

Implementation of a WebGIS-Based Geological Environment Data Management Information System for Guangyuan City

Ji Jian^{1*}, Shiyuan Li², Zhangsheng Wu¹, Qi Liu¹, Yunhai HU¹, Sisi Chen¹, Yang Xu¹, Shun Liu¹, Hanhu Liu¹ and Ke Bai²

¹Institute of RS and GIS, Chengdu University of Technology, Chengdu, 610059, China

²Geological Environmental Monitoring station of Guangyuan City, Guangyuan, 628017, China

Abstract

Geological hazard is one of the major natural hazards world facing now, In order to prevent and predict geological hazard, techniques for geological hazard management, assessment and prediction must be developed for the prevention of geological hazards. In this paper, a geological environment data management information system (GEMIS) was implemented based on WebGIS. GEMIS is designed for management geological environment data, as well as geological hazard point. GEMIS has achieved the functions for geological environmental data displaying, querying and analyzing, and many users can share the same geological environmental data due to the B/S frame work. The use of GEMIS can improve and enhance the rapid identification of receptor sites and fate of geological hazards, improving response time and mitigation strategies in the event of a geological hazard. GEMIS also provides each incident responder with access to the same maps and geological hazard information that other responders possess.

Keywords: Geological Environment Data; WebGIS; Management Information System

Introduction

Geological hazard is one of the major natural hazards the world facing now, and each year is responsible for enormous property damage involving both direct and indirect costs [1]. China is a typically developing country. Risk management has become an inevitable trend in China's geologic hazard management and it is imperative to conduct geologic hazard risk evaluation. Although China has laid the foundation for geologic hazard survey and zoning, the large-scale geologic environment information is not fully available and the geologic hazard risk evaluation must be pressed ahead steadily [2]. In order to prevent and predict geological hazard, techniques for geological hazard management, assessment and prediction must be developed for the prevention of geological hazards [3]. Many studies have been carried out on geological hazard evaluation using GIS and Geoinformation-related techniques. And some achievements have been gained [3-6,1].

It is now commonly recognized in geotechnical and earthquake engineering fields that local geological site conditions have a profound influence on the amplification of ground motions [6]. Thus, the geological hazards such as earthquakes, landslides, floods and land subsidence are mainly caused by local geological environment. Geological environment mapping, modeling, and zoning could help to identify geological hazards and to estimate the influence on individuals or populations, property, and environment [5].

Guangyuan, a city of Sichuan province, is a vulnerable district to geological hazards for its special location and geological construction, especially after Wenchuan earthquake. Great changes have taken place in the geological construction and environment of Longmenshan Mountain and Michangshan Mountain, which are the main mountains in Guangyuan city. This leads multiplied geological hazards in this area. In order to more effectively manage geological environment data in Guangyuan city, this study provides an approach to implement a geological environment data management information system (GEMIS) based on WebGIS.

Methods

Study area

Guangyuan city is located in the northwest of Sichuan province

(shown as Figure 1), Longmenshan mountain and Michangshan mountain are the main mountains in this area. The geological environment in this area is complex, which leading a geological hazard-vulnerable and geological hazard-multiple area.

Data

GEMIS is a base to predict geological hazard, the data in GEMIS

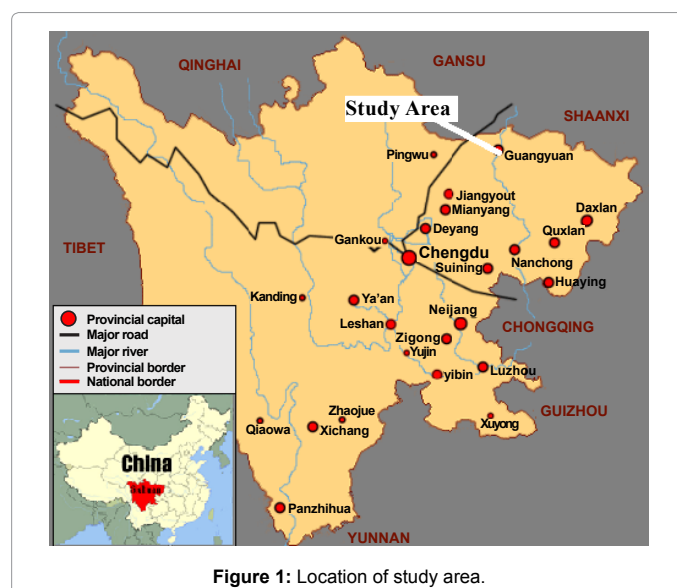


Figure 1: Location of study area.

