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Application of Computer and Artificial Intelligence Technology in Mine Electrical Automation Control

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Abstract: ***This article comprehensively explores the application and significant effects of computer and artificial intelligence technology in mine electrical automation control. The article elaborates on the core values of these technologies from three dimensions: improving production efficiency and work safety, reducing energy consumption and resource waste, and improving the production environment and ensuring production quality. Through intelligent and automated production methods, not only can production efficiency and stability be improved, but the safety and environmental protection of mines can also be enhanced, laying a solid foundation for the sustainable development of mining enterprises.***

Keywords: Mining; Electrical automation control; Computer; Artificial intelligence technology.

1. CONCEPTUAL ANALYSIS OF ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI), as a cutting-edge interdisciplinary field, has the core concept of simulating, extending, and expanding the theories, methods, technologies, and application systems of human intelligence. It aims to enable machines to perform complex tasks that typically require human intelligence, including but not limited to learning, reasoning, self correction, natural language processing, image recognition, speech recognition and synthesis, and decision-making. The implementation of AI relies on the deep integration of multiple fields such as computer science, mathematics, control theory, linguistics, psychology, etc. Through algorithm design, big data analysis, machine learning, deep learning and other technological means, the performance of intelligent systems is continuously optimized and improved. Among them, machine learning is one of the core driving forces of AI, which allows systems to automatically learn and improve from data without the need for explicit programming. With the continuous advancement of technology, AI is gradually penetrating into various fields of the social economy, from intelligent manufacturing, smart healthcare, intelligent transportation to financial risk control, education and entertainment, greatly improving production efficiency, service quality, and people's convenience in life. However, the development of AI is also accompanied by challenges such as ethics, privacy, and changes in employment structure. Balancing technological progress with social welfare has become an urgent issue that needs to be addressed. Chen et al. (2022) proposed a one-stage object referring method integrated with gaze estimation[1]. Wang (2025) developed a joint training approach for recommendation systems under missing-not-at-random data conditions using targeted learning[2]. Privacy concerns in advertising are addressed by Li et al. (2025) through a federated learning framework enhanced with differential privacy[3]. Generative models have been applied to urban design, as demonstrated by Xu (2025) in public space development[4], while Tu (2025) built an intelligent platform for 5G interoperability testing[5]. Real-time industrial monitoring was optimized by Xie and Liu (2025) using OpenCV and WebSocket[6], and Zhu (2025) proposed an LLM-based backbone system for improving platform stability in small businesses[7]. Zhang Yuhan (2025) introduced reinforcement learning for automated ad campaign optimization[8], and Hu (2025) developed few-shot neural editors for 3D animation in SMEs[9]. Tan (2024) reviewed AI application trends in automotive production[10], and Zhuang (2025) analyzed digital transformation in real estate marketing strategies[11]. Han and Dou (2025) designed a recommendation method combining graph attention networks with multimodal knowledge graphs[12]. Yang et al. (2025) explored RLHF fine-tuning of LLMs for alignment in conversational recommenders[13]. Zhang Jingbo et al. (2025) applied AI-driven sales forecasting in the gaming industry[14], and Yang Yifan (2025) optimized high-availability cloud computing architectures[15]. Tong et al. (2024) built a hybrid ML-DL framework for credit approval prediction[16]. Tian et al. (2025) proposed a cross-attention multi-task model for ad recall[17]. Legal text classification was advanced by Xie et al. (2024) using a Conv1D-based approach[18]. In healthcare, Chen Yinda et al. (2023) developed a vision-language pretraining method for medical image segmentation[19]. Li Huaxu et al. (2025) enhanced intelligent recruitment with transformer and GNN-based resume-job matching[20]. Network traffic forecasting was improved by Zhang Yujun et al. (2025) with a hybrid

model[21], while Zhang Zongzhen et al. (2025) applied deep learning to carbon market forecasting[22]. Peng et al. (2025) designed a navigation system bridging perception and global planning for autonomous driving[23]. Finally, Fang (2025) proposed a cloud-native microservice architecture for cross-border logistics support[24].

