Redeveloping a Distributed Earthquake Disaster Reduction System Skeleton

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ABSTRACT: First, the development of Earthquake Disaster Reduction System is generally introduced. Then based upon a finished Earthquake Disaster Reduction System, redevelopment of the system skeleton is well discussed, including technical skeleton, function composition, structure of software and hardware, redevelopment languages, databases, and remote linking and calling of analysis modules. Finally this paper presents that extending and utilizing the function of remote sensing information on the basis of the current distributed Earthquake Disaster Reduction System Skeleton would become a new trendency on the field of Earthquake Disaster Reduction System.
KEYWORDS: redeveloping, distributed, earthquake disaste, remote sensing

1. EARTHQUAKE DISASTER REDUCTION SYSTEM

About earthquake disaster reduction system, the U.S.A. and Japan have studied in this field early. In nineteen seventies, National Oceanic and Atmospheric Administration and United States Geological Survey organized a team of specialists, which include engineers and geoscientists, to take big scale disaster losses research. Focused on four big city: San Francisco, Los Angels, Puget Sound and Salt Lake City, then materialized a so called NOAA/USGS method. In the Fourth International Earthquake Zonation Conference in 1991, some GIS related papers were presented, for example American's Borcherdt used GIS to study San Francisco Bay local site effects to earthquake waves, Boyle used GIS founded a specialist system and analyzed earthquake hazard, and so on. At that time, in earthquake disaster prevention field, GIS was not so popular. After several years, until the Fifth International Earthquake Zonation Conference, GIS was generalized in earthquake engineering field. The developed countries have utilized GIS very early. Their traditional GIS Earthquake Disaster Reduction Systems are basically mature, and they are in upgrade stage and needs to be redeveloped.

In China, GIS application researches have been widely taken in the National Nature Science Foundation Program of the Eighth Five-year Project, named City and Engineering Disaster Prevention Basic Research. Many universities took part in this Program. Tangshan, Zhenjiang, Shantou and Anshan were selected as model cities to take disaster prevention study. And this well finished Program facilitated Chinese GIS application. In the Ninth Five-year Project, with 9506 Program, named Big City Earthquake Disaster Prevention Research and Application, earthquake administration founded GIS based information and decision-making support systems of earthquake disaster prevention in Urumuqi, Tianjin, Dalian, Hefei, Zigong, Taizhou, Fuzhou, Xiamen and so on.

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They utilized GIS software to integrate local earthquake environment, earthquake disaster forecast and decision-making support models. Then GIS application research becomes popular. Besides, in Beijing and Shanghai, city geographic information systems are also built subsequently. Compared to developed countries, the application of GIS technique to Earthquake Disaster Reduction in China is utilized recently, the construction of basic geographic information database is incomplete, and the step of industrialization is slow. Although the traditional GIS Earthquake Disaster Reduction System is basically mature, it is in upgrade stage and needs to be redeveloped for they are all treated on single machine.

2. INTRODUCTION OF A OIL FIELD EARTHQUAKE DISASTER REDUCTION SYSTEM

The system was proposed early in 1996. On July 1996, the research expenditure was carried out. By the end of June 1998, construction of information system, establishment of forecast for earthquake influence field and program of analysis module of earthquake disaster forecast for single building had been completed. Leading group fully inspected this item and tested information system and analysis modules of forecast of earthquake disaster, loss and casualty before concluding the project. In August 1998, Earthquake Emergency Response Decision-making Support Subsystem was constructed. On the basis of repeated program testing and debugging, in September 1998, system integration, testing report, investigation and manufacture report, and user manual were completed. In the early October 1998, this project was checked and accepted. It realizes the function of management the basic data of anti-seismic and disaster reduction and analysis and evaluation of earthquake disaster for an integrated corporation or enterprise, using GIS technique. It improves a series of computer analysis programs to forecast for earthquake disaster and evaluation of loss and casualty. This system is a relatively mature earthquake disaster reduction system in the condition of stand-alone computing, and it is developed through VB5.0, Arcview3.0, and PC ArcInfo3.5 based on Windows98 operation system. Redeveloping the Distributed Earthquake Disaster Reduction System Skeleton on the basis of this system has generally applicable significance.