***Corresponding author:** Ji Jian, Institute of RS and GIS, Chengdu University of Technology, Chengdu, 610059, China, Tel: 0086-28-84078820; Fax: 0086-28-84079069; E-mail: simple_ji@hotmail.com

Received December 14, 2011; **Accepted** January 27, 2012; **Published** January 29, 2012

Citation: Jian J, Li S, Wu Z, Liu Q, Yunhai HU, et al. (2012) Implementation of a WebGIS-Based Geological Environment Data Management Information System for Guangyuan City. J Geol Geosci 1: 101. doi: [10.4172/2329-6755.1000101](https://doi.org/10.4172/2329-6755.1000101)

Copyright: © 2012 Jian J, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

includes foundation geological data of the area including geological stratum, geological lithology, geological structure and physiognomy; foundation geography data including boundary map, place name map, hydrology map, communication map and relief map; environmental geology data including crumble data, coast data, debris flood data, unstable slope data, surface collapse data, ground fissure data, groundwater data and mine environment data; hydrometeorology data including the location of weather station, precipitation data, the location of hydrometrical station and foundation data of river hydrology; remote sensing image of the area and so on.

System framework

Two types of information systems underpin GEMIS: GIS and a database management system (DBMS). GIS is an information technology utilized to maintain and analyze geographic data capable of organizing data into layers and relating sets by geography. GIS functionality may also be delivered through a standard Internet browser, a valuable feature enabling the distribution of uniform and current data [7]. DBMS refers to software that collects, manipulates, queries, and retrieves tabular data. Efficient database construction and combination of project-relevant datasets into a single application reduces instances of data redundancy, error, and computational lag time [7]. Browser/Server(B/S) framework and Web service are applied in GEMIS. The system framework is shown as figure 2. Map GIS k9 was employed as the WebGIS platform, Oracle 10g was employed as the database engine, and Flex and C# was employed as the developing tools.

System components

GEMIS was divided into the following parts: Map display and manipulation accomplishing map zoom, map pan, map overlay, foundation map switch and so on; Information query accomplishing spatial query, attribute query and query by hazard type; Statistical analysis accomplishing regional statistical and theme map-creations; Dynamic-monitoring accomplishing rainfall monitoring and shift monitoring; Sequence map display and System Management, shown as figure 3.

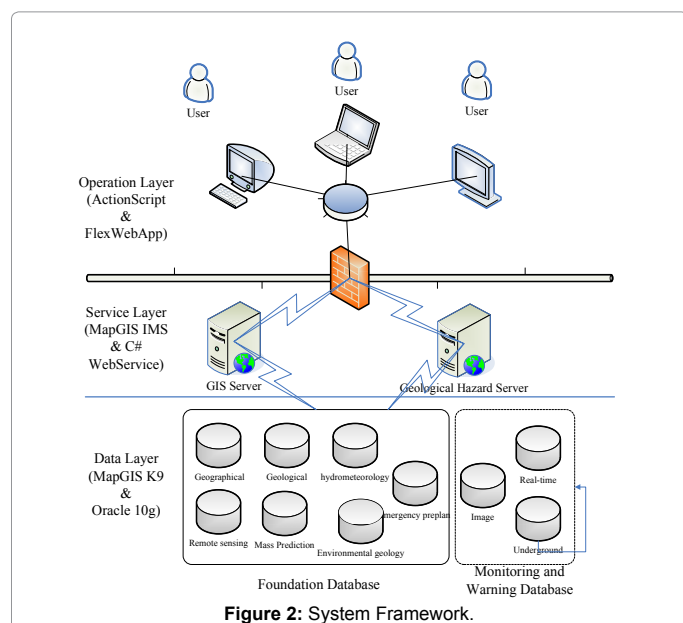


Figure 2: System Framework.

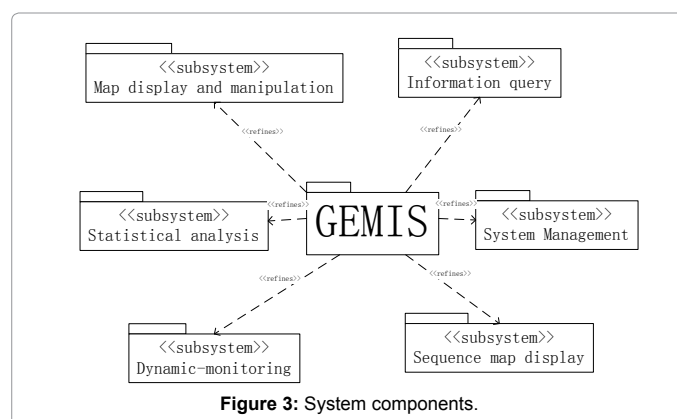


Figure 3: System components.

