Intelligent Mining Monitoring System Based on Big Data Technology

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Abstract: With the continuous improvement of my country's economic level, both the construction of urbanization and the continuous improvement of science and technology require a continuous supply of mineral resources and energy. Big data is a data processing and analysis technology. It was originally designed to solve the storage and processing problems of large amounts of data in distributed networks. Because of its high-precision and high-efficiency data analysis advantages, it has been widely used in various fields. Based on this, this article combines big data technology with mining intelligent monitoring system to design an intelligent mining monitoring system based on big data. Aiming at the problem of the traditional system's low accuracy of mining monitoring equipment, this article uses wireless sensors, card readers and central processing units in the hardware design of the system to achieve the system's collection of mining monitoring equipment operating data. The hardware design of the system; through the use of cloud computing and information fusion technology in the big data technology, the system has realized the analysis of the mine electromechanical equipment data, completed the system software design, and formed a big data-based mining intelligent monitoring system. Studies have shown that the specific high accuracy of the system designed this time is proved to ensure the safety, scientific and stability of the mining work.

1. Introduction

In recent years, various mining enterprises have continued to develop, but safety accidents still occur one after another. People have begun to carry out modern mine safety management and monitoring work to ensure the safety, scientific and stability of the work of mining [1]. Relying solely on manpower and equipment for mine safety monitoring and management [2-3] can no longer meet the needs of the current society and the development of the times. It is necessary to introduce big data [4-5] processing technology, so as to improve the efficiency of mine safety management and reduce the safety accidents caused by various unstable factors.

The faults of mine electromechanical equipment during operation can be roughly divided into electrical faults [6] and mechanical faults [7]. Electrical faults: when the mine power supply voltage is unstable and the motor starts frequently, it will cause the main motor cable Grounding accident; if the control line plug of electromechanical equipment is connected, the belt conveyor will be stuck; if the wire of the smart phone coil device is connected, the belt of the electromechanical equipment will stop running; the inverter communication address conflict will cause the belt conveyor frequency conversion failure; Damage to the insulation winding will cause the oil pump motor to burn out. Like other fields, big data analysis technology has brought brand new solutions and working methods to the current mining management work. According to the application and experience of big data in other fields, the most common working method in the mining management process is through Correlation analysis of historical data in the corresponding time period of the accident to find out the historical data or the laws and changes existing between the historical data at the time of the accident, so as to find the correlation with the accident and data, and monitor the

accident related data in real time [8], Can achieve the purpose of preventing safety production accidents.

On this basis, this paper analyzes and studies the intelligent mining monitoring system [9-10] based on big data technology. Traditional manpower and equipment for mine safety monitoring and management work were used as the control group, and the intelligent mining monitoring system based on big data technology was used as the experimental group for comparative analysis. Research shows that the application of big data technology in the intelligent monitoring system of mine electromechanical equipment improves the monitoring effect of the system and provides a good guarantee for the normal operation of mine electromechanical equipment and mine safety management.

2. Design of Intelligent Monitoring System for Mine Electromechanical Equipment Based on Big Data

2.1 System Hardware Design

The design requirement of the card reader for intelligent monitoring of mine electromechanical equipment is strong power storage capacity. Therefore, the system design adopts a card reader. The card reader has a built-in NY2012 chip, which has extraordinary standby capability and data reading capability. In the design of wireless sensors, a "one-to-one" form is adopted. In the monitoring range of the system, different wireless sensors are arranged according to the operation characteristics of electromechanical equipment, including temperature sensor, speed sensor, current and voltage sensor, vibration sensor, detection sensor and pressure sensor.

The hardware equipment of the intelligent monitoring system for mine electromechanical equipment based on big data is mainly composed of wireless sensors, central processing units and tunnel card readers. According to the system's design requirements for high data transmission rate and fast data processing efficiency of the central processing unit, the selected central processing unit should have the advantages of PIC, and its external interface has good scalability. Single cycle is mainly used when executing system instructions. And it can provide multiple power interfaces and multiple OI ports, which can cooperate with the serial peripheral interfaces of other hardware devices in the system when acquiring wireless sensor data to realize the function of receiving data quickly.

