Practice of Cloud Computing in Coal Mine Safety Production

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Abstract. With China's entering the information age, science and technology have entered all aspects of our lives. However, from the perspective of the current coal industry, there are still problems in the safety supervision system, such as the scarcity of personnel, heavy workload and low level of information, which have been unable to adapt to the continuous development of the current society. Based on the above background, the purpose of this paper is to study the application of cloud computing in coal mine safety production. This paper is based on the network technology platform and the SaaS architecture of management. It uses the mode of centralized management and distributed processing to form an integrated coal mine safety supervision information system, so as to solve the safety problems in coal mines. This paper provides a complete and feasible scheme for coal mine safety production monitoring. At the same time, the platform itself is a general monitoring platform with excellent expansibility. Wireless sensor network can carry a variety of different sensors, realize more monitoring functions, access server can realize a variety of access means, which is conducive to the transparency and standardization of coal mine production information. All of these are conducive to strengthening our country. At present, the coal mine production monitoring level, the monitoring platform has a wide range of application prospects.

Keywords: Coal Mine Informatization, Cloud Computing, Production Safety, Wireless Sensor

1. Introduction
China's coal storage accounts for 11.6% of the world's carbon stock, and the coal that can be mined accounts for the second place in the world [1]. As the main energy of our country, coal continuously promotes the economic development, which is also an important factor for the sustainable development of our economy [2]. In this regard, it is necessary to constantly ensure the safety production of coal mines, in order to continuously promote the progress of the coal industry and achieve sustainable development. At the same time, safety production also directly affects the rise and fall of the coal industry, relates to the healthy development of the social economy, and has a very important significance for the development of China [3-4]. In recent years, with the development of information technology and the emergence and popularization of cloud computing, the safety supervision of coal mines has won a new management idea. Relying on the network technology
platform, using virtual technology and platform, large-scale data calculation and resource integration can be realized to ensure the smooth progress of coal mine safety supervision and promote the development of coal mine industry [5].

Due to the constraints of historical reasons and the complexity of coal mine underground environment, compared with other industries, the comprehensive automation construction of China's coal industry started relatively late [6]. Until the beginning of this century, China's coal industry has set off the climax of the construction of coal mine comprehensive automation. At present, the formulation of integrated automation has not been unified. Different researchers put forward different formulation, such as integrated automation, automation, informatization, digitalization [7]. However, the practical work of comprehensive automation is similar, that is, the networking and remote control transformation of each subsystem equipment, the construction of a backbone communication network covering the whole mine, and the construction of a software platform that can realize the data access and display of each system in the whole mine [8]. The safety production of coal mine is inseparable from cloud computing technology [9-10]. Although the modern coal mine production has completed the modernization construction, the coal mine still can only display and classify the data basically, and can't show the internal connection and value of the data, and the data can't play its due role. Once the construction of the mine Internet of things is successful, the data will be more and more complex, which is not a small test for coal mine safety production [11]. Because it is very difficult for a large number of data to be analyzed and processed in a short time, to make full use of big data, we must be good at using cloud computing technology. The more data, the more accurate the disaster early warning will be. The accurate disaster early warning also needs the support of cloud computing technology [12].

This paper finds that cloud computing technology can play an important role in coal mine safety production. In the research process of coal mine safety production, in order to really put cloud computing technology into coal production, we need to pay attention to some problems, such as, to develop a unified industry standard, so as to effectively realize the purpose of interconnection between various services, and successfully solve the problem of different standards Cause a connection block problem. The main purpose of applying cloud computing technology to coal mine production is to reduce cost and safety production. Through these methods, cloud computing technology can be effectively applied to safe production and play a role.

2. Method

2.1 Cloud Computing Technology

Cloud computing technology is also a new technology, with the characteristics of on-demand service, super scale, high scalability, virtualization, high reliability, generalization. Due to the high application and commercial value of cloud computing technology, Google, Amazon, IBM, sun, Microsoft and other companies have put forward their own software and hardware architectures.

Nowadays, the emerging cloud computing technology is very popular, which has the characteristics of demand based services, large scale, strong fictional ability, high simulation ability, strong authenticity, and broad development space. Among these technologies, the commercial energy of cloud computing is also incomparable, so it is widely used, and the software and hardware architecture system is also born. For example, Baidu, Amazon, Microsoft and other companies are representative enterprises of system application.

2.2 Cloud Computing Applied to Coal Mine Safety

The cloud computing technology applied in the coal mine safety supervision information system is mainly to integrate the scalable storage data computing and the application of decentralized computing resources, and use the network platform technology to classify customers in the way of using on demand, and provide different storage and computing related services.

(1) Virtualization Technology
The use of virtualization technology can not only improve the frequency of hardware use, but also simplify the software configuration process, so as to improve the efficiency of the computer. This technology can provide a kind of automated, virtualized, efficient and flexible electronic computer infrastructure services for enterprises using cloud computing.

(2) Cloud storage technology
Cloud computing uses distributed saving data technology to ensure the high availability, reliability and economy of data. At the same time, it also uses redundant storage technology to ensure the reliability of data information, which means that the same data has multiple backups. At the same time, cloud computing can meet the needs of many users and provide corresponding services for users. Therefore, cloud storage technology has the characteristics of high transmission rate and high throughput.

(3) Cloud data management technology
Cloud computing can integrate a large number of data and carry out centralized calculation and analysis, so as to ensure accurate and efficient services for users. At the same time, in the huge and complex data, finding the data users need is also the challenge of cloud computing.

