Design of Mobile Monitoring System for Natural Resources Audit Considering Risk Control

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Abstract. In order to better ensure the health of natural resources and environment and avoid the risk of environmental pollution, this paper puts forward the design method of natural resources audit mobile monitoring system considering risk control, optimizes the hardware structure of natural resources audit mobile monitoring system, further optimizes the system software function and operation process, optimizes the natural resources risk identification and control method, and constructs the management index of natural resources audit mobile monitoring. Finally, the experiment proves that the mobile monitoring system of natural resources audit considering risk control has high practicability in the process of practical application and fully meets the research requirements.

Keywords: Risk control · Natural resources · Mobile monitoring

1 Introduction

China has a huge land area and complex natural environment. Under this background, many natural resources are not well and effectively protected, which is very easy to cause resource pollution, damage the ecological balance, and even threaten the monitoring of the masses, resulting in natural resource risk problems. Based on this, it is necessary to monitor the state of natural resources in real time, but the previous human monitoring consumes a lot and is difficult to obtain the state information of natural resources in real time and effectively, It is necessary to combine risk control and modern monitoring equipment for resource monitoring. As a new computing mode, natural resource risk control is the focus of the new generation of information technology, which is of self-evident importance and will bring significant changes to the whole industry and even the whole society [1]. Therefore, a design method of natural resources audit mobile monitoring system considering risk control is proposed. Determine the unified monitoring indicators of the three databases. The system can be divided into five functional modules: monitoring data collection module, monitoring data transmission module, monitoring data management module, early warning module and system management module. The system adopts a distributed architecture and is divided into monitoring server and monitoring agent. In the application process of domestic industry, a massive data cloud storage technology is developed to solve the problems of high-speed and massive digital content storage and subsequent operation at a low cost.

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2 Natural Resources Audit Mobile Monitoring System

2.1 Configuration of System Hardware Equipment Structure

The monitoring system requirements of natural resource risk control platform can be described from two aspects: physical machine monitoring requirements and virtual machine monitoring requirements. The physical machine monitoring is similar to the traditional cluster monitoring, while the virtual machine monitoring needs some new features. From the perspective of monitoring, the physical machine infrastructure of the risk control platform is not much different from the traditional cluster system. The infrastructure is all physical machines, and the number will not change too frequently compared with virtual machines [2]. Just mark the area to which the physical machine belongs. The natural resource risk data storage management system can be simplified as shown in Fig. 1. The figure shows all monitored physical machines, and their number, configuration and IP settings are basically unchanged.

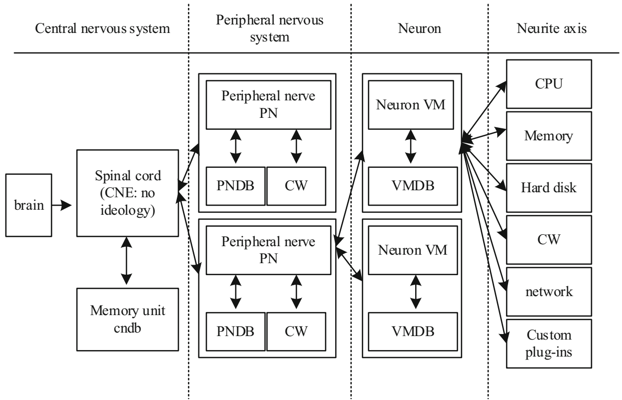

Fig. 1. Natural resource risk data storage management system

The monitoring data storage module receives the monitoring data and stores it structurally. On the one hand, the monitoring system provides users with monitoring view, on the other hand, it provides monitoring data API for other application modules. The system shall also provide early warning function to notify the user when there is an error in the system [3]. At the same time, the monitoring module shall have strong stability and will not collapse after long-time operation. It can run on common versions of Linux and windows systems. Monitoring items can be added and deleted flexibly. If you want to add another special monitoring item, you can also change the system configuration. The monitoring agent on all nodes reads the system performance data every 5min on average, and the impact on the system performance and network bandwidth cannot exceed 5%. This monitoring index can enable the user to understand the current running state of the CPU, including the percentage of time the CPU is in user mode, the percentage of time in system mode, the percentage of idle time, the percentage of soft interrupt and hard terminal time, and the number of interrupts received by the CPU in no second. The data requirements of the operating system are shown in Table 1:

