Electrical Automation Engineering Based on AI Technology

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Abstract: In the research of electrical automation engineering, AI technology has been widely used in industrial production and scientific research. It can help people do deeper and higher quality work, and also improve our ability to develop artificial intelligence systems. Therefore, this paper designs an electrical automation engineering system based on AI technology. Firstly, this paper introduces the concept and composition of electrical automation engineering, then expounds the definition, characteristics and classification of AI technology, then studies the existing problems of electrical automation engineering, designs the electrical automation engineering system framework based on AI technology, and tests the function of the system. Finally, the test results show that in terms of the stability of each module function of the system, the shortest stability time is at least 24 hours, which can ensure the stable operation of the system. In terms of the time spent connecting to the network, the DNS lookup time is within 3 seconds, the server processing time is within 2-3 seconds, and the content data transmission time is within 4 seconds. This shows that the system can run stably.

Keywords: AI Technology, Electrical Automation, Electrical Engineering, Automation Engineering

1. Introduction

The application scope of electrical automation engineering is becoming wider and wider. It mainly includes industrial production, agricultural modernization, power system control and information collection. In today's society, computer technology and network communication have been widely used [1-2]. With the continuous improvement of artificial intelligence and the development and maturity of intelligent manufacturing, intelligent electrical equipment has been widely used. At the same time, it has also brought great changes to the traditional manufacturing industry - from high labor cost to low machine cost. Moreover, the application scope of electrical automation engineering is becoming wider and wider, which can realize the automatic monitoring of factory production process Functions such as remote operation management and control enable enterprises to obtain more profit space [3-4].

Many scholars have done relevant research on electrical automation engineering. Some scholars have proposed an electrical automatic system integration mode (EPC) based on AI technology. Other scholars have established a "smart grid" structure system with computer program control as the core, information interaction platform as the support point and power electronic component interface as the main body, and realized the visualization and automatic control of various data processing processes through software simulation man-machine interface [5-6]. The application of electrical automation has developed for some time in China. Although the domestic technology is relatively mature, there are still some problems. For example, the quality of electrical automation engineering is restricted by the lack of perfect and complete industry standard system, lack of professionals and advanced equipment. The other is the lack of unified and effective management methods. Most enterprises in China adopt centralized mode for production and business activities [7-8]. Therefore, based on AI technology, this paper studies electrical automation engineering.

With the continuous development of electrical automation engineering, AI technology is more and more widely used in power system. Especially in recent years, China's power grid companies have begun to introduce artificial intelligence into intelligent equipment. Firstly, this paper introduces AI and its related terms, characteristics and current research status at home and abroad. Then it illustrates the problems and shortcomings of traditional electricians and robots, and finally summarizes and puts

forward specific suggestions.

2. Discussion on Electrical Automation Engineering Based on AI Technology

2.1 Electrical Automation Engineering

2.1.1 Concept

Electrical automation engineering is the combination of computer technology and artificial intelligence. In the process of design, the system can be automatically controlled to meet various work requirements. At the same time, it realizes intellectualization through software programming, organically combines modern information technologies such as computer network technology and automatic control theory with electromechanical equipment, and fully applies intelligent thinking mode and management mode in the design to realize intelligent management of the whole power system and make it have good performance. Electrical automation is a new subject [9-10]. It mainly includes the following aspects: 1) information acquisition and monitoring system. 2) Data transmission, processing and integrated control system. 3) Communication technology system, etc. There are two communication modes: analog switch and digital signal encoder. In the design process of electrical automation engineering, it is necessary to continuously optimize and upgrade it considering the actual situation and requirements, so as to ensure that the quality level of the whole electrical automation engineering can achieve the expected effect. It mainly includes: electronic technology, microcomputer principle and application and other relevant theoretical knowledge and practical experience, as well as some basic skills, such as data acquisition and processing ability and information processing ability. It also has certain special performance or functional requirements (such as control logic), which can simulate operation and complete tasks on the computer. At present, China's power industry is developing rapidly. With the continuous improvement of scientific and technological level and the increasing requirements for people's quality of life, we must pay attention to the great changes and influence brought by the emerging field of electrical automation engineering. At the same time, it will also promote the further upgrading of relevant enterprises in technology.

