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DEVELOPMENT AND APPLICATION OF ELECTRICAL ENGINEERING IN ARTIFICIAL INTELLIGENCE AND BIG DATA ENVIRONMENT

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Abstract: With the rapid development of artificial intelligence and big data technology, the field of electrical engineering is undergoing profound changes. Based on the development trend and application status of electrical engineering in artificial intelligence and big data environment, this paper analyzes its influence on the development of traditional electrical engineering, its application in power system, power electronics, motor and electrical apparatus, automatic control, signal and information processing are also discussed. It will also focus on the challenges and opportunities faced by big data and artificial intelligence technology in electrical engineering applications, and look forward to the future development direction.
Keywords: Electrical engineering; Artificial intelligence; Big data; Application; Development trend

1 INTRODUCTION

With the continuous development of information technology, especially the breakthrough of artificial intelligence and Big Data Technology, electrical engineering field has ushered in a new development opportunity. Artificial Intelligence (AI) technology can simulate human intelligent behavior [1], such as learning, reasoning, decision-making, etc. . It can be applied to all aspects of electrical engineering, such as intelligent control, fault diagnosis, power grid optimization, etc. , new control methods and optimization algorithms are provided to improve system efficiency, security and reliability. Big data technology can extract valuable information from massive data [2], and provide more accurate analysis results and more effective decision support for electrical engineering field, such as power load forecasting, power grid security monitoring, etc. .

The application of artificial intelligence and big data technology has brought unprecedented changes in the field of electrical engineering, and promoted the development and innovation of electrical engineering technology. Based on the development trend and application status of electrical engineering in artificial intelligence and big data environment, this paper analyzes its influence on the transformation of traditional electrical engineering, its application in power system, power electronics, motor and electrical apparatus, automatic control, signal and information processing are also discussed.

2 BACKGROUND

The field of electrical engineering has been faced with a large number of data acquisition, processing and analysis problems.Traditional electrical engineering systems usually rely on manual analysis and experience judgment, and their low efficiency makes it difficult to meet the demands of modern society for intelligent, automatic and efficient electrical systems. Artificial Intelligence and big data technology provide new ideas and methods to solve these problems in the field of electrical engineering [3-4], and its application will bring the following benefits to the field of electrical engineering: (1) Improve efficiency: Big Data and artificial intelligence technology can automatically process large amounts of data, improve work efficiency, reduce labor costs. (2) Enhanced Intelligence: Artificial Intelligence technology can endow electrical system with intelligent ability, realize autonomous learning and decision-making, and improve the level of intelligence of electrical system. (3) Improved accuracy: big data analysis can more accurately identify the state of the electrical system and provide more accurate predictions. (4) Reduce risk: big data and artificial intelligence technology can monitor the running status of electrical systems in real time, and timely warning of potential risks, improve the safety of electrical systems. (5) Promoting Innovation: Big Data and artificial intelligence technologies have brought new research directions and applications to the field of electrical engineering, driving the innovative development of electrical engineering technologies.

3 TRENDS

Artificial Intelligence and big data technology are profoundly transforming the field of electrical engineering, driving electrical engineering trends in the following areas: (1) Intelligence: Electrical Engineering will be more intelligent, using artificial intelligence [5], big data, cloud computing and other technologies, electrical systems to achieve intelligent control and optimal management. For example, smart grid, smart distribution, smart electricity, and so on. (2) Digital: Electrical Engineering will be more digital, using digital twinning technology, build a digital model of electrical

system, electrical system to achieve virtual simulation and remote control [6]. For example, digital twin power grid, digital twin motor, digital twin power electronic devices. (3) Networking: Electrical Engineering will be more networked, using the Internet of things technology to achieve the interconnection of electrical equipment, and through data acquisition, analysis and processing to achieve intelligent management and control of electrical systems. For example, smart grid, smart factory, smart home and so on. (4) Personalized: electrical engineering will be more personalized, using artificial intelligence technology, according to user needs and environmental changes, provide personalized services and solutions. For example, personalized electricity scheme, personalized charging scheme. (5) Green: electrical engineering will be more green, the use of new energy technologies, reduce energy consumption, reduce environmental pollution, to achieve sustainable development. For example, new energy generation, energy storage technology, energy-saving technology, electric vehicles and so on.