3. REDEVELOPMENT OF THE SYSTEM FRAME, SOFTWARE AND HARDWARE

3.1. GIS Software on Construction Process of System Framework

GIS software applied in construction of system skeleton is ArcIMS9.2 and ARCGIS9.2. This system skeleton can issue, query, update and manage map data by using ArcIMS9.2. The web page is mainly a thin-client-form Html Viewer, thus it can increase the speed of figure and picture display. The web server is Apache and it is well compatible with ArcIMS9.2. IIS of Windows System is not adopted in test for it cannot strongly support the application development of JAVA.

ArcGIS offers a single-user or multi-user execution skeleton and ArcView is the front-end desk geographic information system software, which can contact with user directly. ArcView has extensive drawing and analysis tools, but it can only deal with the files of Shape file format produced by ESRI and some simple space databases. ArcEditor not only has the functions which ArcView can provide but also can modify the Coverage files of ArcInfo format produced by ESRI and space databases.

3.2. Technique Skeleton of Daqing Oil Field Distributed Earthquake Disaster Reduction System

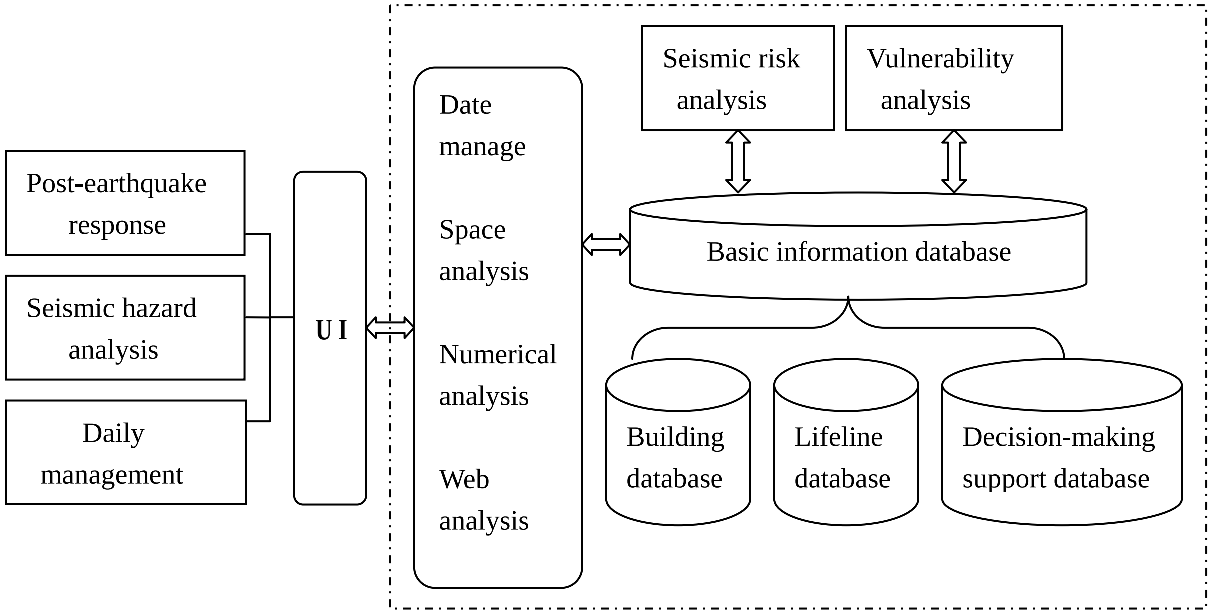

Figure 1 Frame structure of system

The data are simulated and saved in different departments, and they are managed and maintained respectively. Once an earthquake occurs, a lot of information can be got quickly from the net by authorization. Earthquake damages are evaluated, and emergency response countermeasures can be drew from different departments according to seismic hazards. GIS server offers the services of data access, map display, space analysis and model management. Incompatible problems among communication protocol, database query language, application logic, and operation system can be eliminated by the middleware. The safety of the system could be guaranteed by access authorization.