2.1.2 Composition

Electrical automation engineering is mainly composed of sensors, controllers and relay protection equipment, which can be divided into intelligent instrument system, automatic control system, distributed control technology and computer network. In the system, the main control device plays a core role. It can run the electrical equipment according to certain requirements, judge and process its state, while other parts play an auxiliary role, such as signal acquisition circuit. In addition, another important part is the control network structure composed of communication interface circuit between actuator and operating mechanism and monitoring software, which constitutes the electrical automation engineering control system. Intelligent electricity meter combines modern control theory and computer technology to realize the effective utilization of electric energy and improve its economy by optimizing the power system. In the design process, factors affecting the user's use time and equipment operation status shall be fully considered, and a reasonable scheme shall be selected in combination with the actual situation [11-12].

2.2 AI Technology

2.2.1 Definition

AI technology is a new subject. It has great potential in engineering design and electrical automation system control. Artificial intelligence refers to the perception, analysis and judgment of the objective world of nature through the human brain. Intelligent robots usually realize the automatic operation function by computers or other equipment. For example, computers are used in industry to complete various calculation tasks, and mechanical mechanisms can change their parameters according to the actual work requirements, so as to achieve the expected accuracy level, and so on. AI technology has universality and special practicability in engineering field. It perfectly combines artificial intelligence and human-computer interaction. At the same time, AI is also a machine model based on information acquisition and processing. It will collect a large amount of data for analysis and integration, and make decisions and judgments after obtaining the corresponding parameters through a certain algorithm. At the same time, it can adjust its working state or adjust according to the specific environmental conditions to adapt to the environmental changes and continuously improve its

performance. It can also use expert experience to predict the important modules in the system, so as to improve the level of the whole artificial intelligence.

2.2.2 Classification

AI technology can be classified into many types according to its functions. (1) Program according to the control body type. Control program is a computer language with the highest degree of intelligence and the widest range of application. It has the characteristics of high complexity and fast speed. It plays an irreplaceable role in processing data. Compared with human beings, it is easier to remember and maintain the balance between the amount of information and use efficiency. However, its disadvantages are also obvious. For example, the requirements for operators are very strict, and the control procedures are not well understood, resulting in work errors from time to time. (2) Program according to language instructions. All symbols used in the process of program compilation are directly controlled by the programmer and passed to the computer. This method has a very obvious advantage, that is, it can judge its operation and results without manual intervention, and modify the code to realize automatic generation, compilation and other operations. Therefore, it can well ensure the program quality and improve the software development efficiency, and will not produce some unnecessary waste of resources.

2.2.3 Features

AI is characterized by: (1) intelligence. Artificial intelligence technology uses computer language to process information, analyze data and control logic to realize human-computer interaction, so as to achieve the purpose of automation and complete complex tasks. At the same time, it can also coordinate the mutual cooperation between various parts of the system through program operation and execution. During operation, a large number of input signals will be automatically generated and transmitted to the control system in real time to ensure its accuracy and reliability. (2) Strong robustness. AI technology realizes human-computer interaction by using the intelligent characteristics of computer, such as instruction set, algorithm rules and so on. Because AI has strong self analysis ability and strong randomness, it can constantly respond to environmental changes and change its state to deal with the work required in different situations.

2.2.4 BP Artificial Neural Network Algorithm

In general, the topology of BP artificial neural network algorithm model can be divided into the following three layers: data input layer, model hidden layer and learning result output layer. The hidden layer in the model can be one-layer neural network or multi-layer neural network. BP artificial neural network algorithm is a typical supervised learning algorithm. It needs to know the expected value or actual category of each training sample in advance. When training and constructing BP artificial neural network algorithm model, we need to ensure that the input eigenvector of each training data sample has a one-to-one corresponding expected output value. When there is a large error between the expected output value and the actual predicted output value of BP artificial neural network algorithm model, BP neural network can automatically adjust the relevant parameters in the model by means of error back propagation, so that the adjusted parameters can reduce the training error. After many times of training, when the final output results are consistent with the expected output or meet the user's expectations, the learning process of the neural network terminates.

$$M = \sqrt{N + K} + \alpha \tag{1}$$

$$Neu_m^m = \sum_{n=1}^{N} x_n w_{nm} + \theta_m \tag{2}$$

Where a is the adjustment parameter between 1 and 10. When the number of nodes in the bottom input layer, the number of nodes in the final output layer, the number of nodes in the middle hidden layer and the excitation function used in each hidden layer neuron node are determined, a general BP artificial neural network algorithm structure with three-layer structure is built.

