

Analysis of Mine Ventilation Security Instrument and Its Calibration Based on the Perception of IoT

Bojun Li

CCTEG Chongqing Engineering Co., Ltd., Chongqing, 400037, China

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Abstract: The safety of coal mine production is directly related to the life and property security of underground operators and safety instruments are of great significance to ensure the safety of coal mine production. Based on the perception of Internet of Things, this paper designs the instrument system of mine ventilation safety, which greatly simplifies the operation of instrument issuance and recovery, and achieves good results in field application. At the same time, this paper discusses the hardware and software calibration paths of the instrument to provide some references for the production of coal mine enterprises.

1. Introduction

With the rapid development of information industry, especially the research and application of Internet of Things technology, more and more security and convenience are provided for our production and life [1]. For a long time, the work of coal mine safety production has focused on conventional hidden dangers and rescue work, such as gas monitoring, water permeability prediction, underground personnel positioning and so on. To a certain extent, the equipment used in the production process has been neglected. Coal mine enterprises seldom have a set of efficient methods for maintenance and repair, which has laid a hidden foundation for future safety and reliability in the invisible production and use process. In view of the above problems existing in the current coal mine safety monitoring system, the application of intelligent Internet of Things sensing technology to the coal mine safety monitoring system, the use of wireless sensor network to realize the interconnection and interoperability of equipment, at the same time, the data fusion processing of relevant sensors in the working face, and the omni-directional perception of the underground environmental safety situation, are of great significance to enhance the coal mine safety monitoring capacity and safety production. Righteousness. In the production process of coal enterprises, coal mine ventilation is an important measure to effectively avoid safety accidents. To do a good job in ventilation management is the basic condition to ensure the safety of the whole coal mine production. In recent years, various coal mine safety accidents are common in our country, which not only cause great economic losses, but also cause casualties. At present, many safety accidents can be attributed to inadequate ventilation management. In the process of coal mine production, we must strengthen the management of coal mine ventilation, mainly for the management of coal mine ventilation safety instruments. Only in this way can the probability of various safety accidents be effectively reduced. In view of the above potential problems related to coal mine production safety, this paper proposes a new and feasible management method based on the Internet of Things system for some specific ventilation safety instruments and instruments.

2. Design of Mine Ventilation Security Instrument Based on the Perception of IoT

2.1. Overall Design

As an important field of Internet of Things application, "Perception Mine" is to digitize all kinds of monitoring parameters and control operation of safety monitoring system through various perception means [2]. It combines perception technology, transmission technology, intelligent technology, information technology and modern control technology with modern mining and mineral processing

technology to form mine people, people and objects. Material-matter network dynamically and describes and controls the whole process of mine safety production and operation, aiming at ensuring the sustainable growth of mine economy and the ecological stability of mine natural environment, with the goal of guaranteeing efficiency, safety and green mining. Coal mine safety monitoring system based on Internet of Things perception is generally divided into three layers: perception layer, network transmission layer and application layer. The system structure is shown in Figure 1.