Table 1. Data requirements of operating system

Domestic system software	Monitoring indicators
Domestic operating system	Basic system information
	CPU Information
	I/O information
	Virtual memory information
	Network traffic information
	Process information

In order to enable users to clearly understand the reading and writing status of the system disk, this part of the monitoring indicators include the number of merges per second, the reading and writing times of IO devices, the reading and writing times of sectors, the average IO data size of each device, queue length, waiting time, service time and other information. The database includes Dameng, Shentong and Jincang databases, although they are three different databases, However, in order to enable users to compare and analyze the three databases on the basis of understanding the status of all aspects of the database, this topic will determine a unified monitoring index for the three databases. The monitoring indicators of domestic database are shown in Table 2:

Table 2. Database data requirements

Domestic system software	Monitoring indicators
Domestic database	Basic information of database
	Other resource information
	Monitoring interface information

The scalability of the system is essential in the design process of the system. In the way of obtaining data, the method of analyzing data, and even in the design of the interface mode of the system to provide external data, it needs to be considered emphatically [3]. The business layer mainly includes various functional modules in the system, which is the core part of the whole architecture. This layer is mainly responsible for processing various requests accepted by the presentation layer and returning the request processing results to the presentation layer [4]. In addition, this layer is also responsible for the management of monitoring tasks and monitoring data in the monitoring system. The specific system monitoring task control and management framework is shown in Fig. 2:

Monitoring task control module, which is the main monitoring program of the system. In the monitoring system, because different monitoring objects have different methods to obtain data, different monitoring objects have different data acquisition procedures. The monitoring task control module is responsible for the initialization of the task when the monitoring system is started and calling the corresponding data acquisition program

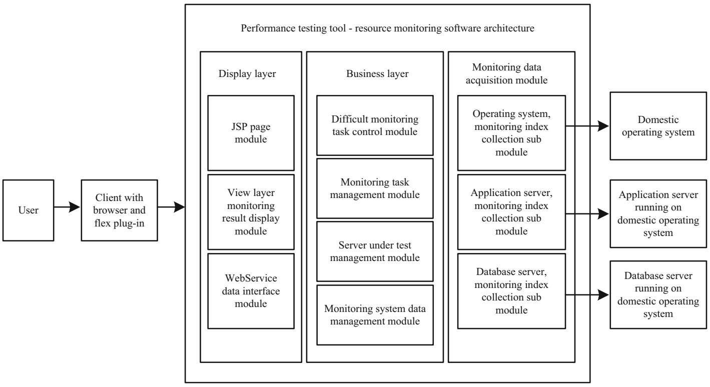

Fig. 2. System monitoring task control management framework

when the monitoring task starts [5]. When the user adds a new monitoring task to the resource monitoring system, the main process of the resource monitoring system will allocate multiple threads according to the newly added task monitoring indicators. If the monitoring task added by the user includes two monitoring indicators of CPU and IO, the system process will allocate one thread for CPU and IO respectively. The corresponding thread will be responsible for timing the monitoring tasks of the corresponding monitoring indicators and calling the monitoring data acquisition module of the monitoring indicators. When the monitoring task reaches the start time, the threads with different monitoring indicators will call the data collection method of the corresponding monitoring indicators. When the monitoring task ends, the corresponding threads will close the collection of monitoring information and close their own threads [6]. In terms of data acquisition method, the design process should not only consider the accuracy of the selected data acquisition method in data acquisition, but also consider the applicability of the acquisition method when facing different data sources. For example, in different versions of linuix environment, whether the same data acquisition command will obtain the same monitoring data is also required to be scalable in the method of analyzing data. When the data source of the monitoring system changes, That is, when the collected data format is likely to change, whether the old data analysis method will adapt to the new data format, or whether the old sentence analysis method is easy to expand on the basis of the new data format, it is also necessary to consider the scalability of the external data interface when designing the external data interface of the system [7]. When the data source or data format changes, and when the system adds monitoring items, whether the data interface service provided by the system can adapt to the changes of the provided data format is also extremely important.

