Digital Management Mechanism of Sudden Geological Disaster Emergency Plan

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Abstract

Digital emergency plan is an important part of the emergency platform. This paper proceeds as follow. Firstly, it presents the key technologies of digital emergency plan, emphasizing feature extraction, multi-source information fusion and GIS technology. And then the processes of the geological disaster emergency plan are discussed based on the “The national sudden geological disaster emergency plan” for guideline, including regional geological disaster warning information response process and single geological disaster emergency response information flow. Moreover, the digital prototype system is designed, including the framework of geological disaster emergency plan of the overall structure, database and function modules. Finally, based on MapGIS platform, B/S mode, using Flex, Flash Builder technology, it developed the prototype system for experiment.

Keywords: Geological disaster; Emergency plan; Digital; GIS

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1. Introduction

China is one of the worst-hit countries by geological disasters in the world. Especially the sudden geological hazard would be hugely damaging, such as collapse, landslides, mudslide ground sink and so on. During the past decade, the sudden geological hazard has caused significant loss of people's lives and property safety each year. It restricts the sustainable development of our society.

When disaster is coming, emergency plan is an important basis for making decision of geological disaster emergency. On January 13, 2006, “The national sudden geological disaster emergency plan” was released in our country. It reflected that the geological disaster emergency response work became standardized and normalized in China [1]. Inform of text, the emergency plan has made outstanding contributions to the geological disaster emergency work. However, with the increasing of sudden geological disasters, some shortcomings of the text emergency plan have occurred in practice. (1) Static text plan is not intuitive, timeliness, poor operability in the process of implementation. (2) Making emergency decision often needs many aspects of emergency information by support, the text plan cannot provide sharing information. (3) Emergency disposal strategies need to be developed by the actual situation of the disaster, the text plan cannot achieve it. Therefore, it is necessary to construct digital plan for using modern technology. It can play an important role in disaster prevention and reduction.

Foreign research of digital plan started early. There are typical projects, such as digital emergency plan system in America Savannah coastal area, American Ohio oil emergency response system [2], emergency response plan and management system in Dartmouth, Britain, crisis prevention information system in Germany [3, 4], the Uthmaniyah gas processing plant emergency response plan system in sandi Arabia and so on.

In the aspect of emergency plan digital technology, Adriaanter Mors [5], Mark Hoogendoom [6], Gheorghe Tecuci [7], Marco Scaioni [8] has done related research work. It mainly concentrated in the process of modeling, emergency operation modeling and evaluation and evaluation system.
China woke up late to emergency management theory and technology. The standard of emergency management system is still relatively frail. Through the massive literature retrieval, we found that the articles about the analysis of digital emergency plan, process modeling are limited. At present, in our country, we have established some digital plan system in several areas, such as the environmental pollution [9, 10], earthquake [11, 12], city track traffic [13], the campus emergency [14], flood control [15]. But the geological disaster emergency plan digital system is an unusual. The sudden geological disasters digital emergency plan is still in an original stage.

Digital emergency plan is the implementation of the platform. It is an important part of the emergency platform. Based on the “The national sudden geological disaster emergency plan” for the program, using feature extraction, multi-source information fusion and GIS technology, the paper analysis process of the geological disaster emergency plan. And then design digital prototype system, including the framework of geological disaster emergency plan of the overall structure, database and function modules. Based on MapGIS platform, B/S mode, using Flex, Flash Builder technology, it developed the prototype system for experiment. It achieves high efficiency and visualization of geological disaster emergency plan implementation process.

The structure of the paper is as follows. To begin with we will provide a brief background on the digital plan. Details on digital management mechanism of sudden geological disaster emergency plan are discussed in later sections. Section 2 discusses sudden geological disaster emergency plan process which includes general process of geological disaster emergency, information flow of regional geological disaster emergency response and information flow of single geological disaster emergency response. Section 3, prototype system is developed for verifying the digital management mechanism. Section 4 is the conclusion of the paper.

2. Research Method

2.1. Key Technology

(1) Feature extraction technology

Feature extraction is from text features to select the most representative features, in order to reduce the dimension of feature space, which can achieve the purpose of reducing the computational complexity and improving the classification accuracy. In the process of the digital geological disaster emergency plan, we need to use feature extraction technology.

For example, extract important information about the geological disaster from “The national sudden geological disaster emergency plan”, such as plans to start conditions, disaster emergency response level, emergency organization, and so on. Extract the truth from the report information, such as geological disaster type, time, place, personnel casualties and economic losses, the rescue, and so on.

(2) Multisource information fusion technology

According to the actual demand of digital plan, for the main elements of information involved in “The national sudden geological disaster emergency plan”, the collation, comparison, processing and coordination and comprehensive treatment of geological hazard information collected is needed to obtain the correlation and integration of information fusion.

In the paper, based on data center technology and spatial data engine (SDE) technology, by means of combination of the multi-source information for emergency plans in space or time redundancy or complementarity, it realizes the unity of the data storage and management of geological disaster spatial and nonspatial data in the database.