2. THE APPLICATION ADVANTAGES OF COMPUTER AND ARTIFICIAL INTELLIGENCE TECHNOLOGY

The application advantages of computer and artificial intelligence technology lie in their unparalleled efficiency, precision, degree of automation, and continuous learning and innovation capabilities. Computer technology, with its high-speed processing and large-scale data storage capabilities, greatly improves the efficiency and accuracy of information processing. Whether it is daily office work, data analysis, or complex computing tasks, computers can complete them in a short period of time, significantly improving work efficiency and productivity. Artificial intelligence technology further extends these advantages by simulating certain aspects of human intelligence, such as learning, reasoning, decision-making, etc., enabling the system to automatically adapt and optimize, and handle more complex and diverse tasks. For example, in the field of intelligent manufacturing, AI can monitor production processes in real time, predict equipment failures, optimize production scheduling, thereby significantly reducing production costs and improving product quality. Artificial intelligence also has strong automation capabilities, which can perform repetitive and labor-intensive tasks, reduce human burden, and avoid human errors. In fields such as healthcare, finance, and transportation, the application of AI has brought unprecedented convenience and security. Most importantly, artificial intelligence systems have the ability to continuously learn and innovate. By continuously learning new knowledge and skills from data, AI can continuously improve its performance and adapt to constantly changing environments and demands. This self evolving ability gives AI unlimited potential for future development.

3. THE APPLICATION OF COMPUTER AND ARTIFICIAL INTELLIGENCE TECHNOLOGY IN MINING AUTOMATION CONTROL

3.1 Design of Mining Electrical Equipment

In the vast field of mining electrical equipment design, the deep integration of computer and artificial intelligence technology is leading a revolutionary change. By utilizing high-precision computer-aided design (CAD) software, designers are able to construct three-dimensional models of electrical equipment with unprecedented precision, simulating their operating conditions under various working conditions. This process not only greatly shortens the design cycle, but also significantly improves the accuracy and reliability of the design. The application of artificial intelligence (AI) algorithms makes the design process more intelligent. AI can analyze massive amounts of design data and historical fault records, automatically identify potential problems in design, and provide optimization suggestions. This data-driven intelligent design approach not only reduces the cost of trial and error in the design process, but also enhances the overall performance and durability of electrical equipment. AI can also play a key role in the equipment selection stage, automatically recommending the most suitable electrical equipment configuration based on the actual working environment and needs of the mine, laying a solid foundation for the long-term stable operation of the mine.

3.2 Design of Mine Power Supply System

The rationality and reliability of the design of the mining power supply system, as the heart of mining production, directly affect the production efficiency and safety of the mine. In this field, the application of computer and artificial intelligence technology has demonstrated significant advantages. By constructing an intelligent power supply system model and utilizing advanced simulation technology, it is possible to comprehensively simulate the operating status of the power supply network under various working conditions, including load changes, fault occurrences, and other situations. AI algorithms can analyze this data in real-time, predict potential power supply issues, and automatically adjust power supply strategies to ensure the stability and safety of power supply. AI can also optimize power supply plans based on the actual electricity demand of mines, combined with historical electricity data and market electricity price information, to achieve the dual goals of energy conservation, emission reduction, and cost reduction. AI technology can also play an important role in the maintenance and management of power supply equipment. By monitoring the operational status and performance parameters of the equipment in real-time, AI can provide early warning of potential faults and scientific basis for preventive maintenance of the equipment. At the same time, AI can intelligently arrange maintenance plans and spare parts replacement based on

device usage and performance degradation trends, ensuring the long-term stable operation of the power supply system.