2.3 Existing Problems of Electrical Automation Engineering

The first is that in the process of electrical automation control, the control system cannot work normally and stably due to insufficient consideration of factors such as system operation environment and relevant technical parameters. At the same time, improper design will also reduce the control effect. The second is lack of advanced nature and rationality. At present, many enterprises in China lack a

certain mature computer network platform to support their data processing function and system security performance. In addition, there are a series of problems, such as serious waste of hardware resources and insufficient software development ability, which need to be paid enough attention to and solved. In the actual operation process of the electrical automatic device system, due to the lack of mastery of product quality detection technology by the construction personnel, the quality performance can not meet the standard requirements. At the same time, there will also be some problems, such as electric leakage, misfusion and so on. In addition, there may be a series of problems such as failure or damage caused by the mismatch between some component parameters and normal working conditions, which need to be solved manually or repaired to avoid unnecessary economic loss and resource waste.

3. Electrical Automation Engineering Experiment Based on AI Technology

3.1 Structural Design of Electrical Automation Engineering
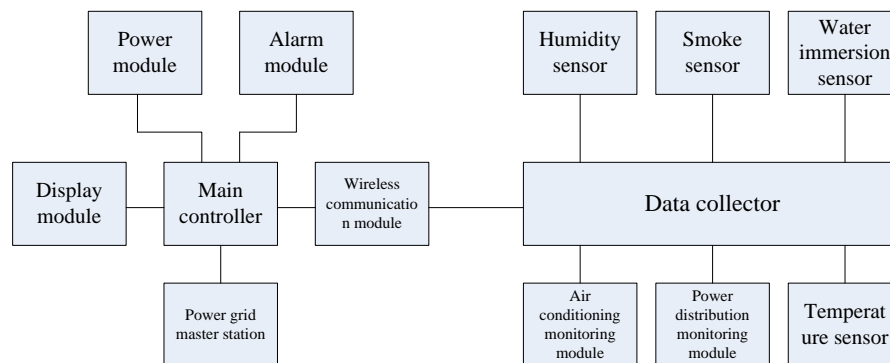

Figure1: Structural design of electrical automation engineering based on AI

As can be seen from Figure 1, the architecture of electrical automation engineering design is mainly composed of computer system, network communication technology, database management and other related software. In the whole system, all functional modules are interrelated and can complete information transmission. The computer system is responsible for data acquisition and processing. By converting the user's request into the corresponding equipment instruction for transmission, it is also necessary to perform the operation according to the corresponding command and record the relevant parameter values for later analysis and maintenance. In addition, it is also necessary to improve and optimize the design of auxiliary parts such as network communication technology, so as to realize remote control, centralized management and unified monitoring.

3.2 Design Principles of Electrical Automation Engineering

The electrical automation system is an interface platform to realize the function of distribution automation. In the construction process of the main station, by comprehensively considering the construction scheme and specific application scope of feeder automation, the overall scale of the system and the whole construction cycle and other factors, the database, network technology, object-oriented modular idea and application component technology are adopted. At the same time, the electrical automation system adopts the information interaction model for architecture, and realizes the information sharing with other systems through bus interaction technology, including system software platform, hardware platform, network platform, application function realization, safety protection and other specific contents. In its construction and implementation, it follows the following basic principles.

(1) The hardware of the electrical automation project adopts advanced devices and equipment that meet international standards, has strong data processing capacity, ensures high safety and reliability, and the equipment has universality and scalability, which can effectively meet the requirements of equipment capacity expansion and transformation.

(2) The software part of the electrical automation system is based on the modular design idea, which can effectively realize the information interaction between the distribution automation system and other systems, such as dispatching system, system, system, etc. Moreover, the software architecture design of the main station of distribution automation provides function expansion and plug-in interface,

which can effectively meet the needs of the actual distribution system, regulators and other aspects. In order to ensure the reliability and security of the system, and to maintain the design's continuity and the advanced nature of the system, the operating system platform is adopted in the server and workstation of the electrical automation system. In order to ensure that the master station can effectively process massive data information, a mature database system is adopted, which can support language and provide effective interface. At the same time, the electrical automation system shall meet the standard requirements of the secondary system in terms of security protection, that is, meet the requirements of partition security, inter area firewall configuration, private network, etc., effectively avoid risk factors such as man-made destruction or virus attack, and effectively ensure the safety and reliability of system data and operation.

