



Discussion on the Application of Intelligent Control Technology to Mechanical and Electrical Equipment in Coal Mines¹

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<https://oajgmb.damray.com/>

OPEN ACCESS

DOI: 10.26855/oajgmb.2023.12.003

Received: December 30, 2023

Accepted: January 28, 2024

Published: February 26, 2024

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Abstract

The rapid development of the social economy has led to a significant increase in coal resource consumption. Thus, ensuring the safe production of coal resources is crucial not only for sustainable development but also for promoting high-quality industrial development and ensuring stable livelihoods in China. Mechanical and electrical equipment in coal mines play a critical role in ensuring the safety and operational efficiency of these facilities. Efficient operation and maintenance of coal mine mechanical and electrical equipment can be enhanced through the application of intelligent control technology. This approach can enhance both the mining efficiency and the utilization rate of mechanical and electrical equipment in coal mines. This article primarily examines the implementation of intelligent control technology in coal mine electromechanical equipment, proposes specific application strategies, and offers practical guidance.

Keywords

Intelligent control technology, coal mines, electromechanical equipment

Currently, coal remains a crucial energy source and significantly influences the country's development. Thus, enhancing coal production efficiency necessitates a focus on technological advancements in coal production. Concurrently, modern intelligent technology continues to progress alongside scientific advancements. Within the coal mining industry of our nation, numerous intelligent control technologies have been integrated into coal mine electromechanical equipment. This integration serves to enhance both coal production safety and efficiency.

1. Intelligent control technology

1.1 Classification

Intelligent control systems are highly systematic and require the use of theoretical knowledge from different disciplines when used in different industries, thus highlighting the complexity of the operating process of the system. In view of the different requirements put forward by different industries for intelligent control systems, it is necessary to appropriately adjust the internal components of the corresponding intelligent control system according to the actual situation, so as to give full play to the benefits of the intelligent control system in actual production. According to the core functions,

¹ The Chinese version of this paper has been published in the Journal of Electrical Engineering and Automation. This version is a translated version and has been authorized and approved for publication by two publishers.

intelligent control systems can be divided into the following categories.

1.1.1 Hierarchical control system

The intelligent hierarchical control system usually divides the levels according to the actual production situation to successfully complete the intelligent control and operation of related equipment. It includes an automatic adaptive control system and a self-organizing control system. Different systems play different functions. Technical personnel are required to control hierarchical intelligent control systems, and the specific levels are divided into organization level, coordination level, and execution level. In actual work, different levels are based on their own functions and can respond to different stimuli, thus exerting control over the overall system.

1.1.2 Learning control system

The learning control system mainly plays an automatic control role. The learning control system analyzes and processes system data information based on actual operating conditions, so subsequent operations of the control system do not require manual control. The learning control system has automatic adjustment and action control functions. Combining the two functions can realize the automatic operation of the system.

1.1.3 Expert control system

The expert control system will collect the intellectual achievements of many experts in the relevant industry and immediately input them into the computer system after processing so that the intelligent control system can be better transformed and improved. In actual operation, if the computer receives stimulus instructions, then the expert control system will use the accumulated expert intelligence results to further identify the stimuli or instructions received by the system, so as to achieve the optimal processing effect. Therefore, the expert control system can completely combine the computer system with the wisdom of experts to obtain the best and ideal processing results.

1.2 Composition

The composition of the intelligent control system must be designed according to the operating principles of computer network technology to ensure its maximum functionality. At the same time, in order to optimize the utilization of intelligent control systems for automating the control of electromechanical equipment, technicians must incorporate high-quality components during the intelligent control configuration process. The most commonly used components include temperature sensors, point inspection instruments, collection stations, and intelligent communication equipment. In the intelligent control system, each component has its own function. Therefore, to prevent confusion during operation, it is essential to conduct a thorough inspection of the intelligent control system before officially starting the system and to guarantee the integrity of the components and good quality so that the electromechanical equipment can operate normally.

2. Overview of the advantages of intelligent control technology

2.1 Wide range of applications

In recent years, intelligent control technology has continued to develop and is widely used in various fields. The significant advantage of intelligent control technology is automation, so in some technical industries, it can replace most of the human resources to achieve truly automated processing and production. Its working principle is to combine intelligent control technology with automation technology and Internet information technology is combined to complete the programming of electromechanical equipment, and finally, the programming program is input into specific mechanical equipment to realize production automation [1].

2.2 Intelligent maturity

First of all, with the advancement of science and technology, information technology has become increasingly perfect, and its integration with intelligent technology has become closer. The maturity of modern intelligent control technology not only refers to automated production, but it can also learn from people's way of thinking and continuously optimize intelligent electromechanical equipment through bionic technology, thus greatly improving its intelligence. On the other hand, compared with conventional electromechanical equipment technology, the internal structure of intelligent control technology is relatively simple and easy to operate, and the intelligent control effect is more obvious. Moreover, it also exhibits a point-like characteristic that uses intelligent specialized control can independently control different modules of the electromechanical equipment system.

2.3 Superior quality

Intelligent control technology has relatively good performance in specific construction operations, especially in difficult construction operations. It also has relatively good performance. It can not only meet the operational requirements in difficult fields but also effectively prevent the influence of external factors. However, from another perspective, my country's development in this field is still in its infancy and needs further improvement [2].

