Applied Mechanics and Materials *Online: 2012-10-26*
ISSN: 1662-7482, Vols. 204-208, pp 3384-3388
doi:10.4028/www.scientific.net/AMM.204-208.3384

Study of Geological Disaster Information System based on Skyline

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Keywords: Skyline; Geological Disaster Information System; 3D Visualization; Data Organization; Spatial Analysis

Abstract. The Wudongde reservoir area 3D visualization geological disaster information system is designed in this paper, based on the superiority of Skyline software and Skyline TerraExplorer API. It consists of two parts: retrieval browsing system and spatial analysis system. Retrieval browsing system has several functions, such as displaying, browsing, information retrieval, data statistics, querying, searching and printing. Spatial analysis system sets the core modules, including spatial calculation, terrain analysis and flood-inundated simulation. It is verified by application that this system can be used for displaying 3D scene of the Wudongde reservoir area terrain, providing decision support for the governor, reaching the design requirements wholly.

Introduction

Wudongde hydropower station is the first cascade hydropower station in the lower reaches of Jinshajiang River. When the normal designed water lever is 975m and the height of the dam is 265m in primary election, its tail lies in Midi village, the east of Panzhihua city. The mainstream back lane of the reservoir is 206.7km, and the tributary is 39km. 52 landslides, 26 collapse accumulation and 21 dangerous rocks were found there based on the geological survey. The total volume of them is 7.37 million m^3, 1.08 million m^3 and 3.24 million m^3.

There are frequently geological disasters occurring in Wudongde reservoir area and the scale of them is large. Along with the advancement of hydroelectric station construction schedule, how to predict, prevent and cure the geological disasters in the reservoir area becomes more and more urgent. On the one hand, the geological disaster engineering needs detailed geological investigation material; on the other hand, the data need effective management. Therefore, establishing information system for the numerous of geological disasters and correctly analyzing the data are quite necessary. It supplies the timely and accurate information for the forecast and treatment.

The geological disaster information was showed and managed by traditional two-dimensional way, for example, drawing AutoCAD plotting elements[1]. However, it cannot satisfy the requirements of spaces 3D analysis. Research of geological environment 3D visualization has made great development with the rapid development of computer technology, aeronautics and space and virtual reality. Using Skyline software to build 3D information database has been applied in actual project from numerous fields[2-4].

This paper has developed geological disaster 3D visualization scene information system with practical engineering application as Staring-point. The system realized functions of geographic information integrative management, displaying, querying, scanning and spatial analysis. And it is providing information service for analysis, prediction and prevention, and improving the information management efficiency and decision-making standards.

General design of the system

Requirement analysis

Complex geological structure and large amount of geological information is the major feature of Wudongde reservoir area. Such features often have great effect on the information management. For this reason, the system has to be built with user oriented, simple operation and friendly interface based on advanced software technology and development mode. Considering the existing geological data, reports and others, the system should be able to organize and manage data effectively in the 3D visualization scene, inquire the attribute information, and provide decision support for the prediction. Particularly, there are three demands in designing the system, include: 3D terrain database, organization and management of data and 3D information system.

System structure

The Wudongde reservoir area 3D visualization geological disaster information system contains three layers structure modes as data layer, operation layer and application layer. Operation layer is the core part of the whole system. It functions as a link between the data layer and the application layer. Furthermore, it reduces the database server's burden and secures the systems stability. The system frame structure is displayed in Fig. 1.