3.3 Function Test of Electrical Automation Engineering Based on AI

In electrical automation engineering, the test is mainly to evaluate the reliability and stability of the system function and whether the intelligent control system can work normally. By checking whether the design meets the needs of users, we can judge whether it can meet the required standards. The automatic protection device is realized by real-time monitoring and control of the state of power equipment. In the actual operation, various signals can be collected by sensors or digital instruments, converted into electrical analog values and output to the electrical automation engineering test function module, and then the test software gives the corresponding data to display the results.

4. Experimental Analysis of Electrical Automation Engineering Based on AI Technology

4.1 Functional Test of Electrical Automation Engineering Based on AI Technology

Table 1 is the electrical automation engineering functional test data.

Table1: Functional test of Electrical Automation Engineering

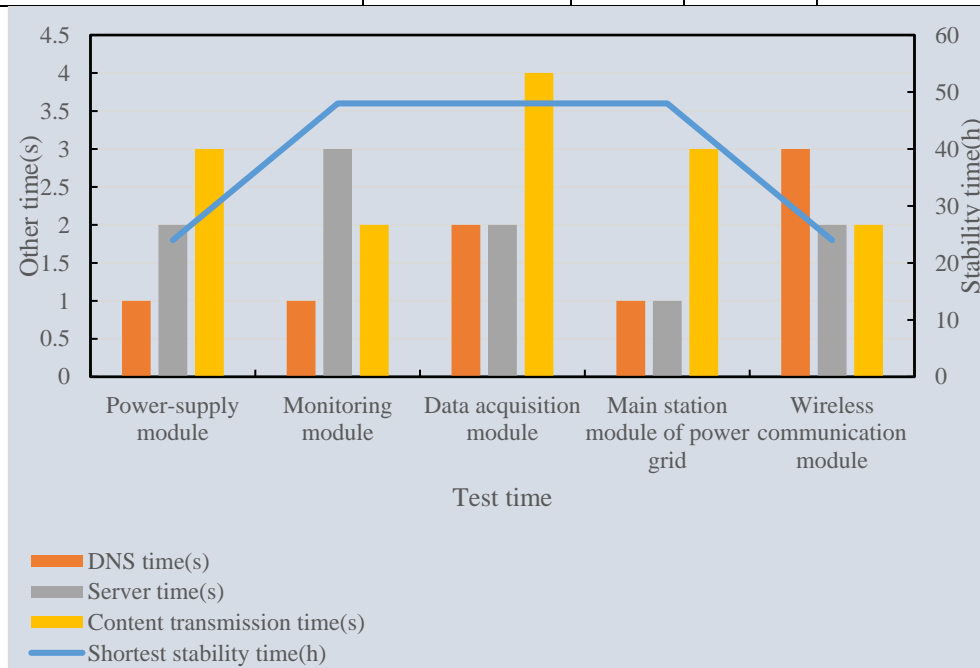| Test module	Shortest stability time(h)	DNS time(s)	Server time(s)	Content transmission time(s)
Power-supply module	24	1	2	3
Monitoring module	48	1	3	2
Data acquisition module	48	2	2	4
Main station module of power grid	48	1	1	3
Wireless communication module	24	3	2	2

Figure2: Functional test of the electrical automation engineering module

System function test is mainly to test each module of electrical automation engineering, including communication between master station and slave station, data acquisition and parameter setting. It is easy to find and solve problems in the commissioning stage. As can be seen from Figure 2, in terms of stability of each module function of the system, the shortest stability time is at least 24 hours, which can ensure the stable operation of the system. In terms of the time spent connecting to the network, the DNS lookup time is within 3 seconds, the server processing time is within 2-3 seconds, and the content data transmission time is within 4 seconds. This shows that the system can run stably.

5. Conclusion

With the development of artificial intelligence technology, AI controlled electrical automation engineering design is more and more widely used in the field of electrical and mechanical equipment. The intelligent, remote network and automatic detection and diagnosis system are analyzed and studied. This paper designs an electrical automation control system based on the principle of computer-aided manufacturing and artificial intelligence. The energy supply management and optimal control of power grid dispatching based on AI technology are introduced to realize the optimal design of power grid structure. The simulation test is carried out to improve the power quality and utilization efficiency.

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