Application of Cloud Computing in Geological Hazard Early Warning System

Pengcheng Liu*
Henan industry and information technology professional college, Jiaozuo, Henan, 454000

*Corresponding author e-mail: lpcxx@163.com

Abstract. China's geomorphology is complex and changeable. Geological hazards occur frequently. Landslides, mudslides and other geological hazards seriously threaten the lives and property of the people. Monitoring and early warning of geological hazards to reduce the impact of disasters is an urgent problem at this stage. In order to ensure the safety of people's lives and property, the design and development of real-time monitoring and early warning systems are the most effective means of preventing and controlling disasters. This article is based on the Microsoft cloud computing platform. The geological data collected by the automatic monitoring station is transmitted to the cloud server through GPRS DTU and stored in SQL Server 2008. Generate Web Service through VS2010 platform, use ASP.NET technology to build dynamic website to display early warning details, complete Web Service call through Android smartphone platform, conduct real-time geological disaster warning information query, and provide users with cloud platform-based geological disaster warning system. After analyzing the causes of geological hazards, a model of geological hazard influencing factors, a model for calculating the probability of hazards in geological structures, and a process for processing geographic information data were designed. Using the data of the extracted GIS spatial database to predict geological disasters.

Keywords: Cloud Computing, Geological Hazards, Web Service, Disaster Early Warning System

1. Introduction
With the rapid development of science and technology, the great power of human ingenuity is increasingly being shown[1]. However, in the face of various unavoidable natural disasters, human beings often appear weak and weak[2-3]. Geological disasters often destroy buildings, block traffic, cause casualties, cause serious harm to ecological environment and engineering construction, and
cause huge losses[4]. According to incomplete statistics, so far, China has experienced at least a thousand hazards and severe landslides and collapses that have killed at least 10,000 people[5]. China's annual losses due to geological disasters such as landslides and collapses are as high as US $ 3-5 billion. Because natural disasters are unavoidable, it is natural that people should pay great attention to the methods of reducing disaster losses. Among various disaster reduction methods, it is the most sensible choice to make predictions and take effective precautions in advance. How to accurately and effectively achieve the purpose of prediction is the key to solving the problem[6].

Cloud computing is the development of parallel processing, distributed processing, and grid computing, and it is also an emerging method of sharing infrastructure[7]. The essence of cloud computing is based on computer networks, using virtualization technology and Service-oriented architecture, integrating a large number of server cluster processing capabilities distributed on the network, providing users with a variety of application data services that are safe, reliable, and convenient[8-9]. Users can use any terminal device that can connect to the network at any time, any place To access these services[10]. Cloud computing has turned the Internet into a large resource library for professional service applications[11-12]. REST is a lightweight Web Services architectural style that consists of a set of constraints applied to elements in the web architecture components, such as HTTP protocol, client-server model, are constraints. REST adds client-server, statelessness, cache, unified interface, layered system, and on-demand code in order from the bottom to the top. Utilizing the network, the water generated by displacement sensors, rain gauges, and video monitoring information at various automatic monitoring stations will be distributed[13]. Geological data such as soil, soil, etc. are released to the cloud computing platform for centralized calculation and processing through a virtual machine to generate relevant early warning information, and generate a Web Service, which is published to user computers and mobile phones, which can effectively and immediately provide early warning of geological disasters and guide reconstruction after the disaster. Relieve people's loss of life and property[14].

This paper proposes design ideas for applying cloud computing algorithms to GIS. After analyzing the causes of geological hazards, a model of geological hazard influencing factors, a model for calculating the probability of hazards in geological structures, and a process for processing geographic information data were designed. Using the data of the extracted GIS spatial database to predict geological disasters. By predicting the level and scope of geological disasters that may occur in the future, disaster reduction and prevention measures and countermeasures can be taken as early as possible to minimize the losses caused by such disasters, which has very important practical significance and huge economic and social benefits.

