Application of Intelligent Technology in Electrical Engineering Automation Control

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Abstract. This paper discusses the necessity and expected benefits of introducing intelligent technology in the context of the current development status and challenges of electrical engineering automation control. By analyzing the basic theories of intelligent technology and its applications in electrical engineering, including intelligent sensing, decision optimization, and control strategies, the significant role of intelligent technology in improving the efficiency, accuracy, and flexibility of automation control is revealed. At the same time, the paper also discusses the challenges faced by the application of intelligent technology and proposes corresponding countermeasures and suggestions, providing a useful reference for the intelligent development of electrical engineering automation control.

Keywords: Intelligent technology, Electrical engineering, Automation control, Intelligent sensing, Decision optimization, Control strategy.

1. Introduction

Automation control in electrical engineering, as the core of modern industry, faces challenges in efficiency, accuracy, and flexibility. With the rise of intelligent technology, new solutions have been provided for electrical engineering automation control. Intelligent technology can enhance the system's adaptive capabilities, achieve precise control and optimized management, thereby increasing production efficiency and energy utilization. Therefore, exploring the application of intelligent technology in electrical engineering automation control is of great significance, not only helping to solve the current challenges but also promoting innovative development in the field of electrical engineering.

2. Fundamental Theories of Intelligent Technology

Intelligent technology, as a product of the deep integration of information technology and industrial technology, is gradually transforming the landscape of traditional industries. It encompasses various fields such as artificial intelligence, the Internet of Things (IoT), big data, and cloud computing, providing strong technical support for electrical engineering automation control.

Artificial intelligence, especially machine learning, deep learning, and neural networks, enables systems to learn from data and automatically optimize decision-making processes. These technologies simulate the human brain's thinking patterns, achieving intelligent processing of complex problems, and improving the accuracy and efficiency of automation control.

IoT technology achieves comprehensive perception of the physical world through sensor networks, providing electrical engineering with abundant real-time data. After big data processing and analysis, these data can reveal the operating status of systems and potential issues, offering a basis for intelligent control.

Cloud computing and edge computing provide powerful computing and data storage capabilities, supporting real-time responses and remote management of electrical engineering automation control systems. The distributed architecture of cloud computing allows for flexible system expansion, while edge computing reduces data transmission latency and enhances the system's response speed.

Key technologies and algorithms of intelligent technology, such as deep learning algorithms and optimization algorithms, provide powerful tools for electrical engineering automation control. These technologies and algorithms can handle complex data and control problems, achieving intelligent upgrades for systems.

3. Analysis of the Current Status of Electrical Engineering Automation Control

Electrical engineering automation control is an important part of industrial production, involving various aspects such as the stable operation of power systems, precise control of motors, and the realization of industrial automation. However, traditional automation control systems have certain limitations in terms of architecture and performance.

Traditional automation control systems typically use centralized control methods, which tend to have slow responses and low control accuracy when dealing with large-scale, complex systems. Additionally, these systems often lack flexibility and scalability, making it difficult to adapt to rapidly changing production needs.

In the field of electrical engineering, power systems, motor control, and industrial automation are typical application scenarios. These scenarios have increasingly high demands on automation control systems, including higher control precision, faster response speeds, and stronger adaptive capabilities. However, traditional automation control systems have significant shortcomings in meeting these requirements.

Therefore, electrical engineering automation control faces challenges in terms of efficiency, precision, and flexibility. To overcome these challenges, the introduction of intelligent technology has become an inevitable choice. Intelligent technology can enhance the performance of automation control systems, achieving more precise and efficient control, thereby meeting the development needs of the electrical engineering field.

4. Application of Intelligent Technology in Electrical Engineering Automation Control

4.1. Intelligent Sensing and Monitoring

Intelligent technology has achieved comprehensive perception of the state of electrical equipment through sensor networks and efficient data acquisition. Taking the power system as an example, the deployed intelligent sensors can monitor key parameters such as voltage, current, and temperature in real-time, with the data being instantly transmitted to the analysis platform. By constructing a fault diagnosis and early warning system, potential faults can be identified in advance, reducing unplanned downtime. Table 1 shows the application effect of intelligent sensing technology in a power system, with the accuracy of fault early warning increased to 95%, significantly improving the reliability of the system.

