

Design of Electronic Automatic Control System in Combination with Computer Technology



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ABSTRACT: Electric automation is a novel electrical information technology for industrial production, which, working with computer technology, plays a key role in industrial production and people's daily life and turns to be more perfect and thorough day by day with rapid development. Pointing at features and patterns of electric-automation control system and comprehensive automation design on central heating system, this paper introduces electric-automation control system under computer application. Besides, this paper takes power plants as examples to give systematic introduction, enabling the public to know and understand more of the system.

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1. Introduction

Electric automation technology, an all-round technology, involves computer technologies, information science, instruments and meters and controlling theory, which can reduce costs, and control, manage and optimize industrial productions to improve production efficiency, product quality, reliability and security [1]. Researches proved [2] several advantages of comprehensive electric automation system, such as strong expansibility, compatibility, stability and reliability, leading to great acceptance from users and more important position in large-scale industrial monitoring project. In other words, it is obvious that electric automation technology has great influence on automatic production, and novel automation technology updates in a high speed [3].

To realize electric automation [4], it is necessary to have relevant software, hardware and system regarding electric automation. To date, widely applied and common electric automation hardware includes human-computer interface (terminator and industrial personal computer), programmable logic controller (PLC), motion controller, motor starter, frequency transformer, contactor, protect relay, sensor, circuit breaker, current source, voltage transformer and industrial Ethernet switches. As for electric automation software and system, Zhang Xiaobo [5] did researches on the design of electric automation system, and stated application of electric automation technology and comprehensive automation system of central heating system, especially the development and design of electric automation control system. This paper, based on computer technology application, studies on electric automation system, and adopts real examples to deeply have knowledge of and grasp theory of electric automation control system design.

2. Electric Automation Control System Design

2.1. Features of Electric Automation Control System

Compared to thermo mechanical equipment, electric automation system possesses the following features [6]: small amount of information, low operation frequency, few controlled object, high efficacy and reliable accuracy. Therefore, it is quite critical and key for electric equipment to have automation devices having strong reliability, high noise resistance and sharp response. In addition, effective management can be satisfied through batch chain protection of electric automation control system.

2. 2. Design pattern of Electric Automation Control System

2.2.1. Central Monitoring

Central monitoring is characterized by convenient self-maintaining; even on the condition of low maintenance requirements, it is easy to design the system. To meet the demand of centralization, a processor is required to centralize all functions to decrease monitoring objects and increase processing, because increased monitoring objects, such as electric equipment, will cause increased electric cable and investment, even decreased system reliability. Besides, it should be paid attention to use hard-wired to insulate disconnecting link and interlock of circuit breaker. What is worse, the second wiring is quite sophisticated, which leads to several problems referring to hard line-inspection, large amount of maintenance and wrong operation.

2.2.2. Long-distance Monitoring

Long-distance monitoring means linking computers which need to be controlled through Internet or remote dialing by computer network, which makes self-computer desktop display desktop environment of controlled computer and realizes long-distance management [7]. Besides, this monitoring pattern reduces cost on cable, materials and installation and improves reliability and configuration flexibility. To date, long-distance monitoring population is limited by lots of factors; for example, communication of some field bus cannot be satisfied, and sometimes even more electric communication is demanded.

2.2.3. Field bus Monitoring

At present, when computer network technology, such as Ethernet and field bus, continually develops and innovates, technologies of comprehensive automation system in converting station enhance in an all-round way [8]. Especially in recent decades, network control system occupies a higher position in electric system in the trend of wide application of intellectual electric equipment. As for field bus monitoring, it possesses advantages of long-distance monitoring, and advantages like strong pertinence and reduced accessory equipment and apparatus. Meanwhile, functions and setups of devices differ from each other, thus devices can only be linked through network, which promises normal operation of other rounds even some device goes wrong. So the whole system keeps working, enhancing operation reliability in a great degree [9]. In a word, the application and research of field bus monitoring are of great importance, which has key influence on electric automation control and pushes the development of computer monitoring system of power plants.

3. Comprehensive Automation Design of Central Heating System

Based on computer monitoring system, comprehensive automation of central heating system controls and monitors start and stop of all heating systems, and exactly and properly distributes loads of the whole station.