System Skeleton is shown in figure 1, including three parts: Daily management, Seismic hazard analysis and Post-earthquake emergency response. Daily management field involves daily query, management and maintenance, etc, including region seismic environment, engineering site, building, lifeline and disaster rescue basic information. Post-earthquake emergency response field includes three parts: Part one: Setting earthquake parameters such as date, time, place, magnitude and rupture direction, and building intensity influence field. Part two: Estimating earthquake damage, loss and casualty of Daqing Oil field by use of the earthquake damage analysis program, according to given intensity influence field, basic data and vulnerability data of Earthquake Disaster Reduction System. The damage assessment includes earthquake damages and losses of the buildings, special structures on oil field, roads system, gas transfers system, water supply system, electric power system, communication system and phone station. The earthquake damages of every part above can be presented as report form. Part three: Starting up earthquake disaster rescue pre-scheme of Daqing oil field on Post-earthquake emergency conditions.

3.3. Redevelopment of the System Skeleton

3.3.1 Framework of software and hardware

The development platform of this system frame, shown in Figure 2, can be run under WinXp System. To compile different-style user interfaces, utilize existing analysis module and date structure, realize remote calling, and develop real-time update, many kinds of program languages are adopted, such as java, javascript, XML, HTML, etc. Apache is introduced for the Web Server, and the Web Platform is constructed by combining java development tools: jasdk and Tomcat. In the stage of technology construction, management and coordination has been completed using applied server without developing javaBean. Now there are many sorts of applied servers facing java, such as Jrun, Weblogic, WebSphere, iPlanet, etc. In the subsequent stage of the development of system frame, if needed, applied servers may be added. ArcIMS9.2 is adopted for Map Server and Oracle10i for date-base. Linking tool between Map Server and date-base is ArcSDE9.2.

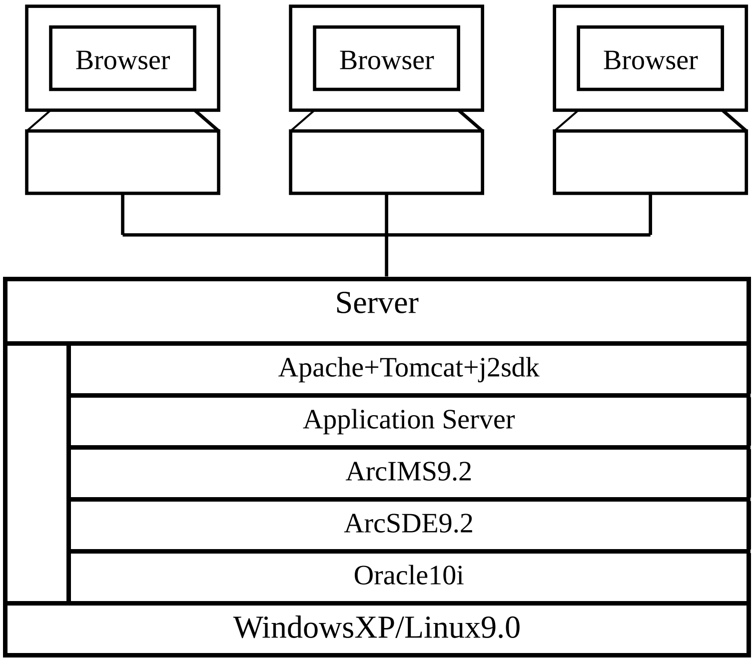

Figure 2 Development platform figure of the system skeleton

In the preliminary stage of system construction, the selection of hardware of system frame depends mainly on the lowest requirement for software. Among several software of development platform, the others can be run on a common high-order computer except Oracle9i, which requires higher system hardware. So it is enough for the allocation of hardware to satisfy the requirement of Oracle10i. The Database software adopted on this system is enterprise-version Oracle10i. Vector dates are adopted mostly and grid dates are adopted secondarily on this system, thus strongly reducing HD room occupied by space distinction dates. Currently, vector form is used for date structure of most GIS systems, and it is also used for date communicating. There are 68 special subject graph layers in the system frame. Every special subject graph layer only corresponds to one set of special content, holding one special distinction. For example, storeroom, station (point distinction) and pipe net (line distinction) should be held individually. Oil transport pipe net and water supply pipe net should be held individually, etc. There are plenty of data files, and analysis modules as DBF, TXT format on this system, with which input of analysis modules, and output of data stream, analysis graph layers, analysis files can be achieved, providing further query and analysis of the results about seismic hazard assessment and Decision-making Support to users. The system is designed as thin client computer form, thus for common users the requirement is not too rigorous and knowing some simple manipulation about Computer is enough. Even filling in and setting some Seismic parameters seems so easy when users are trained and explained simply, although they don’t have much knowledge about Earthquake and Computer originally. However, it is necessary for maintainers to master pertinent application technology about Earthquake Disaster Reduction and Computer, especially experience and skill on GIS and Database.