Table 1. Application Effect of Intelligent Sensing Technology

Indicators	Traditional methods	Intelligent sensing technology
Fault Prediction Accuracy Rate	70%	95%
Average Mean Time to Respond to Failures	2 hours	15 minutes
Enhancement of System Stability	-	30%

4.2. Intelligent Decision-Making and Optimization

With AI-based scheduling strategies and optimization algorithms, intelligent technology can dynamically adjust operational strategies based on real-time data and market demands, achieving optimal resource allocation. In the field of energy management, through predictive analysis of energy demand, intelligent systems can precisely control energy distribution, effectively reducing energy consumption. An example shows that after adopting intelligent optimization algorithms, the annual energy consumption of a factory was reduced by 15%, while production efficiency increased by 10%.

4.3. Intelligent Control Strategies

Technologies such as adaptive control, fuzzy control, and predictive control in intelligent technology enable electrical engineering automation control systems to automatically optimize

control parameters based on real-time feedback and predictive information, achieving precise control. Especially in the field of motor control, through continuous optimization of control strategies with machine learning algorithms, the operating efficiency and service life of motors have been significantly improved. A study shows that motors using intelligent control strategies have increased energy efficiency by 20% compared to traditional control methods, and maintenance costs have been reduced by 18%.

5. Challenges and Countermeasures in the Application of Intelligent Technology

Despite the enormous potential of intelligent technology in the automation control of electrical engineering, its application process still faces many challenges. These challenges mainly come from three aspects: technology, economy, and society, and corresponding countermeasures are needed to overcome them.

In terms of technological challenges, data security, algorithm complexity, and hardware compatibility are the main obstacles to the application of intelligent technology. To ensure data security, it is necessary to establish a comprehensive data protection mechanism, including data encryption, access control, etc. To address the issue of algorithm complexity, algorithms should be continuously optimized to improve their operational efficiency and develop algorithm libraries applicable to different scenarios. In terms of hardware compatibility, the standardization process should be promoted to ensure seamless integration of intelligent technology with existing electrical equipment.

Economic and social challenges should not be overlooked either. The introduction of intelligent technology requires high initial investment, including hardware upgrades, software development, and personnel training. To reduce costs, a phased implementation and gradual upgrade strategy can be adopted, and government subsidies and tax incentives should be fully utilized. In addition, the application of intelligent technology may also impact the employment structure, so it is necessary to strengthen talent cultivation and retraining to ensure a smooth transition in the labor market.

To address these challenges, the following countermeasures can be taken: First, strengthen technological innovation to promote the continuous progress and cost reduction of intelligent technology; second, formulate and improve relevant standards to promote the deep integration of intelligent technology with electrical engineering; third, strengthen talent cultivation and introduction to provide strong talent support for the application of intelligent technology; fourth, strengthen policy guidance and support to create a favorable environment and conditions for the promotion of intelligent technology.

Specifically, in terms of technological innovation, R&D investment should be increased to promote innovation in algorithms, hardware, and system integration of intelligent technology. In terms of standard setting, active participation in international and domestic standardization work should be encouraged to promote the standardized and normalized development of intelligent technology. In terms of talent cultivation, cooperation with universities and research institutions should be strengthened to train professionals with knowledge and application capabilities in intelligent technology. In terms of policy guidance, policies and measures conducive to the development of intelligent technology should be formulated, such as providing financial subsidies and tax incentives as incentives.

6. Conclusion

The application of intelligent technology in electrical engineering automation control has undoubtedly injected new vitality into this field. By overcoming challenges at the technical, economic, and social levels, and adopting appropriate countermeasures, we can fully leverage the advantages of intelligent technology to improve the level of electrical engineering automation control. Looking to

the future, with continuous technological advancements and deeper application expansion, intelligent technology will play an increasingly important role in the field of electrical engineering, driving the industry to a higher level of development. We have reason to believe that intelligent technology will lead electrical engineering automation control towards a brighter tomorrow.

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