Computer Intelligent Cloud Server Platform of Coal Preparation Plant Based on Big Data Cloud Technology

Qing Zhang, Hao Chen, JiaYin Wang*, YuGe Zhu, ChangZhong Zhou

China Coal Technology & Engineering Group Nanjing Design & Research Institute, Nanjing, 210000, China

*Corresponding author: jiayinwang@ccteg.cn

Abstract. This article combines the actual situation of the coal preparation plant and uses big data cloud technology to carry out detailed system requirements analysis and monitoring platform design. The entire design includes server framework design, database design, cloud service deployment and mobile client prototype design. According to the on-site working conditions of electromechanical equipment, the article uses ER model and 3NF method to abstract it and establishes a MySQL real-time database of equipment operating status. Finally, the ECS cloud server is used to complete the deployment, and the JSP technology is used to realize the display of the system's man-machine interface, as well as remote monitoring services for equipment monitoring, information management, and user management. Practical application shows that the system can improve the comprehensive automation and information level of the enterprise, reduce the operating cost of the enterprise, and improve the production efficiency of the enterprise.

Keywords: Big data, cloud technology, coal preparation plant, cloud server.

1. Introduction

Coal mining enterprises’ emphasis on informatization construction and equipment safety production construction has increased with the support of national policies. As an important part of coal mining enterprises, coal preparation plants have transformed their informatization construction from the earliest auxiliary production and operation to promote the development of the coal industry and improve enterprise production. Efficiency, security, and efficient development are widely used. More and more coal preparation plants regard the operation and life of equipment as the focus of future enterprise development [1]. As part of the coal preparation process, the electromechanical equipment of the coal preparation plant is inseparable from the development of the Internet and mobile technology for the development of informatization and intelligence. The Internet has developed into an important means for society to obtain information and the basis for social informatization. The development of a wide range of mobile services provides application platforms and technical support.

The application in coal preparation plants is showing unprecedented opportunities and characteristics. At present, it is not difficult to find that the Android system is popular among developers for its excellent open-source system, according to a survey conducted by American institutions. It also attracts many users because of its simple and fast operation characteristics, occupying most of the mobile phone...
market [2]. As one of the next intelligent manifestations of the coal industry, mobile application software has successfully attracted the attention of coal preparation plant leaders through the powerful mobility and business management capabilities of Android smart terminals. The client ensures that the staff can understand the overall status at the same time, issue strategies in a timely manner to solve problems quickly, and improve the information level of the enterprise.

2. Research on design mode of 3D cloud server in coal preparation plant

Desktop cloud virtualization uses virtualization technology to create independent virtual office desktops for users. The user desktop environment is transferred from the user's local to the background server, and the user accesses the cloud-specific desktop environment through the network, and obtains the same user experience as the traditional desktop environment. The coal preparation plant design unit can realize design software sharing, design resource sharing, centralized data management and maintenance through the desktop cloud platform, thereby effectively protecting the intellectual property rights of engineering design [3]. At the same time, the design unit can also use the cloud platform to realize the collaborative work and mobile office of the professionals in the coal preparation plant.

2.1. Basic platform

The basic platform of the desktop cloud platform includes hardware infrastructure and virtualization. The hardware infrastructure is the basic resource for the realization of the cloud platform, which mainly includes servers, storage, networks, and other hardware devices. Virtualization is the integration of hardware infrastructure through virtualization technology to provide external resource pooling management and operating environment and other basic services. The basic platform of the desktop cloud platform designed by the coal preparation plant is shown in Figure 1.

![Figure 1. The basic platform of the desktop cloud platform.](image)

2.2. Supporting platform

The main role of the support platform of the desktop cloud platform is to provide a unified platform-based system software support service on the basic platform, including the operating system operating environment required by the business system, the virtual desktop service required by the user, the development environment, the design environment, and certification System and so on. The system operation test shows that when all 2D users are working online, the server memory usage is high, the CPU usage is low, Word documents and Excel tables run smoothly, and AutoCAD software runs
normally. When 3D users are also working online at the same time, the CPU occupancy rate increases significantly [4]. When using MicroStation software for image rendering, the CPU is close to full capacity, but the peak GPU usage rate is only about 70%, and the average is about 40%.

2.3. Platform function module design

The comprehensive energy-saving management information system of the coal preparation plant is a platform provided by a third-party service provider and composed of virtual host, storage, network, security, and other hardware resources. There is no need to purchase servers, network equipment and storage equipment, just lease through the network and independently just develop and build an application system. The platform adopts a modular development method [5]. The main modules include the equipment management module of the application management layer, the equipment operation and maintenance module, the data display module, and the equipment abnormal alarm module. Application development module and data storage module of data storage and application development layer. The data transmission module and data acquisition module of the data acquisition transmission layer. The control execution module and the device perception module of the bottom device perception layer. The functional structure of the comprehensive energy-saving management information system of the coal preparation plant based on cloud platform technology is shown in Figure 2.

![Figure 2. The functional structure of the comprehensive energy-saving management information system for coal preparation plants based on cloud platform technology.](image)

2.3.1. Equipment management subsystem. The equipment management subsystem is responsible for the production equipment of the coal preparation plant Management. This subsystem contains the following 4 functional modules.

1. Equipment registration. This module is responsible for registering the coal preparation equipment involved in the coal preparation plant to facilitate the subsequent digital management of these equipment. The registration information should include the manufacturer, production date, service life, maintenance cycle and equipment of the equipment and related parts. The type, model, rated power, rated voltage, and rated current of the product.