2.2 System Software Design

In mine electromechanical equipment monitoring, cloud computing and information fusion technology based on big data is the key to the entire system. Cloud computing analyzes and calculates the fused data through a factor analysis algorithm. This algorithm is simple and effective in practical applications, especially for the calculation and analysis of electromechanical equipment operating data. The calculation formula is:

$$R(G) = P_e(G \times e) + qR(G \div e) \tag{1}$$

$$X = \mu + LF + e \tag{2}$$

$$Cov(X) = LL^{'} + \psi \tag{3}$$

In formula (1), P_e is the probability of equipment failure; G is the standard operating parameters of the equipment, e is the actual operating parameters of the equipment, and qR is the probability of no failure of the equipment. $R(G)$ is the equipment status. When $R(G) \geq 0$, it means that the mine's electromechanical equipment is in normal operation; When $R(G) < 0$, it means that the mine's electromechanical equipment is malfunctioning. The specific location of the malfunctioning equipment is determined by the source of the calculated data to realize the mine based on big data Design of intelligent monitoring system for electromechanical equipment; in formula (2), X is the

$p \times 1$ vector of the measured value, μ is the $p \times 1$ vector of the mean value, L is the $p \times m$ matrix of the load, and F is the $m \times 1$ vector of the common factor; in formula (3), the i-th diagonal element of LL' is called the i-th common factor variance.

2.3 The Development Strategy of Cloud Accounting in the Context of Big Data

1. Ensure the security of accounting data

Ensuring the security of accounting data is an important prerequisite for the development of cloud accounting. The cloud accounting service platform should increase the capital investment and manpower input of cloud accounting, provide professional ethics training for employees, enhance the backward security of cloud accounting, and develop cloud accounting users for data use. Encryption technology can protect accounting data and user privacy.

2. Promote the construction of cloud computing platform

Due to the high funding requirements and long cycles, the risk of building a cloud computing platform is high. Therefore, expect the government to make progress. The government can take the lead and integrate resources, realize the integration of capital, technology, manpower and management of related enterprises, and create a special project to develop a cloud computing platform.

3. Speed up the process of promoting cloud accounting

The difficulty of cloud computing is largely because users have doubts about cloud computing, so ensuring the security of cloud computing is the key. The government has higher requirements for data updates. Service providers must ensure the timeliness and quality of data updates and improve service levels. In addition, according to the special needs of the government, it can be adjusted at any time to meet changing business needs.

3. Experimental Thinking and Design

3.1 Experimental Ideas

This paper analyzes and studies the application of intelligent mining monitoring system based on big data technology. This paper uses traditional manpower and equipment for mine safety monitoring and management as the control group, and the intelligent mining monitoring system based on big data technology as the experimental group for comparative analysis. Each group of real systems intelligently monitor the mining industry for a fixed time, taking the accuracy of the monitoring results as Experimental results.

3.2 Experimental Design

The emergence of big data has brought great convenience and innovation to the current mining monitoring and management work. Compared with traditional management methods, big data has the advantages of high efficiency, modernization, diversification, and integration, avoiding the human working environment. The accidents brought about by the mining industry gradually realized the concentration and storage of mining environmental data, which not only collected and processed the data in the daily management process of mining work and the operation process, but also contributed to the development of the mining industry and the industry. Summary of the law.

The purpose of this research is to study the application of big data technology in intelligent mining monitoring system. According to the division of the experimental group and the control group, the traditional manpower and equipment for mine safety monitoring and management work are used as the control group, and the intelligent mining monitoring system based on big data technology is used as the experimental group for comparative analysis, and a simple scale is used to evaluate the two groups For the financial processing of, 10 points in the score are the upper limit. The higher the score, the better the accuracy of the monitoring results. The specific design of the wireless sensor in the experimental group is shown in Table 1.