2.2 System Software Function Optimization

The system can be divided into five functional modules: monitoring data acquisition module, monitoring data transmission module, monitoring data management module, early warning module and system management module, as shown in Fig. 3:

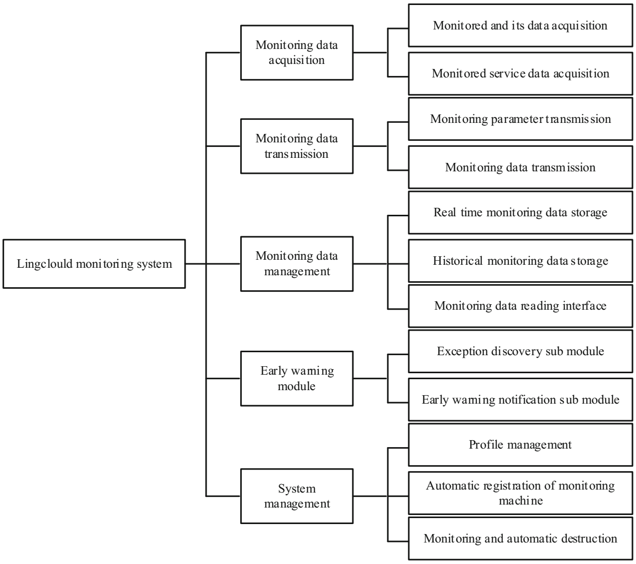

Fig. 3. Optimization of system software function structure

As can be seen from Fig. 3, the monitoring data collection module includes monitoring and its data collection and monitoring service data collection; The monitoring data transmission module includes monitoring parameter transmission and monitoring data transmission; The monitoring data management module includes real-time monitoring data storage, historical monitoring data storage and monitoring data reading interface; The early warning module includes an abnormality finding sub module and an early warning notification sub module; The system management module includes file management, automatic registration and monitoring of monitoring machine and automatic destruction. The research on risk management of regional natural resource shortage should include risk overview of natural resource system, risk factor identification of natural resource shortage, risk analysis and quantification of natural resource shortage, economic loss assessment of natural resource shortage, risk evaluation of natural resource shortage, research on risk management measures of natural resource shortage and risk decision-making of natural resource shortage, We can also study the control standard of regional natural resource shortage risk [8]. The research on natural resource shortage risk management involves resources, environment, society, economy and other systems. It is a complex large-scale system decision-making and management problem. The relevant contents involved in the research include natural resources macroeconomic model, natural resources water demand prediction model and natural resources system simulation model. The specific contents of natural resources risk management research include natural resources risk analysis model, natural resources economic loss model, natural resources risk decision-making model and natural resources risk management model [9]. The relationship between the components of the natural resources system risk management research and the models involved is shown in Fig. 4:

