Application Research of Electrical Engineering Automation Based on Artificial Intelligence

ZhiYing Huang*
Bayingol Vocational and Technical College, Korla 841000, China

*Corresponding author e-mail: Zhiyinghuang@163.com

Abstract. As a derivative of computer technology and cloud technology, artificial intelligence technology can comprehensively improve social production efficiency. Electrical engineering has a direct connection with social production and people's quality of life. How to strengthen the control of electrical automation is a key concern of all levels of society today. Based on this, analyze the advantages of applying artificial intelligence technology in electrical automation control starting with artificial intelligence, and then analyze the application strategy of artificial intelligence based on engineering examples.

Keywords: Electrical Automation Control, Artificial Intelligence, Application, Advantages

1. Introduction

Automation control technology has the characteristics of good operation accuracy, strong operability, high work efficiency, etc., and is widely used in today's electrical engineering\(^1\)-\(^2\). However, the electrical equipment automation system has a certain transient in the operation process, which affects the operation efficiency and safety of the electrical system to a certain extent. This requires to control the uncertain factors in the automation system with the artificial intelligence technology, and control various information through fuzzy logic operation \(^3\)-\(^4\). Artificial intelligence technology uses computer and cloud computing functions based on intelligent technology, to apply related system actions to practical production. Due to the development of computer technology, people can control the supporting equipment of computers through software programming \(^5\). Nowadays, the most outstanding performance of China's artificial intelligence technology is intelligent systems and intelligent robots. Among them, intelligent robots use human brain thinking to transfer data to intelligent systems by simulating human brain thinking, thereby ensuring that the robot can accurately process certain things. From the perspective of the development stage of artificial intelligence, the
artificial intelligence technology has very large development space. The emergence of this technology indicates that people will move from the era of automation to the era of intelligence and apply it to electrical automation control systems, thereby improving the operation efficiency of the automation system[6].

In recent years, artificial intelligence technology has received great attention from all levels of society, and most scientific research units and departments have conducted in-depth research on artificial intelligence technology. For electrical engineering, artificial intelligence technology is mainly applied in electrical equipment design, fault diagnosis, production control, supervision and early warning. First, at the electrical design level in the electrical automation system, due to the complexity and cumbersomeness of the equipment structure, its scope is very extensive, requiring technical staff to have rich operating practices; Second, in terms of accident and fault diagnosis, the advantages of fuzzy logic and neural networks can be effectively used to implement early warning and monitoring functions by applying artificial intelligence technology. If an alarm occurs, it indicates that a problem has occurred in the entire electrical automation control system; Third, the artificial intelligence technology is applied in electrical automation control, conducting intelligent control through three ways of neural network, fuzzy control, expert system, of which the fuzzy control technology is applied the most commonly, which is often called "AI" control, which is often called "AI" control.

2. Advantages of applying artificial intelligence technology in electrical automation control

2.1. Reduce investment in human resources

Compared with traditional automation technology, automation technology can do the corresponding things step by step, that is, mechanized production movement. The artificial intelligence technology can not only effectively replace the manual labor mode, but also can imitate the human brain thinking and control the occurrence rate of errors, which is mainly due to software programming technology. Electrical system operation is a very complicated task, which requires a large number of staff to control the operation, and through the application of artificial intelligence technology, only 1 or 2 managers are required to implement the electrical system operation (mainly for supervision).

2.2. Strengthen product standardization

In the actual operation process, electrical equipment usually runs according to the program standard, and it will not be affected and interfered by external factors in actual operation. All production processes are duplicate programming content, which provides a huge guarantee for production standardization and uniformity. At the same time, application programming technology can be designed according to time and language, and corresponding actions can be made at fixed times according to the programming model, so that the correct production actions can be made at the correct time, which greatly improves the standardization of the product.

3. Application of artificial intelligence technology in electrical automation control

3.1. Project overview

An electrical project is a very typical form of office building construction (main control room for electrical equipment), with a total area of 823.44 m2 and a height of 34 m in 9 floors in total. Among
them, the first floor is mainly electrical equipment room; the second floor is the activity room and storage room; the remaining 7 floors are offices and guest rooms. According to the "Code for Fire Protection Design of High-rise Civil Buildings" (GB 50045) and "Code for Design of Automatic Alarm System for Electrical Engineering", the project belongs to the second-class high-rise building, and the object of the automatic fire alarm system is a second-level unit. The electrical engineering first-level load includes fire pumps, emergency lighting, smoke exhaust fans, indicator lights, and fire control. The power distribution of the power distribution room is as follows: cabinet 1 is used for fire pumps, smoke exhaust fans, fire shutter doors, etc.; Cabinet 2 is used for emergency lighting, safety exit indicators, evacuation indicators, fire control rooms, etc.; the remaining 3, 4, and Cabinet 5 is mainly used for 1 ~ 3, 4 ~ 6, 7 ~ 9 layers of lighting electricity; Cabinet 6 is reserved. This project mainly adopts the power distribution method of trunk and radial combination. The main power distribution trunk is the electrical shaft caused by the cable trough of the ceiling of the power distribution room. There is a main power distribution box in each floor of the electrical shaft. The automatic control system mainly includes equipment detectors, smoke and temperature detectors, graphic display equipment, emergency broadcasting systems, fire telephone hosts, automatic alarm systems, etc., and applies artificial intelligence technology-AI and expert systems.