2. Method

2.1. Introduction to cloud computing
Cloud computing is a model based on networks and computers, which can supply software and hardware resources to computers and a large number of network facilities according to specific needs. The entire operating steps of cloud computing are like the power grid. In the narrow sense, cloud computing is a company that relies on the Internet to obtain corresponding resources based on its own needs, using paid infrastructure: Broad cloud computing is a service delivery and use model that is
based on the Internet and is easy to expand based on actual needs. Ways to get the services you need, and the scope of this service is very large, including services related to software and the Internet, as well as any other aspect of services. Therefore, it has the characteristics of large scale, virtualization functions and reliable and safe effects.

Cloud computing technology can provide enterprises and individuals with powerful computing and storage capabilities. The idea comes from the transmission mode of electric energy: power plants can deliver services (electric energy) to thousands of households after centralized power generation, and users do not have to worry about how to generate electricity and where to generate electricity, just enjoy services. Cloud computing is that the service providers provide the computing power in a centralized way. Users only need to upload the original data to get the results returned by the service providers, without having to build their own computing clusters, or go deep into the "which cloud" their data is calculated in. This is also the development trend of cloud computing: connect huge computing power to thousands of households like hydropower, and save the maintenance cost of computing cluster for users.

2.2. Service characteristics of cloud computing

Cloud computing is that enterprises enter a resource pool on the Internet provided by cloud service providers to obtain the services they need. Cloud computing system is connected to a large number of distributed computers and forms a large data center in a distributed way. The way from non local or remote servers to users makes full use of the high-speed transmission capacity of the Internet to calculate and store resources. The main task of this cloud computing system, which is composed of numerous computer clusters, is to manage distributed computers, that is, the process of cloud computing transferring the data originally stored in the local to the cloud computing system database. Cloud computing system services mainly rely on the three-tier model, and the relationship between the three is closely interdependent, progressive layer by layer:

1) Software as a service (SAAS) is an exclusive service mode provided by cloud service providers for suppliers. It does not need to be installed by customers or new machines. It is to obtain services on demand on the Internet according to the protocol. Customers choose a cloud service provider's product according to their own enterprise's situation. Now this kind of service mode should be widely used, and it is believed that it will be widely used in the future.

2) Platform RPN service (PAAS) is a public platform for customers on the Internet. Customers can get the services they need through the platform without purchasing. As the core of cloud computing services, its technology is very complex, including distributed computing facilities, cloud storage facilities and so on. This platform can better protect the security of customers.

3) Infrastructure as a service (IAAS) refers to the use of professional technology to integrate data resources into a specific resource pool, and then through the means of virtualization to achieve data transmission on the Internet and complete a lot of work, reallocate resources, so that infrastructure can achieve unified management and bind hardware and virtual facilities.

3. Experiment

Step 1: First, collect data with existing monitoring stations of geology, hydrology and meteorology, install DTU (data transfer unit) to convert serial port data into IP data or IP data into serial port data,
and then transmit them to Microsoft cloud computing platform (some data are also available) through GPRS (General Packet Radio Service) It can be transmitted through GSM, ultrashort wave, Beidou satellite and other communication modes. The cloud computing platform receives the transmitted data through wireless terminal equipment and gprsdut receiving software. Some monitoring stations with long communication distance and bad environment can use RTU (remote terminal units) for data monitoring and transmission.

Step 2: After receiving the data, the platform transmits it to the cloud server. The system conducts data management and data analysis on the collected information, and carries out geological disaster early warning analysis combined with the previous standardized data, generates a geological disaster early warning model, visualizes the early warning results, and receives the data from the cloud data processing server when the analysis exceeds the pre gprsdut receiving software When the warning critical point of the structural diagram of the geological disaster warning system based on cloud computing is generated by the EB website (generate web service), the warning prompt information will be sent automatically.

Step 3: In the end, the traditional early-warning methods generally carry out internal early-warning (for the relevant person in charge and disaster handling personnel) and external early-warning (for the whole public) by means of broadcasting, telephone, SMS, etc. For the public, simply knowing the brief information (for example, do not go to places prone to disasters, etc.), it is enough to use TV, radio, SMS and other means. But these information are not enough for the internal early warning personnel (it is necessary to know the dynamic information of the disaster in real time so as to carry out disaster prevention and post disaster reconstruction in real time). In this paper, through the cloud computing platform, the early warning data model is generated into a web service in the network layer and displayed on the website. The internal early-warning personnel can immediately master the latest information of geological disasters by logging in the network and calling the web service with smart phones, and carry out disaster pre-processing and post disaster rescue work in real time.