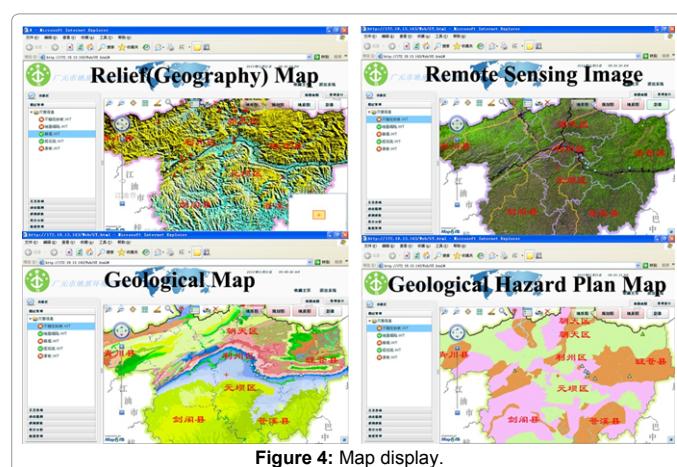


Figure 4: Map display.



Figure 5: Point Identity.

Results

Map display

In GEMIS, all four foundation maps including relief (geography) map, geology map, Remote sensing image and geological plan map can be displayed switchable, shown as figure 4.

Information query

Information query has five forms: point identify, spatial query including circle query, polygon query and rectangle query, SQL query.

Point identity can query a point's information, shown as figure 5.

Other than point identity, users can define a shape such as circle, polygon and rectangle with the draw tools to do spatial query, shown as figure 6.

Also, users can use SQL query to get information about geological hazard, shown as figure 7.

Dynamic-monitoring

In GEMIS, dynamic monitoring gives an interface to rainfall monitoring and shift monitoring display; also, users can define an alarm line to give a hint for risk, shown as figure 8.

Potential applications and Developmental Options for Gemis

Future enhancement of GEMIS may follow three pathways: (i) enhancements to display of hazard points; (ii) enhancements to the

prediction of geological hazards; and (iii) model enhancements for geological environmental data to geological hazards.

While GEMIS has employed foundation maps of relief (geography) map, geological map, remote sensing image and geological hazard plan map to strengthen the hazard points, but the incidence of a hazard has not been put on map in this version. Thus such enhancements may include: (a) the incidence of a hazard, (b) the affected building and other sources and (c) the escape route for a hazard.

The prediction of geological hazards is a difficult problem in engineering geology, GEMIS only addresses the alarm line for rain fall and shift, in next version, GEMIS may enhance the model for geological environmental data to geological hazards to raise the prediction precision of geological hazard.

Conclusion

GEMIS has achieved the functions for geological environmental data displaying, querying and analyzing, and many user can share the same geological environmental data due to the B/S frame work. The use of GEMIS can improve and enhance the rapid identification of receptor sites and fate of geological hazards, improving response time and mitigation strategies in the event of a geological hazard. GEMIS also provides each incident responder with access to the same maps and geological hazard information that other responders possess. Updates to rain fall and shift can be provided to all responders simultaneously. Overall, GEMIS capabilities serve to enhance the usage of geological environmental data. Establishment of GEMIS as part of an organization's hazard response program can assist environmental response teams by improving their ability to coordinate with other agencies to ensure an appropriate and adequate response to a geological hazard response. In addition, GEMIS can provide invaluable open information to public, as well as enhance decision support for governmental administrator. In essence, GEMIS is a software tool designed to help answer the crucial question in any Area geological hazard management: Where is the geological hazards? The potential incidence of a geological hazard? What the factors of a geological hazard? How to design an escape route for a geological hazard? The use of this GIS-based interface module can improve first responders' understanding and fate of geological hazard, potentially improving response time and mitigation efforts in the event of a geological hazard. The use of this tool can improve the comprehension between public and government. In this age of vast information availability, decision makers must work to develop improved tools to disseminate and interpret the increasing amount of available data.

