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The Research on Landslide Disaster Information Publishing System Based on WebGIS

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Abstract

By analyzing the technique features and functions of WebGIS, combined with the landslide disaster characteristics of Lanzhou city, taken MapGIS K9-IMS as map release platform, the landslide disaster information publishing based on WebGIS of Lanzhou city is built. This paper has introduced the overall structure of the system and its functional characteristics, as well as analyzed the key technologies and methods to conduct the system briefly. The system adopts B/S frameworks of three layers, designs and conducts each of the functional modules based on the thoughts of modularization and routing. It includes three modules: rainfall management, warning analysis, warning management, with the warning analysis module as its core. Doing the secondary development based on the MapGIS K9-IMS platform, it can realize these functions: storage and management, query and retrieval, warning and analysis, Web publishing, decision-making of landslide disaster information, etc., which can provide decision support for local disaster prevention and mitigation.

Keywords: landslide disaster, WebGIS, MapGIS K9-IMS, information publishing, Lanzhou city

1. Brief introduction of WebGIS

WebGIS, namely the World Wide Web geographic information system, is the outcome of the combination of Web technology and GIS technology, as well as a distributed GIS based on the Client/server architecture. Its core is the applied system which loads the standards of HTTP and TCP/IP in geological information system to make it is possible for conducting the integration, query, analysis and release of the GIS spatial data in the Internet. In that way, the Internet users, by entering from any node of

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the Internet, can browse the spatial data of WebGIS, make thematic map and conduct all kinds of spatial retrieval and analysis. WebGIS is the expanding and perfection of the traditional workstation GIS, with its features of being distributed and popular, GIS has now actually walked into people's life and working. Meanwhile, it has some incomparable merits with the traditional GIS, such as resource sharing, interoperability, aid decision making, easily use, low cost etc. [1].

By integrating basic geological disasters material and real-time weather, geological disaster body dynamic material organically through WebGIS, processing, analyzing and releasing the data by means of adopting geological disaster warning model to build a sound early warning and predicting system platform, the real-time early warning and predicting of geological disaster can be realized. Users can browse the geological disaster general message of this integration system from any node of WWW, as well as carry out various kinds of information query, browse and process [2]. This can not only provide general information analysis and management support for the governments, but also convenience for the public to know the disaster on time to reduce the loss of the lives and property of the people [3].

2. The current situation of WebGIS

In recent years, with the continuous development of Internet technology and people's increasing needs of geological information system by each passing day, WebGIS has been widely used in the geological disaster early warning and predicting [4-12]. Many researchers have built kinds of geological disaster information systems by using the GIS platform which provides support for standardized management of geological disaster information and geological disaster predicting, as well as valuable experience for the developing of the emergency monitoring and early warning information system. Due to the limitation of technology and conditions, the built current system has some deficiency in these aspects: the accuracy of warning and predicting, disaster region spatialization, public participation, early warning sensitivity etc. Focusing on these problems, Feng Hangjian etc. [13] have put forward a new generation of sudden geological disaster warning information network release framework (NEW) based on WebGIS and researched landslide geological disaster predicting and warning information network publishing system of Zhejiang Province (LAPS_IMS) which have realized the information resource sharing of many departments, improved the public participation and provided powerful technology support for government decision makings.

Landslide is one of the most serious types of geological disaster in Lanzhou city featured by many in quantity, large scale, suddenness, short period and strong destructive power [14] which is a tremendous threaten to people's lives and property security. Therefore, this paper, supported by WebGIS technology, relying on computer network system builds landslide disaster information network publishing system of Lanzhou city which realizes the network sharing of landslide disaster information to lay foundation for the simultaneous development of modernization construction and informatization of disaster prevention and mitigation in Lanzhou city.

3. The design and implementation of landslide disaster information publishing system of Lanzhou city

3.1. The selection of development platform

MapGIS K9-IMS platform offers three types of secondary developments: Tradition, Flex and Building, covering the demands of developers and projects of different levels. Among them, the type of Flex development can build a site in one minute with characteristics of fast speed in secondary development and good visual effect; both of Flex and Building can realize zero programming development and are

simple as well as rapid. This platform abides by OCC standard, support software development of SOA and SIG structure. Based on the SOA platform structure, the connotation of SOA have been fully reflected-business agility, namely the multi-layers distributed deployment, heterogeneous platforms and heterogeneous space data service calls, the standard system which follows the rules, realizing geographical spatial data sharing more flexibly and more conveniently, and achieving the heterogeneous GIS platform interoperability and the integrated application of each business system with low cost and high efficiency. All these have created a wider space for the application of GIS [15]. In addition, MapGIS K9-IMS platform supports multiple operating systems and can realize the cross-platform true 3D digital earth function.