(3) GIS Technology

Geographic Information System (GIS) is a kind of spatial information analysis technology rapidly developed in recent years. Geographic Information System is refers to a kind of computer system, which has the main task including collection, storage, management, retrieval, analysis and description of spatial objects' location and related attribute data, and answer user questions, in the support of computer software and hardware [16].
Using the spatial analysis and spatial database management functions of GIS, combined with the geological disasters emergency procedures, it can provide technical support for the research of digitalized preplan [17, 18].

Table 1. GIS applied in geological disaster emergency plan in digitization

<table>
<thead>
<tr>
<th>The function of GIS</th>
<th>Applied in geological disaster emergency plan in Digitization</th>
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<tbody>
<tr>
<td>Spatial data management</td>
<td>Geospatial information, information on geological disasters, the meteorological early warning information, resource distribution and information management</td>
</tr>
<tr>
<td>Two or three-dimensional visualization</td>
<td>Disaster map display, 3D scene simulation</td>
</tr>
<tr>
<td>Buffer analysis</td>
<td>Analysis of disaster affected area</td>
</tr>
<tr>
<td>Path analysis</td>
<td>Transfer the evacuation path analysis</td>
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<tr>
<td>Overlay analysis</td>
<td>Analysis of the threat of disaster area population</td>
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2.2. Digital Flow Analysis of Sudden Geological Disaster Emergency Plan

(1) Overall process of geological disaster emergency

According to “The national sudden geological disaster emergency plan”, by the idea of emergency management of backbone chain drives the key link of emergency response technology, to design the main process of emergency management. It includes disaster warning, disaster response preparation, identification, emergency disposal, response to the end (Figure 1).

(2) Information flow of regional geological disaster emergency response

Early warning of regional geological hazard warning forecasting, refers to a geological disaster warning information release mechanism in a certain period which geological disasters may occur collapse, landslides, mudslides and others.

Using feature extraction technology, extract feature of “The national sudden geological disaster emergency plan”. According to the regional geological disaster early warning response plan process, it can be divided into the early warning, emergency response plan, triggering, and warning termination stage. The core content of the digital early warning of regional geological disaster response plan is shown in Figure 2.

(3) Information flow of single geological disaster emergency response

Single geological disaster emergency plan is in response to the occurrence of geological disasters, in view of the specific characteristics of geological disaster or hidden points and the environment. According to the local economic and social level or ability, disaster prevention and mitigation work program can ensure personal safety, property safety and environment and advance the development of the good.

Using feature extraction technology, extract feature of “The national sudden geological disaster emergency plan”. The work processes of single emergency plan included preliminary geological disasters, verification, start plan, emergency response and response of end stage.

The core content of the digital early warning of single geological disaster response plan is shown in Figure 3.
Figure 1. Division of geological disaster emergency stage

Figure 2. Information flow of regional geological disaster emergency response

Figure 3. Information flow of single geological disaster emergency response
3. Results and Analysis

3.1. Development Framework

The prototype system is developed based on MapGIS platform, using the browser / server mode (B/S mode). The customer terminal is developed by Flex technology, using Flash Builder 4.5 as the client development environment. Web server uses WCF framework to develop and mature, it will be released to the IIS application server, and for the client calls. The data layer uses Microsoft SQL Server2005 as the database file management system, GIS data server layer uses spatial data for storage and management capabilities provided by MapGIS platform, to solve the complex problems of spatial data access, modify the data type, and so on (Figure 4).

3.2. Overall Framework Design

The construction of sudden geological disasters digital emergency plan system is based on B/S model, MapGIS IGServer platform. The four layer structure including the data layer, GIS application support layer, application layer and user layer (Figure 5).

3.3. Database Design

In the geological disaster emergency plan digital system, it needs the massive spatial data and relational database for data support, the data types can be divided into the following six types of database: basic geographic database, basic geological database, geological hazard database, meteorological warning database, rainfall database and emergency resource database. The spatial data is stored in the MapGIS SDE, using SQL Server database to store the relational data (Figure 6).

3.4. Function Design

According to different contingency plan, the functions of sudden geological disaster emergency plan digital system includes two parts, regional geological disasters and geological disasters haplotype module (Figure 7).
4. Conclusion

In conclusion, the paper analyzes the process of the geological disaster emergency plan. And then design digital prototype system. Based on MapGIS platform, B/S mode, using Flex, Flash Builder technology, the prototype system is developed for experiment. The prototype system inter-face is shown in Figure 8.

It transfers the emergency plan in the implementation of the information from the original into a modern way. It changes the emergency plan in the implementation of technology by the experience of experts into intelligent auxiliary means. Future work includes: (1) To achieve Intelligent emergency plan using intelligent technology. (2) To establish a typical emergency management case data-base is another aspect.

Conflict of Interest

The authors confirm that this article content has no conflicts of interest.

Acknowledgements

This work is supported by the Special Project of Minis-try of Land and Resources for Public Industry Research (201211055) and the Central Universities (CUGL130259), the views expressed are the authors’ alone.
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