References

1. Pradhan B (2010) "Remote sensing and GIS-based landslide hazard analysis and cross-validation using multivariate logistic regression model on three test areas in Malaysia." *Advances in Space Research* 45: 1244-1256.
2. Zhou PG and HQ Chen (2008) "Research on geologic hazard risk management in China based on geologic hazard survey and zoning." *International Journal of Risk Assessment and Management* 8: 362-372.
3. Lee S, U Choi (2003) "Development of GIS-based geological hazard information system and its application for landslide analysis in Korea." *Geosciences Journal* 7: 243-252.
4. Biswajeet P, L Saro (2007) "Utilization of Optical Remote Sensing Data and GIS Tools for Regional Landslide Hazard Analysis Using an Artificial Neural Network Model." *Earth Science Frontiers* 14: 143-151.
5. Di BF, NS Chen, P CUI, ZL LI, YP HE, et al. (2008) "GIS-based risk analysis of debris flow: an application in Sichuan, southwest China." *International Journal of Sediment Research* 23: 138-148.

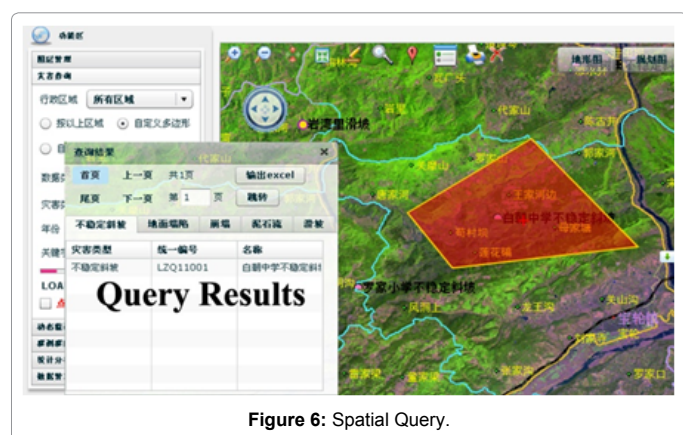


Figure 6: Spatial Query.

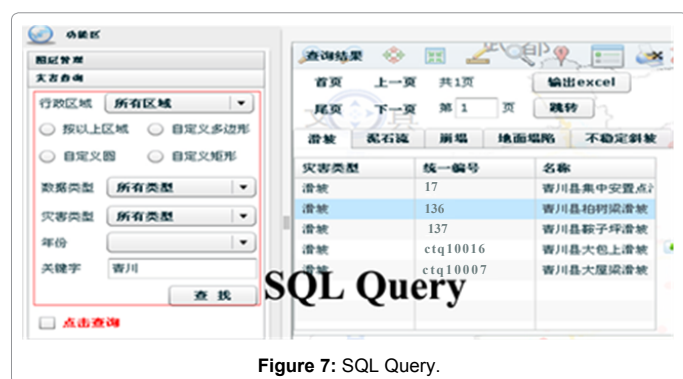


Figure 7: SQL Query.

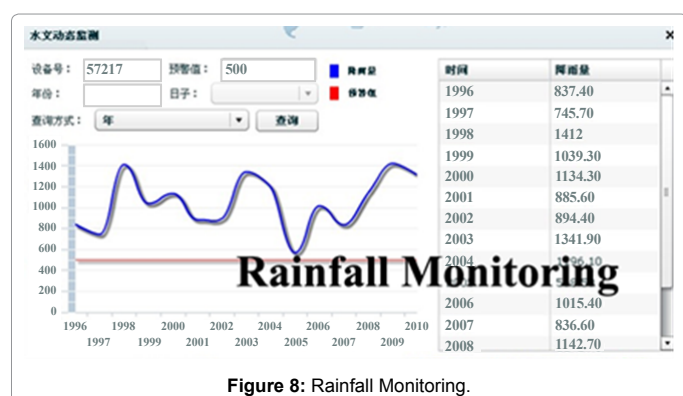


Figure 8: Rainfall Monitoring.

6. Sun CG, SH Chun, Tae-Gyun Ha, Choong-Ki Chung, Dong-Soo Kim (2008) "Development and application of a GIS-based tool for earthquake-induced hazard prediction." Computers and Geotechnics 35: 436-449.
7. Martin PH, EJ LeBoeuf, Daniel EB, Dobbins JP, Abkowitz MD (2004) "Development of a GIS-based Spill Management Information System." J Hazard Mater 112: 239-252.