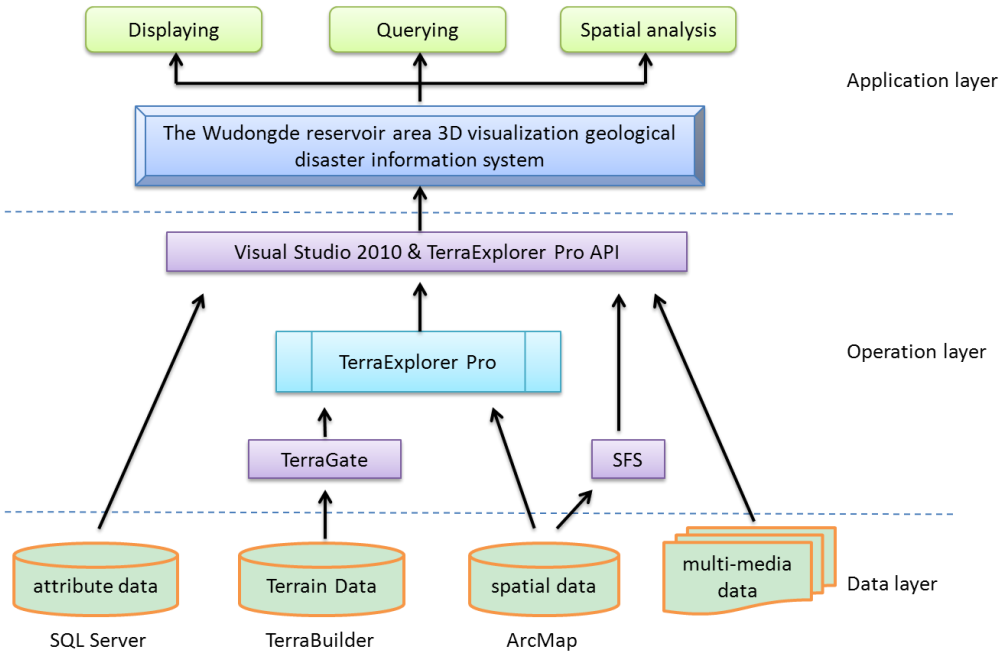

Fig. 1 System frame structure

Data layer is at the bottom of the system frame, includes terrain data, spatial data, attribute data and multimedia data. It mainly deals with all types of the data organization, treatment and management. Operation layer is responsible for the construction of the 3D scene and release. Application layer takes the interactive between the user and the computer, displays and outputs data in 3D scene and realizes the data space analysis function.

Function realization

TerraExplorer Pro API is a powerful interface to integrate TerraExplorer, TerraExplorer Pro and the user defined applications. It also provides the method to access external information like attribute database and basic spatial data. Some can be embedded into the user defined visual interface by TerraExplorer Pro ActiveX, including 3D window, information tree, navigation map and control object [5-6].

The Wudongde reservoir area 3D visualization geological disaster information system is designed for retrieval system and spatial analysis system. Retrieval browsing system is focus on functions of retrieval orientation, browsing, information retrieval, data statistics, and printing the geological disasters. Spatial analysis system sets the core modules of terrain simulation and analysis of the surrounding geological environment. They help decision maker to make the prevention and control measures.

Data organization and management

In the view of 3D spatial data characters, this paper presents a method of data organization of 3D scene data after analyzing the requirement of 3D scene visualization application on data management. The data is divided into four categories: terrain data, spatial data, attribute data and multimedia data [7-10]. How to organize, manage and store these data is the premise and crux of the reliability of every function of the system [11].

Terrain data

TerraBuilder uses of aerial imagery, satellite data and digital elevation models (DEM) to construct an interactive environment. Terrain data is stored in the form of .MPT format. MPT (Multiple resolution data) file is the precise coordinate and basic data of 3D terrain.

Spatial data

For the vector data such as the disasters boundary, backwater line, faults, stratigraphic boundary, geographical name and etc., a file describes the geological environment of the disasters. The two-dimensional vector data can be loaded into the Skyline. In order to manage and analysis data, the same characteristics spatial data stores in the same layer. It is showed in the system operation by the tree structure. Spatial data is divided into four types: Reservoir bank disasters, Geological background, Geographic background and Topical results.

Attribute data

According to the geological disaster data features and the major objective of information system, attribute data includes numbers of datasheet: for example, disaster information table, exploration engineering datasheet, professional monitoring datasheet, experimental datasheet, disaster prevention plan datasheet, etc. Disaster information table is the foundation and link of all other tables. The unity is the key field to connect the other tables. The database makes a whole through this key field. The system puts the attribute data in storage by SQL Server, one large commercial relational database.

