Design and Application of Cloud Monitoring Network Dispatching Command System

Jingyong Liu\textsuperscript{1,2}, Jun Li\textsuperscript{2} and Xiaobin Wang\textsuperscript{2}

\textsuperscript{1}School of Information Engineering, Wuhan University of Technology, No. 122 Luoshi Road, Wuhan, Hubei Province, China
\textsuperscript{2}Henan Energy Chemical Group Xinjiang Company, No. 53 Port Road, Urumqi, Xinjiang, China
Email: 290385792@qq.com; 250304840@qq.com

Abstract. Based on cloud service technology, this paper designs an embedded networking dedicated server and a networked dispatching command system. The server overcomes the shortcomings of the traditional data transmission server: complicated installation and maintenance, poor long-term work stability, lack of wireless backup routes, etc., and realizes reliable collection, compression, storage and uploading of basic data of various monitoring systems of the mine. At the same time, according to the mine management needs, the system extracts various safety and production data and performs unified processing to realize multi-level dispatching, monitoring, supervision and display.

1. Introduction
At present, mines (coal mines and non-coal mines) have been equipped with dozens of modern monitoring systems to achieve full process monitoring of safe production. However, with the increasing number of monitoring systems, various systems are self-contained and independent of each other, so that the equipment in various monitoring systems cannot be fully utilized, the data cannot be fully shared, and the comprehensive benefits of the automation system cannot be fully utilized, which is not conducive to command. Mining enterprises are constantly improving their requirements for safe production, refined management and scientific decision-making. They also put forward new requirements for the comprehensive utilization of monitoring systems: using big data and artificial intelligence technology to dig deep into the massive data of various existing monitoring systems. Processing, analysis and utilization provide guarantee for mine safety, provide decision-making basis for mine production and operation, and provide scientific means for mine management.

In order to adapt to this new demand, we must first build a mine cloud monitoring platform. The construction of mine cloud monitoring platform is mainly reflected in the requirements of reliable collection, secure transmission, unified and efficient storage, fast processing, big data analysis and intelligent decision-making of platform data. There are network security problems such as big data environment, and massive data collection and transmission. Security issues, data consistency, reliability and data security issues in the two-level data storage mode. These problems have become one of the bottlenecks restricting the global unified platform, unified data, unified scheduling, building cloud data centers, and building a modern enterprise information management system under big data and Internet+ mode.

Integration of big data, make production and decision-making more scientific, and make transition to less humanization and unmanned exploitation of coal and other resources. It is necessary to build a cloud-based monitoring and networking command system.
2. Mine Cloud Monitoring Network Server Design

The cloud monitoring networked server is powered by a 220V power supply in the equipment room. The operating system is Linux, wired and wireless transmission interface (3G/4G/5G, WIFI). It realizes long power-off power supply, wired and wireless backup and transmission seamlessly, safe and anti-virus, with alarm function.

2.1. Server function design

The data of each monitoring system of the mine is first transmitted to the cloud monitoring networking server, and the server is verified and then uploaded to the cloud data center according to the data transmission standard. If the following conditions occur during the running of the server, an alarm will be generated: data transmission interruption of each monitoring system, data format error, data center network or hardware problem is unsuccessful. If the network or hardware device in the linked cloud data center fails, the data is temporarily saved in the server, and then uploaded to the cloud data center after the network or hardware device is intact. The design can prevent the network system from intersecting with the mine monitoring system too much, affecting the stability, simplifying the data collection process of the networked system, and only need to take the number from the server, instead of taking the number from multiple monitoring systems separately.

2.2. Server hardware design

The cloud monitoring networked server hardware principle is shown in Figure 1.

The core board iMX283 is based on Freescale's ARM9 core-based i.MX283 multimedia application processor. The processor is 454MHz, supports DDR2 and NAND Flash, and provides 3 UART, 1 FC, 1 SPI, 4 12bit ADC, 1 10/100M Ethernet interface, 1 SDIO, 1 FS interface, 1 USB OTG interface, 1 USB Host interface, TFT LCD screen and resistive touch screen for data acquisition or higher User-interactive consumer electronics and industrial control applications.

The core board has integrated CPU, power, memory, reset, encryption and other circuits, users only need to connect the required peripherals to the corresponding port, the operation is very simple. The system interface is shown in Figure 2.
2.3. Server Deployment and Software Configuration

The server is small in size, convenient to install, and stable in function. It can fully meet the safety networking of monitoring systems such as rapid safety monitoring, personnel positioning, and integrated automation, and realize data networking and verification transmission from the mine to the superior management department. Each mine deploys one server to upload and download all the monitoring and monitoring data in ftp, opc, etc. The device can set parameters such as transmission period arbitrarily. The hardware system based on Linux embedded system can provide various data storage, analysis and forwarding services, integrate communication system switching, firewall, server and routing to ensure high reliability and high security of the system. The deployment of the cloud monitoring server in the monitoring system networking is shown in Figure 3.