Table 1. Sensor monitoring content

Sensor category	Monitored equipment	Monitoring content
Detection sensor	Mine motor	Operation status monitoring
Pressure Sensor	Ventilator	Work pressure monitoring
Temperature Sensor	Road header	Temperature monitoring
Vibration sensor	Conveyor	Amplitude monitoring
Speed sensor	Air compressor	Speed monitoring

4. Discussion

4.1 Discussion on Management Measures of Big Data Technology in Intelligent Mining Monitoring System

Big data is an emerging word derived from social development and scientific progress in recent years. In recent years, my country's science and technology has been developing in the direction of informatization, automation, diversification, and transparency. Industry information collection and data processing have made a very important contribution. At present, a large amount of data appears in the daily work of all walks of life. It is impossible to collect and store information in a timely manner by relying on manual labor. Therefore, big data technology has begun to highlight its own characteristics in the process of information collection, storage, sharing, and management It has shown a huge effect in it. It can unify these links into a whole and build a huge data information database for classification and processing. Big data is a data processing and analysis technology. It was originally designed to solve the storage and processing problems of a large amount of data in a distributed network. Because of its high precision and high efficiency data analysis advantages, it has been widely used in various fields. Combine big data technology with mining intelligent monitoring, and design a mining intelligent monitoring system based on big data to provide good operation guarantee for mine electromechanical equipment. All in all, the current big data gradually has the characteristics of large amount of information data, low value density, fast processing speed, and various types of information data, which have brought great convenience to people's work and life, and greatly liberated labor costs.

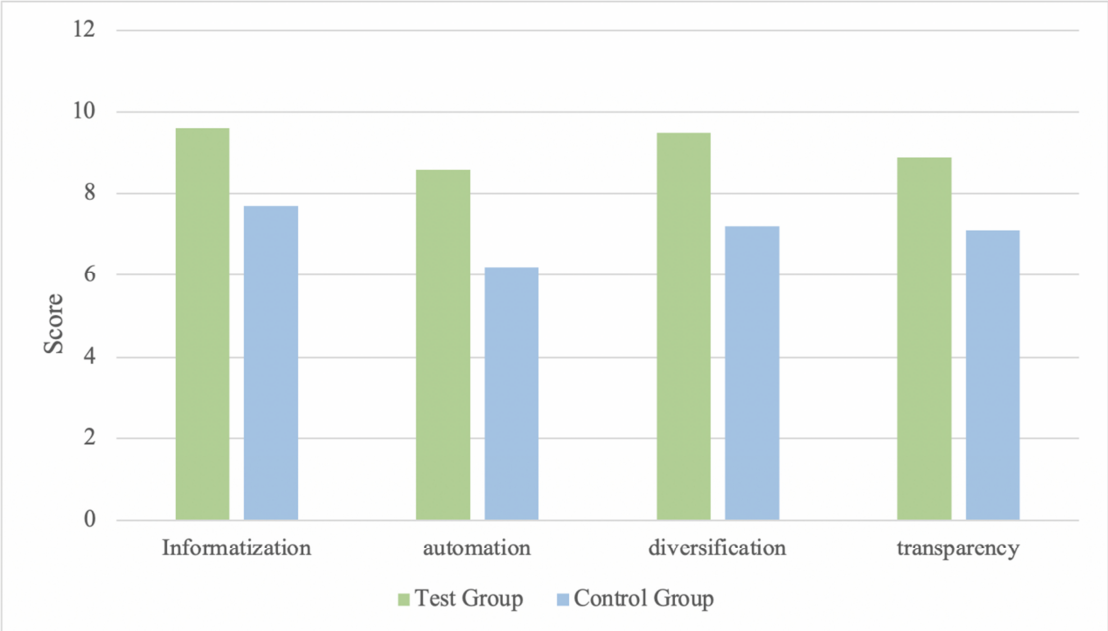

Figure 1. Comparison of characteristics and functions of experimental group and control group

It can be seen from Figure 1 that the experimental group is better than the control group in terms of informatization, automation, diversification, and transparency. It can be seen that compared with traditional management methods, big data has various advantages such as high efficiency, modernization, diversification, and integration, avoiding accidents caused by human working environment, and gradually realizing the concentration and storage of mining environmental data. Combine big data technology with mining intelligent monitoring to provide good operation guarantee for mine electromechanical equipment. At the same time, timely collection and processing of data in the management process of daily mineral mining work and during the operation process, so as to summarize the laws of mineral production and industry development.