Consequently, the system selects the latest MapGIS K9-IMS platform launched by Wuhan Zondy Cyber-Tech Co. Ltd. This platform adopts 4-layer system architecture which is distributed: MapGIS K9 data server layer, GIS Web server layer, GIS Web service integration end and client-side [16]. Among them, MapGIS K9 data server layer offers secondary development assembly and manages geospatial data and provides data and underlying support for GIS Web service layer; GIS Web server layer is the core layer of the Web service processes which offers the core function service interface, such as WLS, MMDS, WAS, WCTS, WMS, MMS, DCCS, CIS, SMS, etc.; GIS Web service integration end receives the requests from the client-side and processes them through the IIS/Tomcat network servers, Web services sample site as well as calls the corresponding services interface of GIS Web server layer for processing; the client-side uses ordinary Web browser to visit WebGIS site and submits operation request to the GIS Web service integration end.

3.2. The configuration of the system environment

The installation and configuration of the software and hardware of the system has been shown in Table 1 and 2. Environment support: Net Framework V2.0and J2EE; the browser: IE 6.0 and versions above; the Web server: Tomcat 6.0 or IIS5.0 (or later versions); the development tool: Visual Studio. NET2005; the development languages: C#, Java Script, Silverlight, JavaScript，HTML etc..

Table 1The hardware configuration of system installation

assembly	the minimum configuration	the recommended configuration
CPU	1.7G Pentium 4 and 1.7 G	3.0GHz
internal storage	512M	2GB DDR2
hard disk	40G	160G
hardware dog	Mapgis K9 USB dog	

Table 2The software configuration of system installation

assembly	requirements
operating system	Windows XP or other Windows platform
GIS platform	Mapgis K9 SP2 version, IGServer incremental bag
data base system(DBS)	SQL Server 2005 and version above

3.3. The general structure of the system

The system adopts B/S (Browser/Server) mode structure, namely three-layer structure mode: data layer, business logic layer, presentation layer. The data layer is responsible for data storage, retrieval and

management; the business logic layer consists of Web server and application server, mainly provides all kinds of service assembly for visiting data service layer and responds to the client-end requests to establish the relation with data layer and presentation layer; the presentation layer, by realizing interaction with user through browser, can meet the user's need of various access to the whole system, and it is the graphic user interface presentation of the whole WebGIS information publishing system.

3.4. The main modules and functions of the system

The building of the landslide disaster early warning system of Lanzhou city adopts modular design. According to its function, it includes 3 modules: rainfall management, warning analysis and warning management. For further planning, each module includes corresponding sub module, as shown specifically in Figure1. Furthermore, the system offers functions of basic operation and browse of map, such as zoom-in /out of maps, reset, refresh, eagle eye, and other functions, which provides good tool support for map viewing.

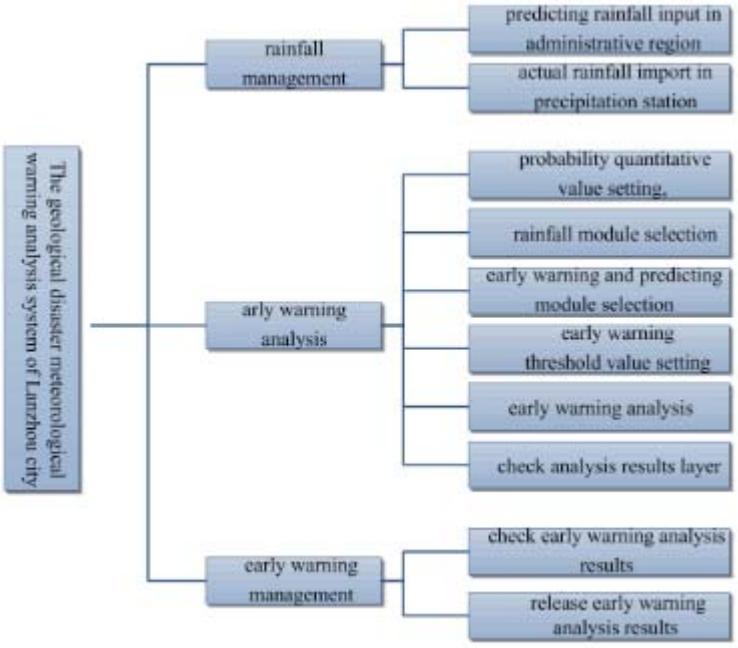

Figure 1 The main modules and functions of the system

(1)The rainfall management

The rainfall management offers functions of inputting predicting rainfall in administrative region and importing actual rainfall in precipitation station as well as manages and maintains rainfall information in order to provide basic data for rainfall module and support for early warning analysis. The user, according to business demands, by selecting the date on which the predicting rainfall to be inputted and the actual rainfall imported, can realize short-term even middle/long-term geological disaster prediction.