![Figure 3. Deployment topology of the server in the monitoring system networking](image-url)
The server management software configuration functions are as follows:

1. System application software is developed using html/js language to improve operational stability.
2. The software can read and upload the file (.txt.mdb, etc.) of the internal hard disk to any position of the external machine;
3. The software can detect the networking status of the DTS and the data source machine and the target machine. When the target machine is disconnected from the network, the data during the network disconnection period is automatically backed up, and after the network is restored, it is continuously transmitted to the specified directory of the target machine, thereby ensuring Data integrity; proactive alert when the data source loses connection.
4. The software verifies the uploaded file in real time according to standard protocols and rules, and the verification fails to prompt the alarm;
5. The software should have network configuration, continuity test, verification rule configuration, acquisition and upload cycle selection, routing and exchange configuration, transparent transmission mode configuration, alarm information setting, display information setting, user permission setting and other functions.
6. The software adopts WEB-based management and operation monitoring, network device restart, configuration import and export functions, and the like. Similar to the router or switch configuration mode, the device's configuration port LAN1 factory ip address is the default (such as 192.168.1.253), which is convenient for users to connect with the IE after the laptop terminal is connected. The management port LAN1 can also be logged in and modified to be the mine office network ip. Segment, convenient for users to manage device configuration through IE in the office (partial mines allow the network to be on the public network, need to be equipped with DNS, in principle, in order to prevent virus intrusion, DTS is not allowed on the public network), LAN2, LAN3 is configured as industrial network IP segment (Not allowed on the public network), LAN4 is configured as an inter-regional telecommunications network IP segment (dedicated line network).
7. The software periodically generates monitoring and running logs and saves them on the device hard disk (the save time can be configured), including important log information such as upload status, network status, device operation, and device operation.

3. Design of Networked Dispatching Command System

3.1. Networked System Solution
On the basis of the existing security monitoring network system, the mining group directly transmits the data collection of various safety production monitoring systems to the central office by deploying a dedicated cloud monitoring networking server, weakening the data management, storage and maintenance functions of the mine end, and reducing the corresponding manager. The system virtualizes the servers of the mine monitoring systems to the group cloud data center for centralized management. The system solves the following series of problems: local maintenance computer network and application system professionals are few, multiple mines repeatedly invest, computing resources can not be fully utilized, can not adapt to the needs of the mine less humanized and unmanned development. The mining group cloud monitoring network system topology is shown in Figure 4.

It can be seen from Figure 4 that the newly developed cloud monitoring networked server has fundamentally changed the regulatory system structure of the mining group company. The structure makes full use of the massive data storage, management and analysis capabilities of the cloud data center, unified management of global data, and flexible use of big data processing methods for analysis, providing decision support for mine safety production; through structural adjustment, the data management complexity of mines is greatly weakened and the safety risk of mine data is reduced. Each mine can use the way of renting the system from the central office cloud center, which greatly reduces system security and management costs.
3.2. Accessible Mine monitoring System

The dedicated networked server uploads the data to the group company's cloud data center through the external data interface provided by the mine monitoring system. The mine monitoring system that can be accessed includes the following systems: mine safety monitoring system, smart mine management and control platform, personnel positioning management system, communication System, work surface monitoring system, lifting system, belt transportation system, beam monitoring system, power supply monitoring system, ventilation monitoring system, mine pressure monitoring system, water pump monitoring system, shearer monitoring system, drilling site and drilling monitoring system, etc. The scheduling command system interface is shown in Figure 5.

3.3. System Function and Display

The system adopts cloud computing, video recognition, AI, VR and big data analysis technology to provide comprehensive analysis and judgment services for mine production, dispatch logistics, safety management and other multi-domain data, improve management personnel’s ability to monitor production sites, and provide comprehensive decision-making. Scientific support. The system integrates the monitoring and information subsystems of the mine to realize the real-time collection of mine production data. It can display the main status of mine safety production on one interface: the operation status of the coal mining machine, the belt running condition, the fan operating status, Number and area of personnel, gas monitoring status, environmental monitoring status, and coal production. The system facilitates the dispatching and commanding of mine safety production and timely discovers and solves problems.
4. Conclusion
The system model is currently successfully applied in nearly 200 mining companies. The system has obvious technical advantages in the network communication of mine integrated monitoring system. The dedicated networked server based on embedded technology is highly reliable and easy to maintain. The distributed data acquisition, processing and uploading technology is mature, stable, safe and reliable. The network as an innovative technology for data uploading backup channels is more suitable for mines in remote areas. This design plan will be promoted and applied in the digital mining industry.

5. References
[1] Enjie DINg, Weizu SHI and Shen ZHANG 2017 Top-down design of mine Internet of things, Industry and Mine Automation. 43(9):1-11
[2] Mei LI, Shuaiwei YANG, Zhenming SUN 2017 Study on framework and development prospects of intelligent mine, Coal Science and Technology. 45(1):121-128,134.
[3] GB/T 34679-2017, General Technical Specification for Smart Mine Information System, Publisher: China Standard Press pp 3–19
[4] GB/T 35589-2017, Information Technology Big Data Technical Reference Model, Publisher: China Standard Press pp 1–6
[5] Xiaoping MA and Wei DAI 2018 Research status and application prospect of big data technology in coal industry, Industry and Mine Automation. 44(1):50-54
[6] GB/T 36345-2018, Information Technology General Data Import Interface, Publisher: China Standard Press pp 1–8
[7] GB/T51272-2018, Design Standard for Intelligent Mines in Coal Industry, Publisher: China Standard Press pp 11–25