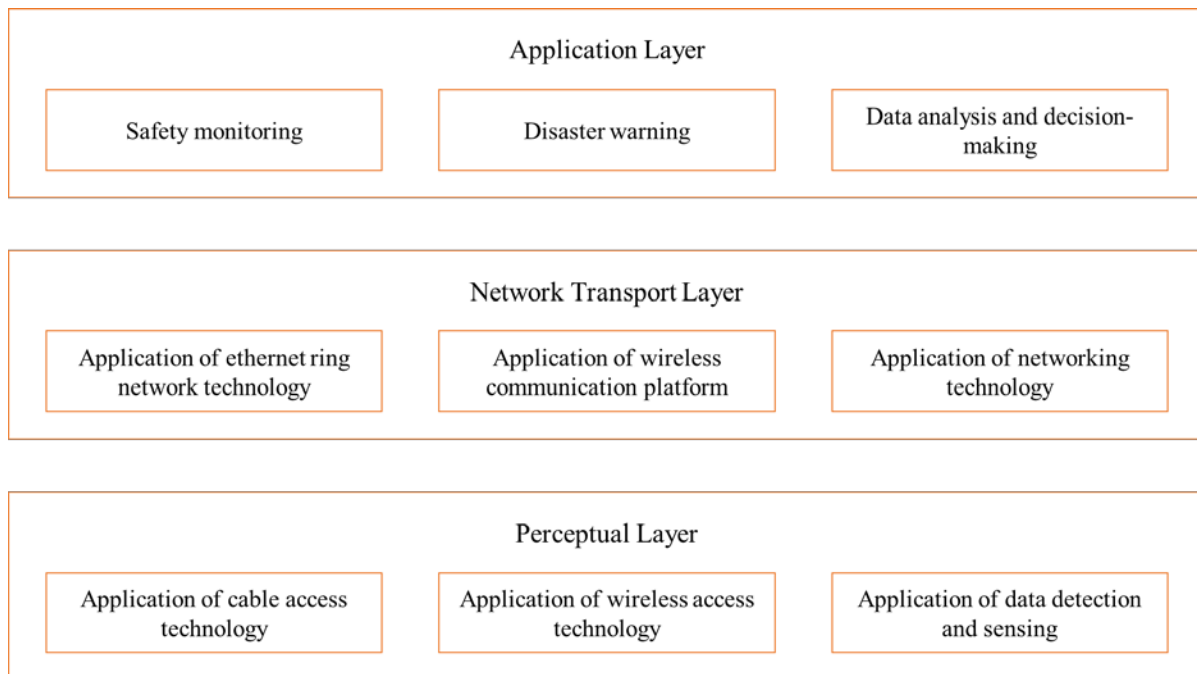


Figure 1. Perceptual mine structure based on IoT

The perceptual layer is composed of various sensors and gateways, which are used to perceive the working environment, equipment working status and natural disaster risk [3]. It is the starting point of recognizing objects and collecting information in the Internet of Things. At the same time, the data in the perception layer is transmitted by jumping, and the data can be shared between sensors. The network transport layer is composed of various wireless and wired communication networks, which is responsible for uploading the information acquired by the perception layer to the application layer. At present, the mine network transport layer is based on Gigabit or Gigabit switches, and forms various forms of ring network. Data transmission achieves redundant backup, and can manage the whole network, which is convenient to observe the real-time state of the network. The application layer provides users with intelligent applications such as centralized monitoring, data fusion, disaster warning and intelligent decision-making.

2.2. Hardware Design

The hardware design of the system mainly includes the design of the information acquisition node and the environmental monitoring node of the storage room. Aiming at the information acquisition node of self-rescue device, based on the S3C24 development board of ARM9 series, each pressure detection sensor, RFID reader and ZigBee wireless module are equipped to realize the acquisition and transmission of weight and coding information [4]. The main information of environmental monitoring node in storage room is indoor temperature and humidity. For some instruments which are susceptible to dust, it is necessary to monitor indoor dust concentration. The environmental monitoring node of storage room is based on CC2430 wireless single-chip computer and carries temperature and humidity sensor SHT11. The data acquisition terminal transmits the data to the server through ZigBee network and wired local area network. After being processed by the server, the relevant instructions are returned. According to the aforementioned function design and implementation scheme, this node is a kind of node which needs to be widely laid in the system. Its function is to detect whether the instruments on the shelf are still stored on the shelf, when to take

them away and put them back. This node can be designed for all ventilation safety instruments. This is a huge network of nodes, which can feedback the storage status of instruments on the shelf. It can provide first-hand information for real-time maintenance and replacement of equipment, and facilitate maintenance personnel to find specific equipment in the first time. At present, coal mine enterprises have a variety of underground personnel positioning system. Because different workers need different equipment to enter the well, the system can know whether the instrument is located or not through this node, to indirectly understand how many workers are underground, what kind of workers are, and can have a specific record in the working period. Temperature and humidity acquisition node. The function of this node is to detect the temperature and humidity of the indoor environment. Temperature and humidity do not differ significantly from each other in terms of indoor location.

2.3. Software Design

The system can continue to work normally and complete corresponding control actions according to the established requirements; the frequency of failure caused by design defects should be reduced as far as possible in the normal use process; in case of failure, the system should maintain its own working ability, not stop completely, resulting in greater losses; after failure, it should be restored to its working state when needed. The room should be short. The object managed by this system is mainly objective objects, which do not involve important control and operation means, and do not contain confidential information of enterprises, but also need to connect data to the local area network of mining area, so the security requirements are not high, just set the corresponding login and operation authority. According to the different identities of the operators, the system sets the rights that the users can get after login, and users can enter the system according to their user names and passwords. Managers have the right to change data, such as modifying employee information, adding sensor nodes, etc. Ordinary users can only browse, and have no right to modify any data. Server is an important part of ventilation safety instrument management system. Server management software runs on the server side, mainly providing database management and maintenance of instruments. The system analyses and stores all kinds of data sent back by the acquisition terminal, alarms when fault is found, and returns instructions to guide the acquisition terminal to collect information. The system involves several aspects such as the administrator, the employee and the instrument itself. Therefore, the server management software is divided into eight functional modules: administrator login, administrator information, instrument-related information, employee, instrument maintenance, detection and alarm, storage status query and data maintenance. Each functional module appears at the top of the screen in the form of menu items in the human-computer interaction interface [5].