(2)The early warning analysis

This module is the key content of the whole system. By adopting streamlined design thinking, it demonstrates the operation process of early warning analysis in streamlines with 6 sub modules, they are probability quantitative value setting, rainfall module selection, early warning and prediction module

selection, early warning threshold value setting, early warning analysis, check analysis results layer successively.

(3)The early warning management

The functions of early warning management module are checking early warning analysis results layer and releasing early warning analysis results. By selecting early warning date and operation date, the input operator checks the results of early warning analysis which have already been done, after which various parameters and releasing warning results of a certain warning analysis can be checked; on the basis of warning analysis checking results, the results of a certain operation can be released as warning, which contains warning words and warning images. The warning words are to be stored on a local disk in the form of text files, while the early warning images in forms of JPG, PNG and BMP format.

3.5. The key technologies and methods

3.5.1 The regional landslide disaster space forecast module

The regional landslide disaster space forecast module, according to the regional law of landslide disaster and the relation between the controlling factors (engineering geological rock group, the hydrogeological conditions, geological structure, topography, etc) and the main influencing factors (rain, human engineering activities, etc), supported by the secondary developing function of MapGIS platform, employs the more mature space forecast method (such as layer analytical method, and fuzzy comprehensive evaluation method, the statistics analysis and information method, artificial neural networks method, etc) to forecast the space range in which landslide disaster happens easily and defines landslide disaster sensitive areas and signifies them with different colors or signs in order to provide explicit space location for real time warning and prediction. At present, the predicted results of space adopts the landslide disaster potential risk assessment results which based on factor weight method, are stored in engineering geological evaluation price nets file in Lanzhou city. In warning analysis, the system reads the data of the file automatically, and combines with rainfall data to conduct the time and space coupling warning forecast of landslide disaster. The engineering geological evaluation price nets file is dynamic, and it can be edited or added with other forecast modules according to the actual need in the future to perfect it.

3.5.2 The time warning and forecast module

The system selects the SQL data base with easier installation and maintenance, and the program operates the data base through ODBC and ADO. During the rainfall, rainfall data is transmitted to the data base by the web page of rainfall information release. On the basis of meteorological real-time data in the data base, the system employs related rainfall modules (such as effective rainfall model, logistic regression model, etc) to probability quantize the dynamic information of real-time rainfall, combined with the space prediction results to realize the coupling of space and time of landslide disaster.

3.5.3 The geological-meteorological coupling module

Landslide is affected by both internal factors (geological structure, landform features, etc) and external factors (rain, human engineering activities, etc), and the instability of the slope caused by rains takes up a big proportion. It can be said that rainfall especially heavy rains often is an important factor that causes landslide disaster. However, most of the former studies about landslide disaster and rains are form the point of view of rainfall. They obtained empirical mode of landslide forecast by analyzing the relationship between rainfall factors (rain degree, rainfall and lasting time) and the landslide. Owing to the lack of consideration of geological factor the slope lies, and the reliability and accuracy of landslide forecast

results can be greatly reduced which may often produces misstatement. In view of the above reasons, this system, adopting the landslide warning forecast model which based on the regional geological meteorological coupling, fully considering all the factors that influences landslide, is an effective method for warning and forecasting the sudden regional geological disaster.

Taking the accuracy of the warning results, etc. into consideration, the system altogether employs 3 types of geological-meteorological coupling module. The user can, in light of actual situations of landslide disaster of Lanzhou city as well as business needs, select appropriate warning module, and couple the probabilities of potential risks of landslide disaster and rainfall module to realize the warning forecast of time and space of landslide disaster in Lanzhou city. This method is not only flexible, convenient but also can be modified and perfected continuously in long term warning forecast practices to improve the accuracy of warning forecast results.

3.5.4 The warning forecast module and WebGIS integration system

Conducting the secondary development based on WebGIS software platform, carrying out development of landslide disaster real time and space warning forecast module and WebGIS integration system, realizing the geological warning forecast system based on WebGIS platform and coupling basis landslide disaster information, space danger division figure, real-time meteorological information and disaster body dynamic information as integration, we can access to, query, browse of landslide disaster information as well as forecast real-time publishing of the information by Internet. It adopts the secondary development modules offered by MAPGIS K9-IMS software platform - API functions, MFC class library and Active control module. These 3 kinds of module are not only independent but also can complement each other, carry out secondary development and integration rapidly, easily and efficiently, along with building the coupling system of landslide disaster warning module and GIS. This system contains regional space prediction module subsystem, regional time prediction module subsystem and monomer geological disaster prediction module subsystems, through the three subsystems, the unities of the geological disaster space prediction and time prediction, the regional prediction and the monomer forecast, real-time short-term prediction and the near disaster warning can be realized.