4 APPLICATION STATUS

With the development of Internet of things and the popularization of intelligent devices, a lot of data are produced in the field of electrical engineering. These data present a new challenge to the traditional methods of processing and analysis, and also bring a great opportunity for electrical engineering. Using big data analysis and artificial intelligence techniques, it is possible to mine valuable information and potential trends from these data, analyze and optimize diagnostics autonomously, therefore, it can provide more accurate and efficient decision-making basis for electrical engineering. This is reflected in the following areas:

4.1 Power System

Applications of artificial intelligence and big data analysis in power systems include the following [7]: (1) Power load forecasting: Based on historical power load data, meteorological data, economic data and so on, this paper forecasts future power load to provide reference for power system dispatching. (2) Smart Grid Construction: using big data and artificial intelligence technology to build smart grid, realize intelligent management and control of grid, improve the efficiency, reliability and security of grid. (3) Optimal dispatching of power grid: using artificial intelligence technology to optimize the operation mode of power system, improve the efficiency of power generation, reduce the operation cost, and realize the rational distribution of power grid resources. (4) Power network security monitoring: using big data analysis technology [8], real-time monitoring of power network operation, identify potential faults and security risks, and timely warning. (5) Power market analysis: using big data analysis technology, analyze power market data, forecast power market price fluctuation, provide decision support for power trade. (6) Power equipment condition monitoring: using big data analysis technology, analyze power equipment operation data, identify potential faults, and carry out predictive maintenance.

4.2 Power Electronics

Applications of artificial intelligence and big data analysis in power electronics include the following [9]: (1) Power electronic device fault diagnosis: The use of big data analysis technology, analysis of power electronic device operation data, identify potential faults, and predictive maintenance. (2) Power electronic converter optimization design: using artificial intelligence technology, optimize the topology and control strategy of power electronic converter, improve the efficiency and reliability of the converter. (3) Power Electronic System Control: the use of artificial intelligence technology to achieve intelligent control of power electronic system, improve the efficiency and stability of the system.

4.3Electrical Machinery and Appliances

Applications of artificial intelligence and big data analysis to motors and appliances include the following [10]: (1) Motor Fault diagnosis: The use of big data analysis technology, analysis of motor operation data, identify potential faults, and predictive maintenance. (2) Motor performance optimization: the use of artificial intelligence technology, optimization of motor design parameters, improve motor efficiency and performance. (3) Motor Control: the use of artificial intelligence technology to achieve high-precision motor control, improve the efficiency and stability of motor control.

4.4 Automatic Control

Applications of artificial intelligence and big data analysis in automation include the following: (1) Adaptive control: the use of artificial intelligence technology, adaptive control, according to the changes in the environment, automatic adjustment of control strategies, improve the robustness and adaptability of the control system [11]. (2) Intelligent Control: the use of artificial intelligence technology, intelligent control, according to the state of the system and target needs, self-control strategy, improve the level of intelligent control system. (3) Fault diagnosis: using Big Data Analysis Technology, analysis of control system operation data, identify potential faults, and predictive maintenance.

4.5 Signal and Information Processing

Applications of AI and big data analysis in signal and information processing include the following: (1) Signal Analysis and recognition: the use of artificial intelligence technology, electrical signal analysis and recognition, such as power system fault signal recognition, voice recognition, image recognition. (2) Signal processing and compression: the use of big data analysis technology, electrical signal processing and compression, improve the efficiency of data transmission and storage efficiency. (3) Information Fusion: the use of big data analysis technology, the fusion of information from different sensors to achieve more accurate system state estimation and prediction.

5 CHALLENGES AND OPPORTUNITIES

The application of artificial intelligence and big data technology in electrical engineering faces the following challenges: First of all, the precision of big data analysis and artificial intelligence algorithms depends on the quality of data, and the data in electrical engineering field often have problems such as noise, missing, incomplete, etc. ,Data cleaning and Pre-processing are needed to improve data quality. Secondly, the data in the field of electrical engineering usually contains sensitive information, which needs data security protection to prevent data leakage and abuse and improve data security. Finally, the complexity of big data analysis and artificial intelligence algorithms is high, requiring high-performance computing platforms and professional algorithm engineers.

At the same time, artificial intelligence and big data technology also bring opportunities for the development of electrical engineering. For example: the continuous development of artificial intelligence and big data technology has brought new research direction and application field for electrical engineering field, and promoted the innovation and development of electrical engineering technology; Promote the upgrading and transformation of electrical engineering industry, improve industrial competitiveness, bring more benefits to society.

6 CONCLUSION

With the breakthrough and application of advanced technologies such as artificial intelligence and big data, the development of electrical engineering will be more widely used and deeply studied. For example, the application of big data and artificial intelligence technology to edge computing in electrical engineering field can realize real-time data processing and intelligent decision-making, and improve system response speed and efficiency. Combined with Internet of things technology, intelligent power grid, intelligent factory and intelligent home are built to realize intelligent management and control of electrical system. The digital twinning model of electrical system is constructed to realize the virtual simulation and remote control of electrical system, so as to improve the efficiency and security of the system. Cross-disciplinary integration with other disciplines, such as computer science, materials science and bioengineering, to achieve cross-disciplinary integration and promote innovation and development of electrical engineering technology.

Artificial Intelligence and big data technology are changing the field of electrical engineering profoundly, bringing new development opportunities and challenges for the field of electrical engineering. In the future, artificial intelligence and big data technology will be more widely used in the field of electrical engineering, and continue to promote the development and innovation of electrical engineering technology.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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