3. Analysis of Mine Ventilation Security Instrument Calibration Based on the Perception of IoT

3.1. Calibration Significance

Coal mine production enterprises should devote themselves to technological innovation and production process innovation of ventilation safety instruments and instruments. Through the research and development and use of new mine ventilation metering devices, enterprises take the initiative to reduce the probability of mine accidents, and then enhance the economic and social benefits of coal mining enterprises. The accuracy of ventilation safety instruments will directly determine whether the occurrence of safety accidents can be eliminated in the cradle, which is of great significance to the smooth progress of the whole mining process. As a sophisticated measuring instrument, the value displayed by the mine ventilation safety instrument will directly determine whether the production will continue or which related ventilation instruments will be opened or closed, thus playing a decisive role in the production of the whole coal mine. Because of the harsh working environment and the high frequency of ventilation safety instruments, it is easy to affect the accuracy of related safety instruments under long-term high load and harsh environment, resulting in unpredictable consequences. Therefore, it is necessary to calibrate ventilation safety instruments regularly, so as to ensure the accuracy of ventilation safety instruments and instruments, so that

ventilation safety instruments and instruments can always serve the efficient production of coal mines. Verification and calibration require relevant operators to have high professional knowledge, but one is mandatory and the other is autonomous. At present, the problem of many coal mine enterprises is that there are no high-quality calibration personnel, which makes the calibration of underground ventilation safety instruments difficult, so that the hidden danger for the occurrence of safety accidents cannot be correctly displayed due to the specific values of related risk factors. Of course, there are many coal mine enterprises regularly change ventilation safety instruments and meters, which is commendable, but invisibly it increases production costs and reduces the economic benefits of enterprises.

3.2. Hardware Calibration Paths

When the concentration of gas or dust in the mine reaches the warning value, the computer can intelligently arrange the fan to increase the air intake, so as to effectively reduce the concentration of gas or dust and reduce the risk of safety accidents. And the application of computer technology in ventilation safety instruments can also monitor whether the ventilation safety instruments themselves are in normal operation, or even carry out automatic calibration to save manpower and material resources for coal mine production enterprises. Strengthen the management of ventilation safety instruments and instruments in coal mines to reduce the probability of various safety accidents. This requires not only the calibration of ventilation safety instruments and meters into the daily work, but also the hardware requirements. There is no need to calibrate ventilation safety instruments and instruments that have been working in underground for a long time. Under harsh conditions, the electronic components of these instruments themselves may have been affected. Therefore, after a period of time, there will still be errors, and there is no need for calibration. With the development of science and technology, a variety of new coal mine ventilation safety instruments emerge in endlessly, such as portable oxygen meter, portable carbon monoxide tester and other instruments, which were not available in the past. With the development of science and technology, the emergence of various new instruments has improved the accuracy of coal mine ventilation safety instruments, but also can monitor more data for underground mine. Production is better served. Therefore, in the management of mine ventilation safety instruments and meters, we should pay attention to the introduction of new ventilation safety instruments and instruments, and timely replacement of instruments and instruments with long working hours. Only in this way can we fully ensure that the values of instruments and meters are correct, and provide a scientific basis for the formulation of production plans of coal mine enterprises.

3.3. Software Calibration Paths

Considering the safety of underground ventilation, the quality standard of underground ventilation is checked systematically to ensure that the underground operation is in a safe environment and reduce the probability of accidents in underground safety production. In the process of mine ventilation safety management, security inspectors should strictly check every production link and production process, and then implement standardized management standards to significantly improve the quality of mine safety management. Coal mine production enterprises have created the database of ventilation safety undermine according to their own conditions. Establishing and using well ventilation safety database, drawing library and model library is the symbol of modern management of mine ventilation safety, and is the basis of regular simulation analysis and modern management of ventilation system by computer. In the production of coal mine enterprises, only by improving the importance of safety instrument calibration and incorporating safety instrument calibration into the technical management of coal mine, can the accuracy of underground mine ventilation safety instrument be fully guaranteed, thus serving the safety production of coal mine enterprises. Therefore, in the rules and regulations of coal mine enterprises, the daily calibration of ventilation safety instruments and meters must be written into them as a necessary work, and relevant personnel should be designated to check and calibrate all ventilation safety instruments periodically or irregularly, such as gas sensors, portable gas alarms, gas oxygen detectors, gas alarm lamps, etc. every other week. Only by assigning responsibilities to individuals can the whole calibration work be fully guaranteed,

and all ventilation safety instruments and instruments run smoothly, so that relevant operators can follow rules and be accountable when problems arise.

4. Conclusion

Ventilation safety instruments not only improve production efficiency, but also ensure the safety of workers. The aging speed of instruments and equipment is faster. Continuous maintenance and replacement are a big expense for any production enterprise. Aiming at the problems of backward management means, inaccurate data and easy loss of information, this paper studies and develops a management system based on Internet of Things. The system can help coal mine enterprises achieve real-time, accurate, safe and efficient management objectives in the management of ventilation safety instruments.

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