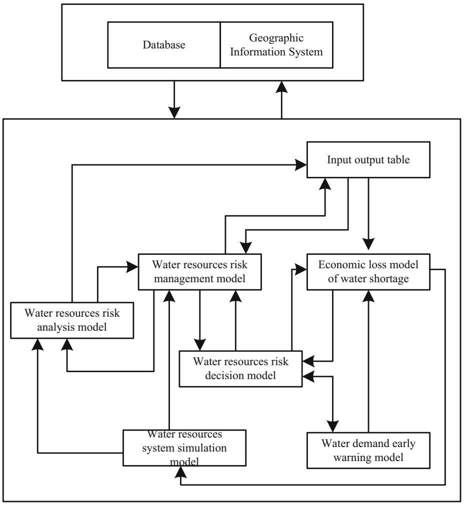

Fig. 4. Risk management content of resource system

After the risks are identified, estimated and evaluated, and several feasible risk treatment schemes are put forward, the decision-makers need to analyze and make decisions on the possible risk consequences of various treatment schemes, that is, decide which risk treatment policies and schemes to adopt. According to their progressive relationship, the research on risk decision-making can be divided into single objective risk decision-making (in_t) and multi-objective risk decision-making ($\text{fist} \mid \text{in}_i$), Considering the utility of decision-makers, the concept of utility can also be introduced to make decisions on natural resource hedging schemes.Risk estimation and evaluation is often the core content of risk analysis. Risk estimation, also known as resource risk measurement, refers to the quantitative estimation of the probability p of risk occurrence and its loss degree D by analyzing a large number of accident data collected on the basis of risk identification and using the methods of probability theory and mathematical statistics. The general risk estimation methods include subjective estimation, objective estimation Extrapolation methods include forward extrapolation and Monte Carlo digital simulation methods. The overall risk estimation of the system is carried out through the analysis of comprehensive risk events and the resulting loss analysis. Generally speaking, the probability description of system risk loss should be established. The general form of risk calculation of the system is:

$$p(\text{ loss }_k) = \sum_i D \sum_m p(\text{ in }_t) \times p(\text{ fist} \mid \text{in }_i) \tag{1}$$

The dynamic resource discovery mechanism thread of risk control realizes the response mechanism of the self-organizing function of the monitoring system on the server side, and its flow is shown in the Fig. 5.

During initialization, create a listening socket and enter the listening state. If there is a request information, parse the request information, and query whether there are records of the corresponding resource domain in the database according to the parsed

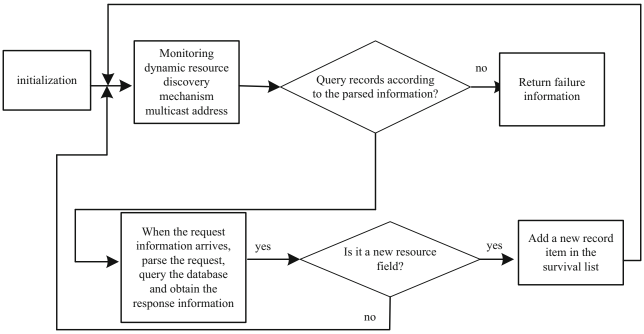

Fig. 5. Server side process of dynamic resource discovery mechanism

information. The database is the database maintained by the management program of the cloud platform. The information when the resource is online is stored in the database, including MAC address, host relationship, resource domain, etc., but the information in the database is static, That is, it will not change dynamically after writing [10]. If the corresponding record cannot be found, the query failure information is returned. If the corresponding record can be found, you should also judge whether the resource sending the request is the first resource in the new resource domain. If so, you should also add a new resource domain record item to the resource domain survival list structure. After judgment, the queried information includes the resource type, host relationship, name of the resource domain The contact information of the spokesperson in the resource domain is returned to the resource sending the request [11, 12]. Cloud platform overview is used to display a series of resource information of the platform; The status monitoring real-time curve displays the performance information of resources, and can display the resource performance of each resource domain; The centralized control provides an instruction issuing interface, which is responsible for transmitting the instructions entered by the user to the background processing program. The decision-making process of independent review and analysis of natural resources risk is shown in the Fig. 6:

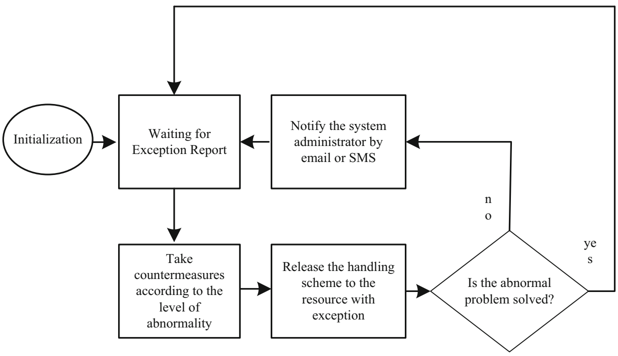

Fig. 6. Decision making process of independent audit and analysis of natural resources risk