3.2. Application of artificial intelligence technology in electrical automation control system

1) Fault diagnosis in automatic control

Because artificial intelligence technology includes neural network control technology, expert technology, etc., in the actual application process, the operating status of electrical equipment can be judged, and at the same time, the fault type can be fuzzy analyzed, so that the accuracy of fault diagnosis of electrical automation control systems can be ensured. Especially in the fault diagnosis of engines, generators and transformers, the efficiency of intelligent technology can be effectively exerted. Because in the entire electrical automation control system, there are many factors that cause failures, and the failure frequency of some equipment is relatively high, so once a failure occurs, the detection equipment in the system will find the failure point and the cause of the failure. If it is a software failure problem, the system will handle it by itself; if it is a hardware failure problem, the system will directly present the failure problem to the computer display terminal, so that effective measures can be targeted.

![Figure 1. Generator fault detection under artificial intelligence](image-url)

In the experiment of the electrical automation control system of this project, the transformer has
had a fault problem. Since the transformer is a hardware fault, the transformer fault alarm is automatically issued in the terminal of the electric control room and the fault condition is displayed. After seeing the terminal display an alarm, the staff turned off the power in the area where the transformer was located and repaired it. The entire fault took only 20 minutes to repair. Artificial intelligence technology can not only improve the accuracy of fault diagnosis, but also improve the efficiency of fault repair.

![Figure 2. Engineering electrical automation control system](image)

2) Implement integrated control

In the practical application of this electronic engineering system, the staff can use expert decision support in the operation process, summarize and classify expert knowledge and electrical automation control experience, and perfect problems existing in software programming. It can strengthen the learning ability of intelligent technology and continuously improve the operating performance of automated control systems.

In the practical application of this project, since the automation control system involves 6 cabinets, a power direction protection method is adopted, that is, a protection method of selecting lines through data concentration. In traditional engineering, if a problem occurs in a certain area, it will prompt a certain area of damage and require the staff to troubleshoot. However, intelligent operation can be performed on the protection device through the introduction of artificial intelligence technology, such as leakage, overload, and phase failure, and the problems of short circuit can be intelligently protected. At the same time, because the sensor is added, you only need to click the corresponding monitoring module in the terminal to get the monitoring data in the area, so as to realize the dynamic management mode.

3) Intelligent operation of electrical equipment
The integration of artificial intelligence technology into the electrical automation control system can effectively avoid the complexity of the automation equipment wiring mechanism, which causes problems such as the lack of reliability of electrical equipment operation. The addition of artificial intelligence enables the automation control system to achieve not only dynamic management functions, but also intelligent operations and remote command functions, that is, on the basis of intelligent operation, it can also operate and control the electrical system targeting at actual work conditions on terminal devices, so as to ensure that the wiring of automation equipment is more flexible, thereby improving the safety of system operation.

The calculation formula of electric power is shown in formulas (1) and (2):

\[ P_I = P_a / \eta_a \]  
\[ P = I^2 R \]

In the formula, \( P_I \) is the input power, \( P_a \) is the rated power, and \( \eta_a \) is the efficiency.

In this electrical project, although the operation mode of the automation control system is not much different from before, the system has not experienced software faults in actual operation, only one hardware failure of the transformer has occurred, and the entire system is very stable, indicating that the anti-interference ability of the whole system has been enhanced. It can be seen that the entire process of the electrical engineering operation is under intelligent monitoring and control, and the secondary equipment also implements dynamic and integrated management through digital control methods. In order to further improve the anti-interference ability and data transmission ability (to avoid signal attenuation), the connection lines of all automatic control equipment are using fiber optic cables, which greatly improves the application effect of artificial intelligence technology. Through practical testing, there is almost no signal attenuation problem in data transmission.

4. Summary
The application of artificial intelligence technology in electrical automation engineering can not only manage dynamically the electrical automation control system, but also ensure the operation safety of the entire system software and hardware. This article focuses on the characteristics, application status, and technical advantages of artificial intelligence technology, and also describes the application of artificial intelligence technology in conjunction with electrical engineering, with a view to comprehensively promoting the healthy development of China's electrical industry.

References
[1] Lingling Tian, Juncheng Jiang, L. Tian. Safety analysis of traffic flow characteristics of highway tunnel based on artificial intelligence flow net algorithm[J]. Cluster Computing, 2019, 22(3):1-10.
[2] Jianzhou Wang, Wendong Yang, Pei Du. Research and application of a hybrid forecasting framework based on multi-objective optimization for electrical power system[J]. Energy, 2018, 148(2):59-78.
[3] Jun Li, Huicong Li, Weiwei Li. Research and application of thermal power unit’s load dynamic adjustment based on extraction steam[J]. IOP Conference Series Earth and Environmental
Science, 2018, 113(1):112-120.

[4] John Howard. Artificial intelligence: Implications for the future of work[J]. American Journal of Industrial Medicine, 2019, 62(4):20-31.

[5] Geraldo Pereira Rocha Filho, Leandro Yukio Mano, Alan Demetrius Baria Valejo. A Low-Cost Smart Home Automation to Enhance Decision-Making based on Fog Computing and Computational Intelligence[J]. IEEE Latin America Transactions, 2018, 16(1):186-191.

[6] Furman J. Should We Be Reassured If Automation in the Future Looks Like Automation in the Past?[J]. Nber Chapters, 2018(1):112-121.