(4) Cloud computing services and related applications
With the advent of the information age, cloud computing has a very wide range of application prospects because of its huge storage space, accurate and efficient data calculation, for example, in the network music, network video, search engine, e-mail, education, telecommunications, insurance certificates, financial and medical applications and other Internet applications, as well as large and dense data industry applications.

3. Experiment
Step 1: First, it is mainly composed of monitoring substation, multiple sensors, functional data transmission port, downhole data display host. Among them, the sensor includes temperature sensor, humidity sensor, carbon monoxide concentration sensor and so on. Through the detection system composed of intelligent data transmission port and supervision substation, it can collect and process the relevant information of the environment, and transmit it to the computer to change some environmental parameters.

Step 2: Next, the monitoring data, transmission software, wireless and wired inspection terminals on different mines constitute the data transmission system. Its main function is to transmit the monitoring data and information of each mine to the data terminal through the single port and embedded software system that is mainly assigned to it. After processing and analysis, it is transmitted to the coal mine safety management by GPRS or wired network Manage the data center.

Step 3: Finally, it is applicable to the existing safety monitoring system, for example, kJ series detection system, which effectively solves the problem that the self-contained system in the coal mine safety supervision is not connected with each other, truly realizes the sharing of coal mine safety information, and provides safety guarantee for the production of coal mine. It can improve the privacy and protection of data and protect the user information in the authentication system, so as to improve the security and reliability of data transmission. And timely convey the alarm information, help the coal mine safety center to find production problems in time, solve problems in time, and improve the safety of coal mine production.

4. Discuss

4.1 Analysis of Experimental Results
Based on the research of cloud computing on coal mine safety production, this paper constructs the risk system model of coal mine safety production under the cloud computing application mode. The details are shown in Table 1.
Table 1. Cloud computing applied to coal mine safety production

| External threat          | Internal vertical threat     | Internal horizontal threat | Cloud computing applications | Centralized data processing |
|--------------------------|------------------------------|-----------------------------|-------------------------------|----------------------------|
| Traditional Internet    | Cloud computing applications | Centralized data processing | Under cloud computing         | Centralized data processing |
| Mobile Internet          | Monitoring and supervision data | End user                     | Cloud computing applications |                           |

With the development of the times, cloud computing is more widely used in various researches in life. This paper analyzes cloud computing applications through data surveys as shown in Figure 1.

Figure 1. Development of cloud computing

It can be seen from Figure 1 that cloud computing has been basically applied to various projects, so it is an inevitable trend that cloud computing is applied to coal mine safety production.

4.2 Work Safety Analysis of the Internet of Things and Cloud Computing in Coal Mine Production

The construction of the mining Internet of Things will inevitably cause changes in the nature of coal enterprises. It is directly foreseeable that after the construction of the IoT of the mine, the coal mine safety production monitoring and monitoring system in a broad sense will be transformed from a passive monitoring and monitoring system to an active, multi-parameter integration and monitoring and monitoring system with an early warning function. Miners have changed from being able to obtain corresponding environmental safety information from the dispatching and commanding center to acquiring surrounding safety information and acquiring early warning and forecast information in a timely manner using equipment that can actively sense the human environment, so that they can quickly evacuate the danger area when a disaster occurs or is about to occur. Only by realizing this transformation can the safety production level of coal mines be substantially improved. Making the most of big data requires the use of cloud computing technology. The main reason for the limited effect of comprehensive automation of coal mines on the promotion of coal mine safety production is that only the data is displayed and categorized, and the inherent connection and intrinsic value of the data is insufficient. After the establishment of the IoT of the mine, the increasingly rich data is both a challenge and an opportunity. This is because the more data there is, the clearer the underlying relationships implicit in the data are and the easier it is to discover. Especially for large systems where the environment, disasters, and human activities in the coal mine are highly coupled, the more data there is, the higher the dimensionality of the disaster warning model, and the more accurate the warning and forecast. The high-dimensional disaster warning model requires high computing power and flexible cloud computing technology to provide computing support.
The bright prospects of cloud computing have led traditional IT vendors to transition to cloud computing. However, due to the lack of unified technical standards, especially interface standards, each vendor has its own role in the development of its own products and services. The interconnection and interoperability poses severe challenges. The ultimate purpose of building the mining Internet of Things and using cloud computing to mine and process big data is to improve the level of safe production in coal mines. However, the modeling, analysis, mining, and security warning of data cannot be completed by computer programs alone, but many experts with rich theoretical and practical experience are required to participate in this process. Therefore, whether there is a need for a data network operator specializing in coal mine safety, and whether it is possible to establish an operator that provides coal mine data analysis services similar to Taobao in the entire coal industry, these issues will be urgently needed.

5. Conclusion
As an important energy source in China, the safe production of coal mines is particularly important. Using a method of integration with computing, quoting related technologies, relying on network platforms and related technologies, effective supervision of coal mine safety is used to form a scientific and reasonable coal mine. The safety inspection system promotes the sustainable development of the coal industry. This paper uses cloud computing technology to develop a set of monitoring platforms that can be used for coal mine safety production, to achieve measurable environmental parameters in coal mine production, such as gas and wind speed, and also to connect traditional wireless personal area networks to the Internet to achieve coal mine the intelligent monitoring of the safety production process also makes the transmission of mine production information faster and avoids the asymmetry of underground and underground information.

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