The principle of status monitoring real-time curve display is to generate PNG pictures according to the stored data and display the PNG pictures on the web interface. In order to display the changes of the curve in real time, PNG pictures need to be generated at a certain frequency and displayed on the web interface. When the monitoring page is opened, the page will request data from CN at a certain frequency, and a PNG picture will be generated and displayed on the web interface for each request. When the request frequency is small enough, a real-time effect can be achieved.

Implementation of Mobile Monitoring of Natural Resources Audit

Like the general concept of risk, there are many definitions of natural resource system risk. In random hydrology, it is defined as the probability of a crash; In the economic analysis and evaluation of natural resources engineering, risk refers to the possibility or probability that a decision-making index is less than or greater than a specified value 1 in the whole application time of the project when considering the randomness of characteristic indexes. The risk in resource operation is defined as "the possibility or probability of accident during operation and operation of the reservoir and the degree of deviation from the normal state or expected goal". To sum up, natural resource system risk generally refers to the unexpected events and their probability and the resulting loss degree in the natural resource system under specific space-time environmental conditions. Specifically, the research on the risk of natural resource system includes the research on the reliability of the operation of natural resource system itself (the opposite of risk relative to risk), and its research object is the causes of risk events and the probability of risk events; And the potential adverse impact or harm of natural resource system crash on human property, health, psychology and ecological environment, that is, the probability distribution of loss caused by the crash in currency. Natural resource risk is actually a system involving "man nature society". If the accident has no impact on human and society, it can not be called a risk event. As a natural resource, there are several modes for the occurrence of risk events: one is because the uncertainty of risk factors acts on the natural resource engineering system. The natural resource engineering regulates this uncertainty to a certain extent. If it exceeds the engineering regulation ability, it may form a risk event. After the risk event is formed, it acts on the human social and economic system and causes losses, Then the final risk forms a kind of risk event that the risk factors directly affect the human social and economic system. The formation mode

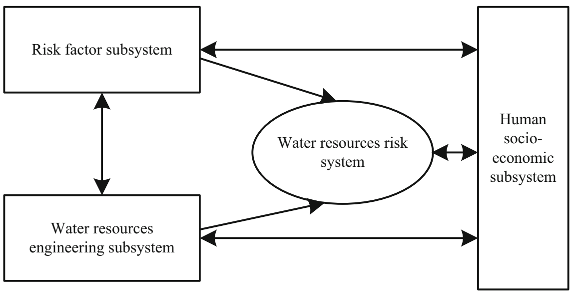

Fig. 7. Schematic diagram of natural resource risk system

of any kind of risk event is inseparable from the risk factor system and human social and economic system (Fig. 7).

There are various risks in the natural resource system. The methods of risk analysis and evaluation are different, but their basic modes are the same. They can be summarized into defining system problems, risk identification, risk analysis (risk estimation and evaluation), risk treatment and risk decision-making, as shown in Fig. 8.