3.5.5 The Web publishing of landslide disaster real-time predicting information

The Web publishing system of landslide disaster real-time predicting information falls into three layers, the GIS data server layer, the WebGIS server layer and the browser layer. The functions of GIS data server layer are geological disaster information data storage, processing, warning forecast, etc, as well as sending the warning forecast results to the WebGIS server; the WebGIS server layer is responsible for, by taking use of GIS Server, processing, analyzing and calculating user's requests of the browser layer after it received to respond to a series of ASP programs of user's requests, and getting fast generation; the browser layer is different user groups and its task is to visit the related ASP pages of WebGIS server, ask for the data and information of geological disaster and prediction results, and obtain information by receiving ordinary HTML page.

4. The conclusions

The high speed development of Internet technology provides information release platform for realizing the real-time warning forecast of landslide disaster, and the fast-changing WebGIS technology provides powerful functions and convenient effective approach for the research of landslide disaster warning forecast. By analyzing the landslide disaster characteristics of Lanzhou city, conducting secondary development on MAPGIS K9-IMS platform, we have built the warning predict release system which integrates the functions of storing and managing, query and retrieval, warning and analyzing, Web

publishing, decision making of landslide disaster information, thus realizing the opening and sharing of landslide disaster prevention information and providing scientific basis for disaster prevention and mitigation. At present, the investigation work of key technologies of the system has been done, as well as the test run in Lanzhou city which turned to be relatively stable. While the research of this system is still in an elementary stage, and it needs abundant and continuous test in practical applications to expand and perfect its functions constantly to get better warning prediction effect.

References

[1] Meng L K, Shi W Z, Zhang H L. Principle and technology of WEB GIS[M]. Beijing: Science Press, 2005(in Chinese).

[2] YIN Kun-long, ZHANG Guirong, GONG Rixiang, et al.A Real Time Warning System Design of Geo-hazards Supported by Web-GIS in Zhejiang Province, China[J]. Hydrogeology & Engineering Geology, 2003, (3): 19－23.

[3] Zhou Pinggen, Mao Jiguo, Hou Shengshan, et al.The Design and Construction of Landslide Warning System based on WebGIS[J].Earth Science Frontiers,2007,14(6):038-042.

[4] ChenYuda, WangXinqing, LiuYanmei, et al.Research on Sharing and Interoperation of the Geological Hazards Data Sharing Platform[J]. Environmental Scince and Management, 2007,32(6):185-189.

[5] ZHANG Guirong, YIN Kunlong, LIU Liling, et al. A Real-time Regional Geological Hazard Warning System in terms of WEBGIS and Rainfall[J]. Rock and Soil Mechanics, 2005,26（8）：1312-1317.

[6]LIU Yingli, ZHU Li, ZHU Qingjie.Disaster Prevention Information Publishing System based on WebGIS[J].Journal of Natural Disasters, 2008,17(28):122-126.

[7] YANG Jun,GUO Jian,CHU Guang.Disaster Situation Map Issue System of the Wenchuan Earthquake Based on SuperMap IS.NET[J]. Geomatics& Spatial InformationTechnology, 2009,32(2):179-180.

[8] ZHU Liangfeng,WU Xinca,LIU Xiuguo. Management and Predication Information System of Geo-hazards for Railway based on GIS Technique[J].Journal of Mountain Science, 2004,22（2）：230-235.

[9] Deng Yuechuan, Wang Guanyong, Li Peng. Landslide Prediction System Construction of Zhejiang Province along Highway Supported by WebGIS [J]. Journal of Chuzhou University, 2007,9 (3) :87-89.

[10] Wang, H. B. and Sassa, K.Rainfall-induced landslide hazard assessment using artificial neural networks[J].Earth Surface Processes and Landforms,2006(31): 235-247.

[11] ZHU Liangfeng , WUXincai , LIU Xiuguo. Design of Architecture for Railway Geo-hazards Information System[J].Railway Computer Application, 2003,12(11):22-25.

[12] LIU H ao , ZHU Jieyong , ZHONG Y anjiang. Establishment of the Geological Hazard Information System of Kunming based on Web-GIS[J].Yunnan Geology, 2005, 24(4): 450-454.

[13]FENG Hangjian, LI Wei,MA Tuhua, et al. Geological Disaters Darly Warning and Forecast Information-releasing System: a new generation of releasing system based on ANN and GIS[J]. Journal of Natural Disasters, 2009,18(1):187-193.

[14] WU Hong,SHAO Liang,LU Ddengrong,The Geological Calamity and the Rainstorm Intensity in Lanzhou City[J].Arid Meteorology, 2005,23（1）：63-67.

[15] Wang Shun, Ye Changchun. The Design and Construction of Tax Collection System Supported by MapGIS K9 IMS [J]. Software Guide, 2011,10 (8) :84-86.