3.3 Design of Data Transmission Function

In the mining automation control system, data transmission function is a key link to achieve equipment interconnection, information sharing, and remote monitoring. The application of computer and artificial intelligence technology provides powerful technical support for the design of data transmission functions. By building an efficient and stable data transmission network and utilizing advanced communication technologies and protocols, real-time data exchange and sharing between various equipment within the mine can be achieved. In this process, AI algorithms play an indispensable role. AI can intelligently compress and encrypt transmitted data to reduce bandwidth usage and ensure data security during the transmission process. Through intelligent compression algorithms, AI can effectively reduce data transmission redundancy and improve transmission efficiency while ensuring data integrity. The application of encryption technology ensures the confidentiality and integrity of data during transmission, preventing illegal theft or tampering of data. AI can also perform real-time analysis and processing of transmitted data. By constructing data analysis models, AI can automatically identify and extract useful information from data, providing strong support for mining management decisions. For example, AI can analyze the operational data of devices, predict maintenance cycles and failure risks of devices; Production data can also be analyzed to optimize production plans and scheduling schemes. AI technology can also play an important role in handling data transmission failures. By monitoring the status and performance parameters of the data transmission network in real-time, AI can automatically detect and locate fault points, quickly restore data transmission functions, and ensure the stable operation of the mining automation control system.

3.4 Design of Mine Emergency System

In the design of mine emergency systems, the integration of computer and artificial intelligence technology provides strong guarantees for mine safety. By building an intelligent emergency command platform and utilizing computer technology to quickly collect, integrate, and display information, comprehensive and real-time emergency information is provided to decision-makers. Artificial intelligence technology can simulate various emergency scenarios, conduct emergency plan simulation exercises, and optimize emergency response processes. In emergency situations, AI can automatically analyze the cause of accidents, assess the scope of impact, and quickly generate scientific emergency response plans to guide rescue personnel to act quickly. AI can also monitor mining environmental parameters in real time through IoT technology, such as gas concentration, temperature, humidity, etc. Once abnormalities are detected, the warning mechanism will be triggered immediately to ensure the efficient operation of the mining emergency system.

3.5 Anti interference design in mine automation control

The complex and ever-changing mining environment poses severe challenges to the stable operation of automation control systems due to factors such as electromagnetic interference and mechanical vibration. To address these challenges, computer and artificial intelligence technologies are widely used in anti-interference design. By adopting advanced filtering algorithms and signal processing techniques, computers can effectively suppress external interference signals and ensure accurate transmission of control signals. Artificial intelligence technology can learn and adapt to the dynamic changes in the mining environment, automatically adjust system parameters, and improve the system's anti-interference ability. AI can also identify potential sources of interference in advance through predictive analysis and take corresponding preventive measures to ensure the stable operation of mining automation control systems.

3.6 Fault diagnosis function design

The fault diagnosis function is crucial for timely detection and resolution of problems in mining automation control systems. The application of computer and artificial intelligence technology makes fault diagnosis more intelligent and efficient. By constructing a fault diagnosis model and utilizing machine learning algorithms to learn historical operating data of equipment, AI can automatically identify characteristic patterns of equipment faults and achieve rapid fault localization. AI can also provide corresponding maintenance suggestions and solutions based on the type and severity of faults, helping maintenance personnel quickly eliminate faults. AI can also provide scientific basis for preventive maintenance of mining equipment by predicting and analyzing potential faults in advance. This data-driven intelligent fault diagnosis method not only improves the efficiency and accuracy of fault handling, but also reduces maintenance costs and extends the service life of equipment.

4. THE EFFECT EVALUATION OF COMPUTER AND ARTIFICIAL INTELLIGENCE TECHNOLOGY IN MINE ELECTRICAL AUTOMATION CONTROL

4.1 Effectiveness evaluation of improving production efficiency and work safety

In the field of mine electrical automation control, the deep integration of computer and artificial intelligence technology has had a significant effect on improving production efficiency and work safety. From the perspective of production efficiency, the application of these technologies makes the mining production process more intelligent and automated. By integrating advanced control systems and algorithms, mining equipment can achieve precise control and efficient collaborative operations, thereby significantly improving production efficiency. Intelligent devices can automatically complete repetitive and labor-intensive tasks, reducing the burden on manual labor and allowing workers to focus on higher value work. This intelligent and automated production method not only improves production efficiency, but also reduces the risk of human error, further enhancing production stability and reliability. In terms of work safety, the application of computer and artificial intelligence technology also plays an important role. By real-time monitoring of mining environmental parameters and equipment operation status, AI systems can timely detect potential safety hazards and trigger warning mechanisms to remind relevant personnel to take corresponding measures. This warning mechanism greatly reduces the probability of accidents and ensures the safety of workers' lives. Smart devices also have self-protection functions, which can automatically shut down or take other safety measures in case of abnormal situations to prevent accidents from escalating.