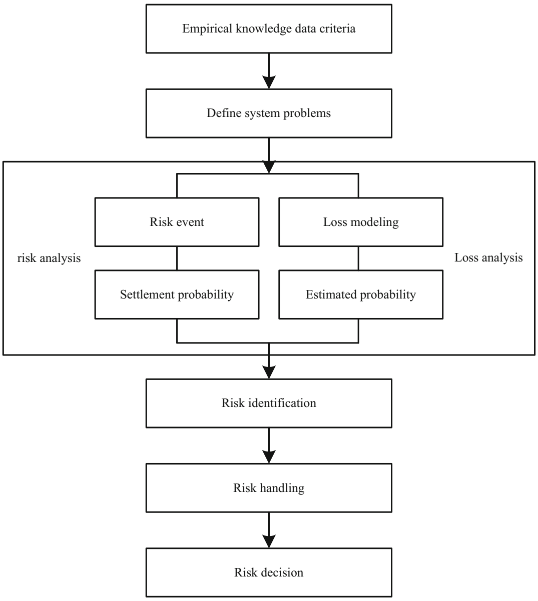

Fig. 8. General process of natural resources system risk assessment

The system is a distributed architecture, which is divided into monitoring server and monitoring agent. The monitoring agent is used to collect local information and communicate with the monitoring server. The monitoring server is used to receive the data sent by the monitoring agent, store and manage the data, implement the early warning strategy, and provide the monitoring data access interface. The monitoring agent is deployed on each monitored physical machine and virtual machine. One is designated as the monitoring server in each monitored domain, and the monitoring server program is deployed on it. Deploy monitoring agents on all service nodes, storage nodes and other devices in the computing device layer and common computing resource layer of the monitored system. Specifically, collect virtual machine monitoring information, host monitoring information, virtual network monitoring information, virtual storage monitoring information, public service monitoring information, etc. on the device. Collect the information from the monitoring agent on the server side, and finally present it to the administrator. Processing layer, data collection layer and monitoring application layer. The figure shows the system hierarchy of the risk control platform (Fig. 9).

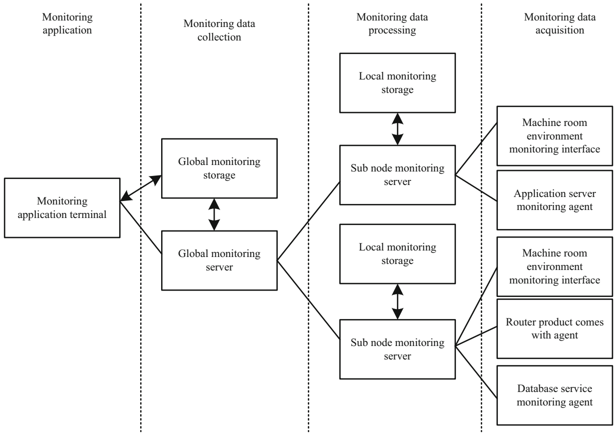

Fig. 9. Hierarchical structure of natural resources audit and monitoring system

The monitoring agent is deployed on all nodes of the data collection layer system, including physical machines, virtual machines and various application servers of the system. The monitoring agent is used to collect the monitoring information of the machine locally. In the monitoring data processing layer, due to the network firewall and other reasons, it may not be directly accessible between hosts. Therefore, this layer is added to the monitoring module. The machine monitoring data of the same cluster is collected on the cluster head node first, and then transmitted to the general monitoring server. The data acquisition method is shown in Fig. 10.

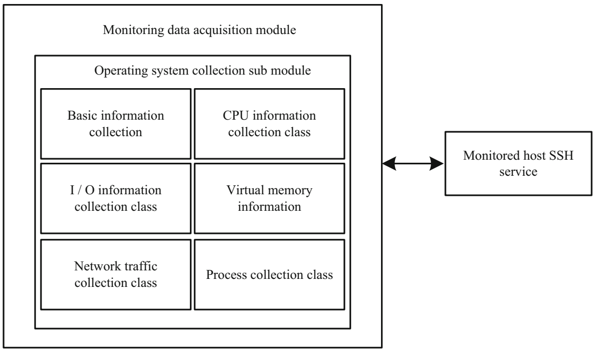

Fig. 10. Resource audit risk data collection method

The monitoring application layer includes monitoring display interface and monitoring data API. The monitoring display interface provides three monitoring interfaces: area view, physical machine view and virtual machine view. Display real-time monitoring information and historical monitoring information to users. Use the corresponding Java classes defined in the operating system acquisition sub module in the monitoring system, remotely connect to the monitored host through the risk control protocol, send the data acquisition command to the monitored host at the same time, control the data acquisition of the monitored target host, and then transmit the collected data to the data processing class of the data acquisition layer (Fig. 11).