2. Equipment maintenance. This module is responsible for the maintenance management of equipment and related parts. According to the equipment information entered in the equipment registration, the module automatically arranges maintenance tasks and sends it to the relevant
maintenance personnel and related persons in charge according to the set date in advance to remind a certain equipment or component. When the accessories need to be overhauled to prevent equipment failures and safety production accidents caused by human negligence.

(3) Equipment status. This module is responsible for the current operating status of the equipment. Each production equipment feeds back the current operating status parameters of the equipment and the surrounding environmental parameters through the field control bus system and the enterprise’s industrial Ethernet network [6]. The relevant person in charge can check the abnormal parameters in advance. Classification, and set the corresponding reminder level, for example, the reminder level can be divided into reminder, warning, and danger.

2.3.2. Dispatch management subsystem. On the one hand, the dispatching management subsystem is responsible for dispatching production resources and related personnel from the coal preparation plant to realize overall voltage, production; on the other hand, it realizes remote control of equipment through the industrial Ethernet network and fieldbus system in the enterprise. And can display the production status of each production equipment in real time. The subsystem contains the following four functional modules: equipment scheduling, personnel scheduling, display management, and instruction management.

2.3.3. Process management subsystem. The process management subsystem is mainly responsible for the management of the coal preparation process. For some mature coal preparation processes, this subsystem provides the function of the process template, so that the relevant operators can quickly organize the coal preparation process. The subsystem contains the following three functional modules: process registration, process selection, and process progress.

2.3.4. Warehouse management subsystem. The storage management subsystem is responsible for the management of the receiving coal bunker and the finished coal bunker. The subsystem includes the following three functional modules: coal bunker registration, coal bunker statistics, and coal bunker weighing.

2.3.5. Cloud computing centre subsystem. The cloud computing centre subsystem is mainly responsible for processing storage requests and business logic requests sent by the various subsystems or modules of the platform, and through the analysis and mining of the data stored in the entire platform, the process technology and production equipment involved in the coal preparation plant Analyse with warehousing and give the analysis results in the form of reports to provide intellectual support for the production plan of the enterprise. The subsystem is divided into a cloud management host and a computing storage node at the physical level. The cloud management host is responsible for receiving requests and distributing the requests to the corresponding computing storage nodes for execution. Computing storage nodes are divided into computing nodes and storage nodes. The computing node is responsible for executing business logic processing and sending the number of tasks currently being executed to the cloud management host in real time. The storage node is responsible for storing various types of information as a data warehouse and sending it to the cloud in real time. The management host reports the current storage status of the node.

3. Database design
The design of the database is very important in the realization of the remote state monitoring system of the electromechanical data of the coal preparation equipment. In the database design process of the coal preparation plant automation system, it is first necessary to complete the collection and analysis of the system data, and then process the data. In the same way, the ER model and the 3NF method are used to abstract it, and the physical structure is designed. Finally, perform performance evaluation and testing. If it does not meet the design requirements, it needs to be redesigned. The specific design process is shown in Figure 3.
Among them, senior administrators are used for system administrator authority distribution and information management. At the same time, the system administrator can realize the management of inspector information and equipment information. The inspector information database is linked to the equipment information database and is used to record the equipment information uploaded by the inspector. There is an information exchange function between the equipment information database and the detection information. According to the inspection requirements, the inspection system includes the inspection unit, inspection cycle, electrical information, and mechanical information of the equipment and so on. The main information of the equipment status monitoring table 1.

**Table 1. Device status monitoring information table.**

| Serial number | Field name     | Types of name      | name                      |
|---------------|----------------|--------------------|---------------------------|
| X001          | Use ID         | Character type     | user account              |
| X002          | Device ID      | Character type     | device ID                 |
| X003          | Device Tempure | Character type     | Equipment temperature     |
| X004          | Device Vib     | Character type     | Equipment vibration       |
| X005          | Device Current | Character type     | Device current            |
| X006          | Device Voltage | Character type     | Equipment voltage         |
| X007          | Device Power   | Character type     | equipment power           |
| X008          | Code           | Character type     | Name of inspector         |
| X009          | Date           | Date type          | Inspection date           |

**4. System Test**

The electromechanical equipment detection information platform can be divided into four modules, and each module has different sub-modules, and each module is tested for its function. Perform functional testing of the prototype client system according to the required functions. When you enter the main interface of the client, there are four controls on the bottom tab bar, which are the system homepage, device detection page, inspection information page, and detection diagnosis page. The homepage is matched according to the server-side data to complete the monitoring of the equipment operation status and the detection of the operation status of the detection area site. As shown in Figure 4.
The device status detection page is tested. The page contains six subsystems, which correspond to the server terminal modules. The detection information sub-module is the core sub-module of the electromechanical equipment parameters, including the mechanical state parameters and electrical state parameters of the equipment. At the top is the search bar, which can be retrieved according to the device name.

5. Conclusion
Aiming at the needs of coal enterprise informatization and intelligent construction, this paper uses spring framework and MVC architecture to design a remote state monitoring system for electromechanical data of coal preparation equipment. Based on the analysis of enterprise user requirements, the system uses ER model and 3NF method to abstract electromechanical equipment data, and establishes a MySQL real-time database of equipment operating status. At the same time, the ECS cloud server was used to complete the deployment and tested on the client side, and the system was running well. The content of this research is of great significance for realizing the remote state monitoring of the electromechanical data of the coal preparation equipment in the coal preparation plant.

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