based on the past experiences besides the current applicable needs. Site selection models, resource management models, simulation models, data exchange interfaces, and path finding models are the common spatial and attribute models in disaster management. Because of the natural and artificial sources, each disaster has different social and security levels, disaster management systems also have several executive parts which must work together simultaneously. Group of servicing, repairing, and rebuilding the urban infrastructures, medical and health care groups, statistics and recording groups, camp groups, and so many others are the most important branches of executive part. Basically, all these groups should work together as correspond as possible and be in direct-contact with the controlling center. As it cited earlier, because of the various levels of natural disasters in a place there is a need of good association among governmental and non-governmental organizations as well as an enough budget [2,7,10].

The Problems of Implementation a Disaster Management System

There are a set of problems and issues when a disaster management system is going to be created as following:

1. The avoidance of cooperation among different levels of organizations (i.e. local, national governmental and/ or non-governmental).
2. Absence of a social knowledge about working with geospatial data and broadly with digital data.
3. Designing, implementing, and developing a geospatial system is a long time process in comparison with management systems.
4. Variety of data sources and differences in nature of data (e.g. scale, format, date, and etc.) cause differences among gathered data.
5. Technologic problems, such as communication infrastructure problems and access to applicable software.
6. The renewing of computer hardware and system equipments desires a large amount of money.

CONCLUSION

Development of GIS systems due to managing a disaster, especially natural disasters is not only an urgent strategic and national need, but also is an organizational process which summons all the powers to be implemented. Data gathering, either spatial or attribute, and database designing are the most important executive parts of a system. The former experiments shown that the value of urban and rural data in form of maps, charts, or images are very high and with a powerful national database in hand the decision making task will be as precise and fast as possible for managers. Basically, natural disasters, such as earthquakes, tornados and volcanoes will always be a danger for people living in certain part of the world. In other words, warnings can be given, preparation can be made, but we cannot be completely protected from the full force of nature.

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