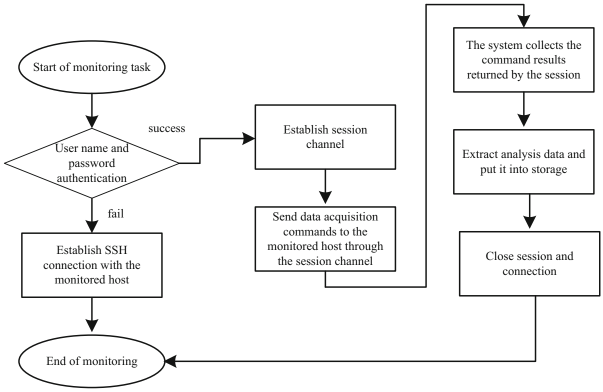

Fig. 11. Review and identification process of natural resource risk data party

In this data acquisition mode, when the system monitoring task starts, the main monitoring program calls the corresponding monitoring data acquisition class according to the monitoring index selected by the user. The monitoring class of each monitoring item first establishes a remote connection with the monitored host through the login user name and password of the risk control protocol. The establishment of the connection adopts the verification method of the risk control standard. If the verification fails, the connection class will throw an exception to the monitoring task and end the monitoring task; If the verification is successful, the monitoring system will establish a session channel with the monitored host through the risk control protocol, and send the data acquisition command to the monitored host through the channel. After the monitored host executes the data acquisition command, it will also return to the monitoring system in time through the session channel. After receiving the original data, the acquisition program at the system end will extract and analyze it, and store the extracted monitoring data into the system database. When the monitoring end time expires, the system will control to close the connection between the session channel and the monitoring host, so that the monitoring ends.

3 Analysis of Experimental Results

3.1 Experimental Environment

The software environment used in the test includes the software environment for deploying the resource monitoring system and the software environment of the monitored host. The software environment of the monitored host is a domestic operating system equipped with domestic database and domestic application server. Here, due to the confidentiality

Table 3. Server side software environment

Software category	Software name	Edition
Operating system	Windows 10	SP10
Database	Server2008	V5.6
Browser	360, QQ	V9
Tested sample	Performance testing tool - resource monitoring software	V1

problems of the project, the monitored environment will not be introduced in detail. The software environment for deploying the resource monitoring system is shown in Table 3:

This experiment analyzes and verifies the self-organization function, self repair function, the monitoring efficiency of cloud resource monitoring system and the accuracy of monitoring data. Two Dell high-density servers are used in the experiment, and each computing node is configured as follows: the CPU is 16core; Memory is 128 GB; Disk is 3TB and bandwidth is 1000 mb/s. Run KVM virtual machine, configuration: CPU is 2core; Memory is 4GB; Disk is 50 GB; Bandwidth is 1000 mb/s. The server adopts Debian 6 0.5, the virtual machine adopts windows ver2008 operating system. The distribution and configuration of computing nodes are shown in Table 4.

Table 4. Distribution and configuration of computing nodes

Node	Number of VMS	Is it a control node CNE	Server
Q1	15	Yes	A
Q2	35	No	B
Q3	35	Yes	A
Q4	35	No	B

Each node acts as a separate domain, in which all virtual machines belong to form an independent peripheral nervous system pn. The experiment is as follows: firstly, N1 is configured and started as the control node. After all the virtual machines are started and the network data transmission volume of the system is stable: start N2, N3 and N4 nodes at the same time, and designate the No. 1 virtual machine of each node as the management node MPN of the peripheral nerve. After the virtual machines of the three nodes are established and the network data transmission curve tends to be stable, the experiment ends.

3.2 Experimental Results and Analysis

The main purpose of system function test is to check the integrity and availability of system functions. This section tests the functions of the system through system test cases to test whether the system meets the needs of users. This section describes the functional test results of the system through two modules: monitoring server management function and user-defined monitoring task. The management function test results of monitoring server are shown in Table 5.