4. Discuss

4.1. Analysis of experimental results

The occurrence of geological disasters is a very complex process, including the interaction of various factors. When determining the factors that affect the occurrence of geological disasters, we must comprehensively consider various induced causes. In this paper, the prediction and early warning of geological disasters are divided into five levels, and the specific division is shown in Table 1.

| Warning level | Meaning                        | Color | Likelihood of occurrence |
|---------------|--------------------------------|-------|--------------------------|
| First level   | Warning level, especially serious | Red   | >80%                     |
| Secondary     | Forecast level, serious harm    | Orange| 60-80%                   |
| Third grade   | Warning level, serious harm     | Yellow| 40-60%                   |
| Fourth grade  | Forecast level, average harm    | Blue  | 20-40%                   |
| Fifth grade   | Regular, non-hazardous         | Green | <20%                     |

Through the use of cloud computing in the geological disaster early warning system, China's annual loss due to geological disasters is decreasing year by year, as shown in Figure 1.
It can be seen from the figure that the application of cloud computing in geological disaster early warning can effectively reduce the economic losses.

4.2. Cloud application development based on web service

In order to maintain the overall compatibility and efficiency of Microsoft's Hyper-V platform, the cloud server adopts Windows Server 2008 R2, the cloud data terminal adopts Microsoft's SQL Server 2008, and the system software development adopts Microsoft VS2010 based on C++. For the data received by the receiving software through gprsdut, the system directly transforms and stores it in SQL Server 2008. At the same time, in order to facilitate the call of website and smartphone, the data information is directly generated into XML based web service by using the support of web service built in VS2010 platform. The dynamic website uses asp.net technology to build and use, and uses ado.net to call the data in SQL Server 2008 or web service directly to complete the construction of geological disaster early warning platform website. Analysis of data management of geological disaster early warning analysis subsystem visual expression of early warning results of geological disaster early warning model management.

Due to the popularity of smart phones and the maturity of GIS technology, the project team uses the Android platform architecture to call the web service generated by the server, and through data comparison of the web service return value, displays the corresponding blue (primary, caution), yellow (disaster occurrence, caution), orange (disaster is more serious), red (disaster is very serious) warning information. Through the secondary development of Google map API, the map layer is customized, and the disaster warning information is displayed on the map, which is convenient for users to query and ridicule, and the detailed disaster prevention and rescue web page information can be displayed through the dynamic link.

Service interface is a programmable interface for users, including metadata query, system management, spatial data processing, business processing and other service interfaces. The purpose of designing service interface is to enable users to retrieve the functions provided by the geological disaster early warning and prediction meteorological platform or to operate the data stored on the
cloud platform. The externally called interface is also the content of the services and resources in the cloud service directory provided by the platform. Users realize specific cloud computing resource management and services through them. Service aggregation operation can be broadly divided into two modes: static aggregation and dynamic aggregation. In the static aggregation mode, which component services realize the function of aggregation service is statically determined. On the basis of static aggregation, dynamic selection of component services can be realized by certain means. During the aggregation process, dynamic discovery, matching and calling of third-party services can achieve To the purpose of service function sharing. The registration and management of services provide a platform for aggregation and separation of GIS services. Service registration is actually the embodiment of service aggregation configuration capability. In this paper, the network element service (WFS), which is the potential calculation service provided by the geological disaster meteorological early warning and prediction system, is used to illustrate the implementation scheme.

5. Conclusion
There are many types of geological disasters. This paper mainly discusses the monitoring and early warning of debris flow in geological disasters. Firstly, this paper introduces the research background of the monitoring and early warning system of geological disasters and the development status at home and abroad in recent years, and puts forward the significance and purpose of the research. Then the overall scheme of the geological disaster monitoring and early warning system is described. The system is installed in the area prone to geological disasters, which can monitor and forecast the debris flow disaster in a long-term way. The monitoring and early warning system is mainly divided into two parts: monitoring station and monitoring center. The monitoring station collects and transmits data, which is mainly composed of front-end sensor and remote monitoring terminal.

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