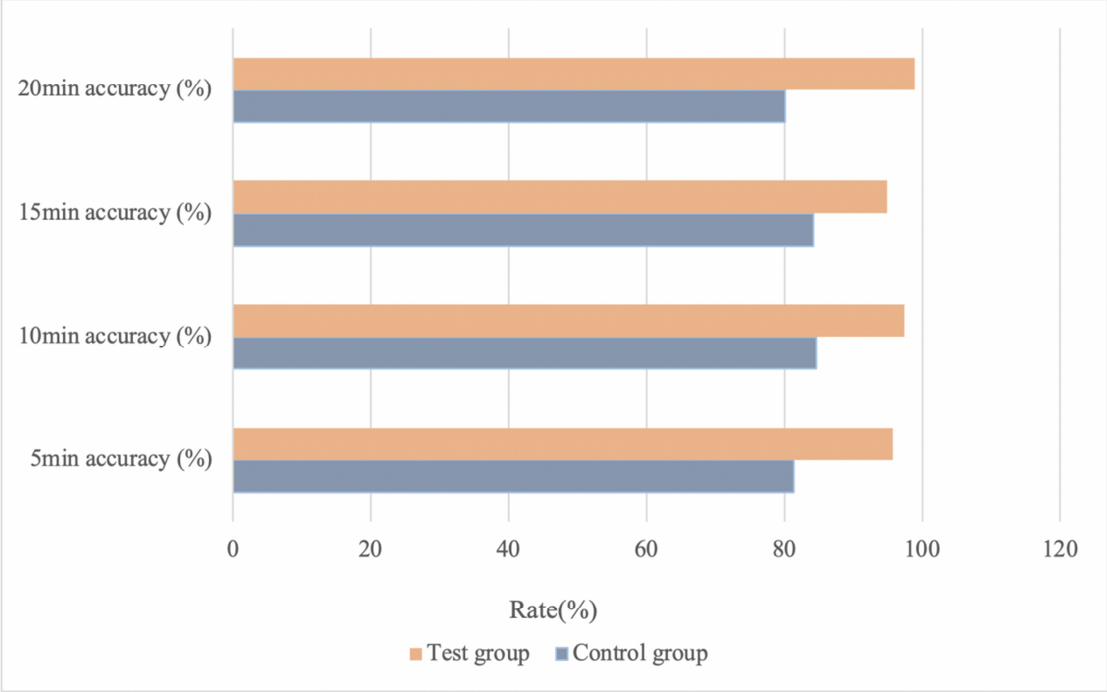

Figure 2. Comparison of monitoring accuracy between the experimental group and the control group

It can be seen from Figure 2 that in the comparison of the accuracy of 5min accuracy (%), 10min accuracy (%), 15min accuracy (%) and 20min accuracy (%) of the two-system monitoring, the experimental group is significantly higher than Control group. It can be seen that all walks of life There will be a lot of data in daily work. Only relying on traditional manpower and equipment to carry out mine safety monitoring and management cannot take and store information in a timely manner. Therefore, big data technology has begun to highlight its own characteristics, in the collection, storage, and storage of information. The process of sharing and management has shown a huge effect, which can unify these links into a whole, and build a huge data information database for classification processing.

4.2 Complexity of Mine Safety Supervision Objects and Suggestions

Mine working environment and mining area have very complicated geological environment and working status, which also increases the difficulty of daily safety supervision work. The complexity of mine safety monitoring is embodied in the following aspects:

1. The complexity of mining

When working on minerals, underground mining is generally used. In the daily work process, the roadway is narrow and the environment is harsh. When working in the underground, the visibility is too low. At the same time, there is a lot of dust. Therefore, various safety accidents One after another, it is difficult to effectively suppress.

2. The complexity of mine production

The work includes mining system, transportation system, lighting system, drainage system,

ventilation system and monitoring system, etc. The complexity is high, and it also brings great difficulty to the work coordination between various links, which is easy to cause related safety accidents.