Multimedia data

Multimedia data contains maps, video, report, statements and so on, which is related to geological disaster. It is an important problem that store and organize multimedia data. It proceeds from the characteristic of multimedia data to set up database by file type and briefly title.

Retrieval browsing system

Retrieval browsing system has several functions, such as displaying, browsing, information retrieval, data statistics, querying, searching and printing.

3D display module dynamically load reservoir area 3D scene. The users just have to make a click, and the 3D window can display terrain data, space data and navigation. The layer data will be loaded in information tree window. The users may choose the layer independently.

Flythrough module is the most fundamental function of the system. The users can observe the visual and lifelike terrain scene with the multi-perspectives and Omni-directional observation method, and might real-time roam the partial or the overall scene by mouse and keyboard.

Information retrieval module transforms the information, inputted by the user, into the SQL language, and fuzzy query the database. The results will be showed in the form of list in the query area. Click on them, 3D space will work with it and realize the geological disasters environment information visualization display. All of the different type of disasters is supported to inquire.

Data statistics module: some methods to statistic the objects provided by geological disasters attribute database. The objects include space object and geological environment object. Statistics will be showed by all kinds of cartogram to the users intuitively.

Disasters attribute information will be showed on the pop-up window while the users click the label. All the information could be seeing in the different attribute information term.

The system can show and give a printout of the detail material. The detail material will be displayed in the new opened web pages while the users click the linking. The new web pages have the functions: browsing page, deriving and printing.

Spatial analysis system

Spatial analysis system sets the core modules, including spatial calculation, terrain analysis and flood-inundated simulation.

Spatial calculation has several functions, such as distance measurement, area measurement and etc. It supports the measurement in any direction of the disaster or its surrounding.

Terrain analysis module has several tools, like slop analysis, profile analysis, contour line generating, flood-inundated simulation and so on (Fig.2). It will help the designer to roundly grasp the terrain environment of the geological disaster.

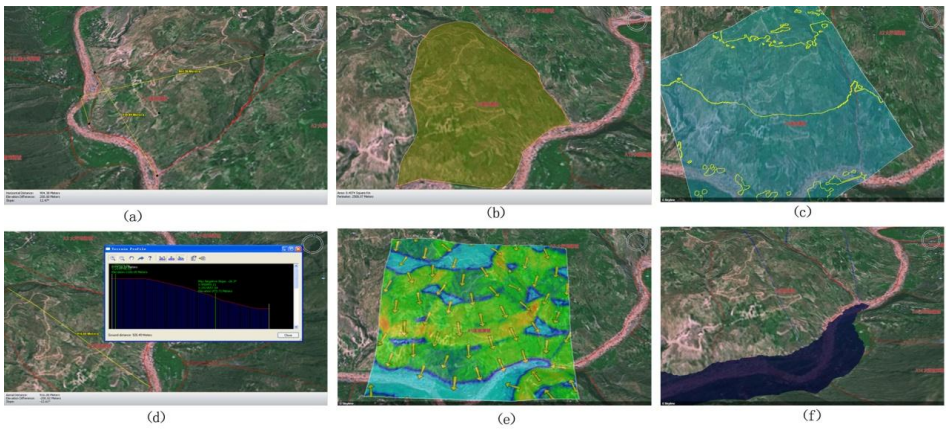

Fig.2 The function of spatial analysis system

Conclusion

The Wudongde reservoir area geological disaster information system builds by combining mass aerial photos, satellite images, geographic terrain information, digital elevation models, vector data, attribute data, and multimedia data. Based on the research of information organization management, 3D display and spatial analysis, the system can assist the decision-maker to appraise and forecast from the intuitive, authentic, accurate terrain data.

The Wudongde reservoir area geological disaster information system overlooks the relationship between the monitoring data and the terrain data. It has important significance to organize the monitoring data, establish the real-time prediction system and simulate disasters process in the 3D information system.

Acknowledgements

This work was financially supported by the Special Funds for the Ministry of Water Resources on Public Welfare Industry Scientific Research and Project (201001008) and Major Scientific Research Project of Three of the Three Gorges Reservoir Area Geological Disasters Prevention (SXKY3-2-1).

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