3. Intelligent control technology is applied to coal mine electromechanical equipment

3.1 Utilization in mining equipment

3.1.1 Utilization in coal mining equipment

The use of intelligent control systems in coal shearer equipment can transmit data in real time, making it easier for staff to understand the operation of the coal shearer equipment. Intelligent control technology can be used to control the overall operation process. In actual work, workers can use intelligent communication technology to transmit various data information to the central computer control system and formulate targeted work instructions based on the actual conditions and operating needs of the coal mine. Coal mining enterprises can analyze equipment performance based on the intelligent control system, cancel the manual inspection mode, ensure the equipment inspection effect, and at the same time optimize the control of shearer equipment [4].

3.1.2 Utilization in coal mine monitoring equipment

In the coal mining process, intelligent control technology can enable online monitoring, fault diagnosis, and automatic alarms in the mine. Therefore, applying intelligent control technology to the coal mining process aims to maximize the safety of coal mine production and protect the lives of underground workers. The utilization of intelligent control technology to monitor coal mine operations has a significant impact on the entire operational process of the system. By utilizing online monitoring, the main performance is as follows: through intelligent control technology, the operating conditions of electromechanical equipment motors, working devices, hydraulic systems, and braking systems can be effectively detected. This ensures the safety of subsequent coal mine production operations to the greatest extent possible. Through intelligent control technology, fault diagnosis, and automatic early warning systems, mechanical and electronic equipment can be monitored effectively. Through this method, mechanical and electronic equipment can be inspected when an abnormality occurs. Early warning information can be promptly sent to managers, enabling them to utilize this information to replace equipment that has experienced abnormal conditions. This facilitates the quick execution of subsequent maintenance work in a timely manner. In coal mines, the most important thing is to ensure the safety of coal mine production and protect the lives of workers. If there are signs of landslides or explosions, the system will notify workers promptly to allow them time to evacuate.

3.2 Utilization in electromechanical transportation

3.2.1 Application of sensor technology

With the development of intelligent control technology, sensor technology has also made great progress and plays a very key role in mechanical and electrical transportation in coal mines. To optimize the mine electromechanical transportation system to the maximum extent, it is possible to integrate intelligent devices into the original electromechanical equipment of the mine. By building upon these intelligent devices, the sensors can be updated and upgraded to better connect with external control systems [6]. The use of sensor technology is conducive to the efficient transmission and reception of various signals from coal mine electromechanical transportation equipment and cooperates with the information processing system to further analyze and process the signals, and transmit the processing results to the control personnel, thus truly realizing the sensor Intelligent operation and control. In the mining work of the mine, the important role of sensors is reflected in the electromechanical transportation of the mine. Through the comprehensive use of Internet of Things technology, etc., it can effectively contact the external control operation center.

3.2.2 Timing positioning technology

The environment of coal mine mechanical and electrical transportation is very complex, resulting in many operating links of mine mechanical and electrical transportation and many people involved. Therefore, as long as there is an error in any link, it will cause safety accidents in mine mechanical and electrical transportation. For example, when the probability of errors in mine mechanical and electrical transportation increases, it is necessary to locate it in real time and for relevant staff to conduct in-depth verification and analysis to ensure that the problem can be solved in a timely manner. On this basis, ensure that the mechanical and electrical transportation can proceed smoothly. In order to better ensure the

transportation effect of mechanical equipment in mines, sufficient timing and setting of the mechanical equipment transportation process are required. In order to successfully realize the transportation purpose of intelligent control technology, it is necessary to accurately position the coal mine electromechanical transportation process, and at the same time, it is necessary to use coal mine electromechanical transportation timing positioning technology, which is conducive to better implementation of coal mine electromechanical transportation. Wireless positioning node technology can be promoted during the transportation process of mine electromechanical equipment. In this node, signal acquisition equipment is used to comprehensively collect information and transmit terminal signals to electromechanical equipment.

3.2.3 Network transmission technology

Applying computer network transmission technology to the process of mine mechanical and electrical transportation can transmit a series of information about mine mechanical transportation to the management department and control center. In mine electromechanical transportation, the commonly used network transmission technologies include wired and wireless control. Among them, each operation mode can be networked with sensors, which is conducive to the timely transmission of equipment monitoring results to the main control platform. The main control platform quickly processes these data and then transmits these data to a series of function expansion nodes. The application of network transmission technology in coal mining transportation has improved the level of intelligence and automation in coal mining machinery transportation. Network transmission technology has been used to establish an external information exchange platform for coal mining machinery transportation, making it easier for operators to judge faults of electromechanical transportation equipment.

3.3 Use of ventilation equipment

Using intelligent control technology in mine ventilation equipment can improve the safety and reliability of the overall ventilation system. The role of mine ventilation systems is to first expel toxic and harmful gases, bring in fresh oxygen, and ensure the safety of production work. By introducing intelligent control systems into mine ventilation equipment, firstly, it can optimize the airflow of fans and control systems to achieve braking purposes. It automatically adjusts the airflow based on the real concentration of harmful substances, which is faster in response compared to manual control methods underground, thus enhancing the safety of the ventilation system. Secondly, it can effectively reduce the energy consumption and air supply loss of ventilation devices, ensuring the efficiency of the devices. Finally, adopting intelligent technology can effectively reduce the workload of personnel and prevent safety accidents caused by operational errors.

4. Conclusion

The continuous development of intelligent control technology has led to ongoing improvements in the optimization of coal mine electromechanical equipment. Intelligent control technology not only enhances coal mine production efficiency but also reduces labor costs and safety hazards by releasing the workforce. Nevertheless, the intelligent control technology in our country requires further improvement. Relevant technicians and experts should focus on enhancing and optimizing it, thereby promoting both the development of intelligent control technology and ensuring the stable growth of the coal industry.

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