3. Geological disasters

Mine mining is extremely susceptible to natural disasters. If underground mining is unscientific, it is extremely easy to damage the geological structure where the minerals are located and roadway collapse is prone to occur.

The continuous innovation of big data technology has contributed to the current data processing efficiency and use efficiency. The law of industry development that was not discovered by humans has begun to be clearly presented. Using the current data model technology, actual simulation exercises can be carried out through the electronic sand table, real monitoring and online monitoring of safety accidents that may occur during the mining process, and continuously improving the level of mine safety monitoring and management.

5. Conclusions

In the application research of the intelligent mining monitoring system based on big data, the hardware design of the system adopts the architecture form of wireless sensor, card reader and central processing unit to realize the collection of operating data of mine monitoring equipment by the system, and complete the system Hardware design; through the use of cloud computing and information fusion technology in big data technology, the system has realized the analysis of mine electromechanical equipment data and completed the software design of the system; the application of the intelligent mining monitoring system based on big data technology is The experimental group used traditional manpower and equipment for mine safety monitoring and management as the control group for comparison. The two systems monitored at 5 min accuracy (%), 10 min accuracy (%), 15 min accuracy (%), and 20 min accuracy. A comprehensive analysis is performed in the accuracy comparison of (%). The research results show that only relying on traditional manpower and equipment for mine safety monitoring and management work cannot collect and store information in a timely manner. Therefore, big data technology has begun to highlight its own characteristics in the process of information collection, storage, sharing, and management. It shows a huge effect, improves the monitoring effect of the system, and provides a good guarantee for the normal operation of mine electromechanical equipment and mine safety management.

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Study on the basic theory of utilization technology on high-magnesium copper-nickel sulfide tailings (2020J0523).

References

[1] Loganathan, P., Naidu, G., & Vigneswaran, S. (2017). Mining valuable minerals from seawater: a critical review. Environmental ence: Water Research & Technology, 3(1), 37-53.

[2] Chen, M., & Wang, K. (2019). A bow‐tie model for analyzing explosion and fire accidents induced by unloading operation in petrochemical enterprises. Process Safety Progress, 38(1), 78-86.

[3] Chartrand, S., & Fischer, A. (2015). Assessment and management of connective tissue disease-associated interstitial lung disease. Sarcoidosis, vasculitis, and diffuse lung diseases: official journal of WASOG / World Association of Sarcoidosis and Other Granulomatous Disorders, 32(1), 2-21.

[4] Shakhovska, N., Boyko, N., Zasoba, Y., & Benova, E. (2019). Big data processing technologies in distributed information systems. Procedia Computer ence, 160(1), 561-566.

[5] Wang, F. (2016). Analysis on the construction of computer data processing mode based on era of

big data. Journal of Computational and Theoretical Nanoscience, 13(12), 10347-10351.

[6] Quittan, M., Sochor, A., Wiesinger, G. F., Kollmitzer, J., & Mayr, W. (2015). Strength improvement of knee extensor muscles in patients with chronic heart failure by neuromuscular electrical stimulation. Artificial Organs, 23(5), 432-435.

[7] Pham, D. A. K., & Gockenbach, E. (2016). Analysis of physical transformer circuits for frequency response interpretation and mechanical failure diagnosis. IEEE Transactions on Dielectrics & Electrical Insulation, 23(3), 1491-1499.

[8] Zaveri, A., Rula, A., Maurino, A., Pietrobon, R., Lehmann, J., & Auer, S., et al. (2015). Quality assessment for linked data: a survey. Semantic Web, 7(1), 63-93.

[9] Z. Wang. (2017). Numerical simulation of residual oil in horizontal wells with intelligent completion of well network. Ship Building of China, 58(1), 674-683.

[10] Salehi, H., Das, S., Biswas, S., & Burgueno, R. (2019). Data mining methodology employing artificial intelligence and a probabilistic approach for energy-efficient structural health monitoring with noisy and delayed signals. Expert Systems with Applications, 135(11), 259-272.