Table 5. Server management module test table

Functional module	Server management function			
Use case description	Users can manage and monitor the server on the server page			
Function description	Prerequisite	Testing procedure	Expected results	Pass or not
Display host information	There is a monitored host in the system	Enter the server interface	You can view the monitored host information	Yes
Add monitored host	This host does not exist in the monitoring system	Enter the server management interface, enter the added host information, and click the Add button	Pop up the prompt of adding successfully	Yes
	A host with the same information has been added	Enter the server management interface, enter the same information as the added host, and click the Add button	Pop up the prompt box of adding failure and prompt that the server already exists	Yes
	This host does not exist in the monitoring system	Enter the server management interface, enter the added host information, and click the Add button	Pop up the prompt box of adding failure, and prompt the wrong format of the input information	Yes

The non functional test of the system mainly tests the data accuracy of the resource monitoring system. Through the functional test of the system, it is known that each functional module in the system operates normally, but the normal operation of the system function does not mean that the monitoring data of the system is accurate. This section will test the accuracy of monitoring data. The data acquisition objects in the monitoring system include system basic information, CPU information, IO information, virtual memory information, network traffic information and process information of domestic operating system; The application server information of manufacturer a and manufacturer B of domestic application servers are compared with the monitoring data collected by the above data object monitoring data collection program with the monitoring results collected by some authoritative third-party monitoring tools. The following are the monitoring data obtained by the CPU monitoring data acquisition program and the monitoring data results obtained by other monitoring tools. Table 66 shows the eight groups of monitoring data obtained by the CPU acquisition program of the resource monitoring system every five seconds, and table shows the CPU monitoring data collected by other third-party monitoring tools at the same time. See Table 6 and Table 7 for details:

Table 6. CPU sampling data of resource monitoring system

Time	User	Nice	Sys	Iowait	Irq	Soft	Steal	Idle
10:15:13	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:20	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:25	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:28	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:33	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:38	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:45	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2
10:15:49	0.65	0.01	1.45	0.00	0.00	0.00	0.00	98.2

Table 7. CPU sampling data of other monitoring tools

Time	User	Nice	Sys	Iowait	Irq	Soft	Steal	Idle
10:15:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0
10:15:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0
10:15:25	0.00	0.00	1.00	0.00	0.00	0.00	0.00	99.0
10:15:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0
10:15:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0
10:15:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.0
10:15:45	0.00	0.00	5.00	0.00	0.00	0.00	0.00	95.0
10:15:49	0.00	0.00	1.00	0.00	0.00	0.00	0.00	99.0

It is found that the data obtained by the third-party monitoring tool is different from the data obtained by the third-party monitoring system. Through data comparison, it is found that in addition to CPU monitoring information, IO virtual memory and network traffic information have such phenomena. The monitoring data collected by other modules of the system has no such problems and is consistent with the monitoring results of other monitoring tools. Through the non functional test of the system, it is determined that the system has problems in the accuracy of monitoring data of CPU, IO virtual memory and network traffic, which is deviated from the monitoring results obtained by other monitoring tools. Through the functional test of the monitoring system, the results show that each functional module of the system runs normally, the system is relatively stable, and meets the needs of users. The selection of test cases in functional testing is more in line with the requirements of test case writing, so the test process and test results are more objective and can reflect the real state of the system. In the process of data quasi determination test in the non functional test of the system, the deviation problem in the monitoring data of individual monitoring items is found. This chapter deeply analyzes the problem through the data acquisition method of the system, and gives specific solutions. Overall, after the system test, the stability and availability of the system are determined to meet the needs of users, and the data acquisition method is further improved in the test process.

4 Conclusion

Resource monitoring system is a distributed system based on wide area environment, which can monitor and audit all risk data in the environment. Its goal is to provide a unified, centralized and visual management tool for local and remote administrators, and provide reference for the decision-making of administrators or other grid users by evaluating the performance of the system. Starting with the system design, this paper expounds the functional requirements of the system and the design ideas of system architecture, information model and communication, and finally gives the reference implementation of a system prototype.

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