4.2 Effect evaluation of reducing energy consumption and resource waste

The application of computer and artificial intelligence technology in mine electrical automation control has significant effects on reducing energy consumption and resource waste. Firstly, by optimizing the power supply system and equipment configuration, AI algorithms can accurately calculate the energy consumption requirements of each production process, achieving on-demand allocation and refined management of energy. This refined management approach not only reduces energy waste, but also improves energy utilization efficiency. Intelligent devices have automatic adjustment functions, which can automatically adjust their operating status according to production needs and environmental changes, further reducing energy consumption. For example, in the mine ventilation system, AI algorithms can adjust the fan speed and air supply volume in real time based on the underground air quality, ensuring air quality while reducing energy consumption. The application of computer and artificial intelligence technology also helps to reduce resource waste. By building intelligent logistics systems and inventory management systems, AI algorithms can accurately predict production demand, arrange material procurement and inventory scheduling reasonably. This predictive analysis method not only reduces the risk of inventory backlog and material waste, but also improves the response speed and flexibility of the supply chain. Intelligent devices also have automatic detection and recycling functions, which can identify and recycle waste materials and scraps, achieving the recycling of resources.

4.3 Effectiveness evaluation of improving production environment and ensuring production quality

The application of computer and artificial intelligence technology in mining electrical automation control has significantly improved the production environment and ensured production quality. In terms of improving the production environment, these technologies ensure that the production environment meets safety standards and environmental protection requirements by monitoring and controlling mining environmental parameters in real time, such as temperature, humidity, dust concentration, etc. The intelligent ventilation system can adjust the ventilation volume in real time according to the underground air quality, ensuring sufficient air circulation and oxygen supply. The application of these technologies not only improves the production environment, but also enhances the work comfort and health level of workers. In terms of ensuring production quality, the application of computer and artificial intelligence technology also plays an important role. By constructing intelligent detection systems and quality control models, AI algorithms can monitor various parameters and indicators in the production process in real time, ensuring that product quality meets standard requirements. AI algorithms can also deeply mine and analyze production data, discover potential quality problems and improvement space, and provide scientific basis for the continuous optimization of the production process.

5. THE APPLICATION VALUE OF COMPUTER AND ARTIFICIAL INTELLIGENCE TECHNOLOGY IN MINE ELECTRICAL AUTOMATION CONTROL

The application value of computer and artificial intelligence technology in mine electrical automation control is immeasurable. They not only bring unprecedented levels of intelligence and automation to mining production, but also greatly improve production efficiency, work safety, energy utilization efficiency, as well as production quality and environmental standards. By integrating advanced control systems and algorithms, computer and artificial intelligence technologies enable mining equipment to achieve precise control and efficient collaborative operations, significantly improving production efficiency and stability. These technologies also have powerful data processing and analysis capabilities, which can monitor and predict various parameters and indicators in the production process in real time, providing scientific basis for production decision-making and optimization. In terms of safety, the application of computer and artificial intelligence technology effectively reduces the probability of accidents and ensures the safety of workers' lives. They detect potential safety hazards in a timely manner by monitoring the environmental parameters and equipment operation status of the mine in real time, and trigger warning mechanisms, enabling management personnel to quickly take measures to respond. Smart devices also have self-protection functions, which can automatically shut down or take other safety measures in case of abnormal situations to prevent accidents from escalating. In terms of energy and resource management, these technologies optimize the power supply system and equipment configuration to achieve on-demand allocation and refined management of energy, reducing energy waste and resource consumption. They also promote the recycling and reuse of waste materials, driving the green development and circular economy of mines.

6. CONCLUSION

The application of computer and artificial intelligence technology in mining electrical automation control is a key force driving the transformation and upgrading of the mining industry. They not only improve production efficiency and reduce costs, but also enhance safety and improve the environment, bringing unprecedented development opportunities for mining enterprises. In the future, with the continuous advancement of technology and the continuous expansion of application scenarios, there is reason to believe that these technologies will play a more important role in mine electrical automation control, leading the mining industry towards a more intelligent, green, and sustainable future.

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