Development and Realization of Electrical Automation Control System

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Abstract. With the development of computer intelligence technology, it has brought new opportunities and challenges to the development of electrical automation control systems. This article mainly analyzes the automatic detection technology and the design of the electrical automation control system. It also studies the electrical automation control system.

Keywords: Computer Intelligence Technology, Automatic Detection Technology, Electrical Automation Control System

1. Introduction

In addition to the rapid economic growth, China's power and energy sector has also made considerable progress. Nowadays, the application of automatic control technology based on computer technology in the power energy system is also increasing. In order to strengthen its own development, enterprises must constantly update related technologies and make full preparations for the next development [1].

2. Automatic detection technology

2.1. The function of automatic detection technology

Automatic detection technology means that the system can automatically detect errors without requiring people or a few people, and this automatic monitoring technology can effectively reduce the factors of human intervention and human error. It not only enhances the accuracy of measurement and analysis, but also ensures the reliability and performance of the production process or equipment. Automatic detection technology is developed on the basis of the use, development, production and measurement of equipment and meters. It needs to directly measure and display the measured parameters. It provides users with information about the changes in the measured object [2]. The other is a front-end system used as an automatic control system, which implements automatic control according to changes in parameters. Its modular design framework is shown in Figure 1.
2.2. Application of detection technology
Automatic detection technology is a kind of technical control, the main content is to study the extraction and processing of valuable information data in the automatic detection system. It mainly detects special or uncertain symbols, identifies specific information characteristics, and collects information with suitable equipment under specific conditions. The core content of automatic search technology research includes data measurement, measurement methods, measurement systems, and data processing [3].

3. Design of electrical automation control system
There are three main modules in the electrical automation control system based on computer intelligence technology, as shown below.

3.1. Support vector machines
Suppose there are l training samples \( X_i \in \mathbb{R}^d \), the samples are labeled as \( y_i \in \{-1, +1\} \). If the sample is linearly separable, the support vector machine method is to find an optimal hyperplane, as shown in formula (1):

\[
W^T X + b = 0
\]  

(1)

In formula (1), \( W \) and \( b \) are the normal vector and intercept of the optimal hyperplane, respectively. The solution of the optimal hyperplane needs to be minimized \( \frac{1}{2} \|W\|^2 \), that is, the quadratic programming problem shown in formula (2) is calculated:

\[
\begin{aligned}
\min_{w,b} & \quad \frac{1}{2} \|W\|^2 \\
\text{s.t.} & \quad y_i(W^T \cdot X_i + b) \geq 1, i = 1, 2, \ldots, l
\end{aligned}
\]  

(2)
If the sample is linear and inseparable, a relaxation factor needs to be introduced when calculating the quadratic programming problem $\xi_i$, $i=1$, 2, ..., l, as shown in formula (3):

$$\begin{align*}
\min_{w,b,\xi} & \frac{1}{2}||w||^2 + C\sum_{i=1}^{l} \xi_i \\
\text{s.t.,} & y_i(w^T x_i + b) \geq 1 - \xi_i \\
& \xi_i \geq 0, i = 1, 2, \cdots, l
\end{align*}$$

(3)

3.2. **Intelligent monitoring module**

The combination of intelligent technology and automation technology has effectively improved the real-time performance level of electrical systems. It has also effectively strengthened and expanded the level of technological innovation of electrical systems. With the introduction of remote control technology, the development of power systems has begun to develop towards remote control. Relevant personnel can perform remote real-time monitoring through remote control technology, which not only reduces the cost of manpower and material resources, but also effectively improves work efficiency. On the other hand, the safe and stable operation of the system can be ensured. At the same time, users can obtain accurate and effective information by observing and monitoring various data signals of the system [4].

3.3. **Intelligent diagnosis module for electrical faults**

The process of detecting faults in the electrical system is mainly to determine the status of the system by analyzing real-time data information, and send the status information feedback to the system for management, so that it is convenient for management personnel to maintain. The operation flow chart of the designed electrical fault diagnosis module is shown in Figure 2 [5].

![Figure 2. Operation flow chart of electrical fault diagnosis module](image-url)
The main principle of this fault diagnosis method is: the system stores the real-time data of the status of each device in the database during normal operation. When the system fails, the system can reflect the various data information under the fault state to the host. It is an important basis for further processing by the operator.

3.4. Intelligent control module of electrical equipment
The intelligent control function of power equipment is a key function in the automation system. Through the intelligent control function, the system status data information can be detected and collected in real time, and the latest collected data will be compared with the last collected data. If there is a big gap between the two sets of data, the system may be malfunctioning. At this time, the system uses intelligent control algorithms to self-rest and send warning messages to the monitor, so that the staff can find and solve the problem in time. In addition, the modified logic and control function model can execute the implemented plan on time, control possible problems, and identify them in time to avoid the risk of system defects. Intelligent power tool management has changed the primary demand for effective interaction power and effective tools for intelligent software control [6]. This reduces the maintenance costs of equipment and human resources, and improves system problems.

4. Realization of electrical automation control system

4.1. The overall framework of the control system
Based on the aforementioned intelligent technology, the framework of the electrical automation control system designed in this article is shown in Figure 3.

![Figure 3. The framework of the electrical automation control system](image)

4.2. Centralized monitoring and decentralized control
The centralized monitoring function is mainly to complete the link analysis of the product and integrate the data into one place. However, all data is collected in one processor, which causes the processor to process a large amount of data in a short time. Obviously, the data processing cannot be completed more efficiently, and the probability of work errors or system failures increases. Therefore, the distributed control function is usually added to the centralized control function for data processing,
so that each subsystem runs independently without interfering with each other, which improves the efficiency of control [7, 8].

4.3. Remote control
With the development of automation control, the power system has gradually developed in the direction of remote control. The remote control technology is mainly aimed at remote and unobservable places. The principle is to collect field data through the remote control system, and the process of processing and analyzing the data has gradually changed. This type of technology is used to control specific areas that cannot be entered by force. For example, in order to control the power line, we can use this control method [9]. The principle of the remote control method is to collect data online through remote monitoring tools, and then return to the control center, and then issue orders to the administrator to establish management standards.

5. The application of electrical automation control system
With the technological improvement and development of electrical automation control systems, its applications in some fields have become more and more extensive, such as its application in steam, electro-hydraulic control systems. Nowadays, the electro-hydraulic control system has become the most important part of China's steam turbine control [10]. The integration of the electrical system has greatly improved the reliability of the steam electro-hydraulic control system. The automobile system must pass through seven contacts before enabling the generator to generate electricity to normally generate electricity as shown in Figure 4).

![Figure 4. Generator power generation process](image)

6. Conclusion
With the development and improvement of computer technology, it has brought great opportunities and challenges to the development of electronic automation control systems. Of course, there are more problems and hidden dangers. In the future, we need to have a deeper understanding of the automation control system, and on this basis, we must pioneer and innovate, and jointly improve China's electrical automation control technology.
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