3.3.2 Redevelopment languages of the System framework and remote calling

Development of the distributed Earthquake Disaster Reduction System depends on improvement of computer technology, involving all aspects of computer application technology, such as GIS, JSP, SERVLET, EJB, HTML, RMI, ORB, Database, WEB SERVICE, Graph manipulation, etc. And many computer languages are used, such as JAVA, C++, VB, JavaScript, XML, SQL, FORTRAN, AML, etc.

On the construction process of system frame, some computer languages are used to redevelopment. Actually, no current distributed software can meet characteristics of Earthquake Disaster Reduction and be directly applied. Using some supported computer languages, Integration is completed based on some software all supporting distributed characteristics, according to distributed computer technology principles and requirements of the Daqing Oil Field Earthquake Disaster Reduction System. Then, the distributed Earthquake Disaster Reduction System Skeleton is primarily generated.HTML and JavaScript Language are adopted for many pages on the development process of system frame, realizing some functions: User interface and uploading parameter. Server port and middleware, such as long-distance query and search program modules, are generated, compiling Java, C++ languages; long-distance commands can be called by using AML, XML, and SML languages.

In addition, long-distance transmission and storage of database can be completed by software AreSDE. AreSDE (Spatial Database Engine), one member of ArcGIS family of ESRI Company, is a channel between GIS and relational database. ArcSDE provides the primary functions on multi-user system and distributed GIS system. The spatial data of DBMS can be directly settled with ArcSDE, and GIS software (ArcInfo, ArcView, ArcIMS, etc). On the construction process of system frame, the required basic geographic information and graphic file is put into Oracle database with the format of list through ArcSDE, using ArcCatalog9.2. First, the required list spaces and serves need to be created in Oracle database. Then on the state of DOS, lots of lists and link service are built in advance in Oracle database by inner commands of ArcSDE. Those lists are auto-generated for storage of geographic information and graph data transferred from complex mathematical calculation. The file formats, which can be input by ArcCatalog9.2 mainly include Raster files, CAD files, Table files, Coverage files and shape files. So the basal information stored by graph layer format can be transferred to shape file format. Make sure the shape property of Theme characteristic in the graph layer has be chosen when shape files are generated. Then input these files into database by ArcCatalog and ArcSDE. Of course, this work can be completed by using inner commands of ArcSDE on the state of DOS. However, it is very inconvenient. Here are no more details about the types and distributed structure of basic information shape files of the system due to limited page space.

4. CONCLUSION

Recently, the development of space technology deeply widens the eyeshot of mankind. By means of aerial remote sensing, satellite remote sensing, and aerial measure, etc, the quantity, quality, and efficiency on information accessing have developed strongly, providing a new approach on Seismic hazard assessment. Remote sensing image can be obtained rapidly and reflect objective world comprehensively and visually, offering a new information source. For wide covering scope, convenient image accessing, better quality and accuracy, low accessing expenditure relative to aerial remote sensing image and shorter period of repeatedly accessing image in the same area, satellite remote sensing technology shows its favorable application prospect on seismic hazard assessment. Obviously, combing GIS with remote sensing technology can not only offer seismic hazard information enough rapidly, but also offer real-time revising experiential estimate using obtained remote sensing information, thus enhancing the function and applicability of the current system. Extending and utilizing the function of remote sensing information on the basis of the current distributed Earthquake Disaster Reduction System Skeleton will become another developmental direction of the study on Earthquake Disaster Reduction System.

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