3.1. Computer Monitoring System

To fully display the function of computer monitoring system in auto-heating system, proper monitoring pattern and system is quite necessary to avoid copy of standards for large-scale heating system [10], on the condition of strict reference to heating system type, stand-alone volume, total installed capacity volume, and functions and patterns of heating system. Nowadays, most computer monitoring takes the pattern of computer monitoring assisted by regular control, which is advantaged by small investment and low requirements with fully requirement satisfaction. To be specific, computer monitoring system is consisted of central monitoring and distributed monitoring like fully distributed and layered distributed [11]. Taking flexibility, reliability and practicability of the system, it is decided to use layered distributed computer monitoring of auto-heating system. In addition, computer monitoring system can monitor and control objects through main heating control layer, share monitoring and data via control layer of subordinate equipment, and have powerful self- diagnosis by microprocessor based relay protection.

3.2. Communication Network System

The key to determine operation effects of comprehensive system is communication network system advancement, meaning that only if communication network system is equipped with strong stability and data-transformation and featured by open, simple as well as easy-maintaining, the system can be better applied in comprehensive auto-system for heating system [12]. To date, Ethernet, with strong openness and expansibility and high speed of transformation, usually links different computers.

3.3. Automation Software

Comprehensive automation-software of auto-heating system involves several fields, such as operation, monitoring, utility software and tool software. Through system source management, those fields realizes data and information collection, interpersonal interface management, self-diagnosis, communication adjustment, counting, calculation and data base management [13]. Operation software of the system, real-time software, is stable with practicability and portability, which can have friendly interaction with humans. In details, utility software is divided into several types, such as inter-field heating, auto-control, inter-plant monitoring, and assisted-guidance and management of heating running.

4. Examples

Speaking from set-up way and amount of automation system of power plant, power consumption equipment is separately set up in power distribution rooms and motor control center. Due to large amount of elements and large information of operation management, inspection and maintenance turn to be tedious and complicated. Compared to heating system, electrical installations do not run in a high frequency, but requires strong reliability and high running speed. Once electric automation system is fully comprehended and mastered, its function in power station can step into a further degree.

4.1. Design Theory of Electric Automation Control System

Major theories include design pattern of electric automation control system mentioned above, like central monitoring pattern, long-distance monitoring, and field bus monitoring.

4.2. Components of Electric Automation Control System

Generally speaking, auto-control system, based on known requirements, combines interacting parts into a entirety with specific functions to realize auto-control. To be specific, the system is consisted of control object, sensor (and transmitter), controller and performer, which can be found in figure 1 showing auto-control system of room temperature. In figure 1, controlled object refers to thermostatic chamber, sensor means temperature sensor, controller is the temperature controller and performer is electric control valve. In figure 2, combined parts of the system are shown in square frames, and parts' inter-relationships are performed through arrowheads on which the letters represent different function signals. According to figure 1, controlled object (thermostatic chamber and hot-water heater) is regarded as the generalized plant to tell from real

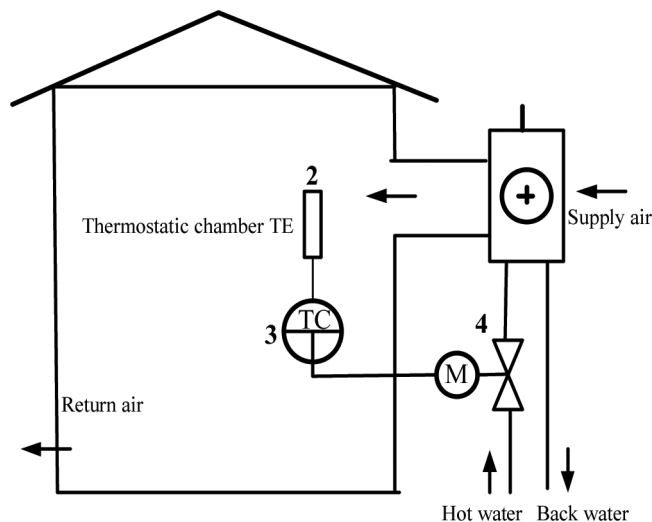


Figure.1 Automation control system

controlled object, while controlled variables must meet designed value. If auto-control system is interfered, controlled variables changes from designed value, and residual quantity will help adjust the performer. Thus the interference is removed through changes of object inventory.

In conclusion, control system, as shown in figure 2, works on the condition of preset and inference. In theory, controlled variables change in accord with system presets; however, interferences in real operation are assignable and unavoidable, which has more or less effect on the system. Figure 2 tells that auto-control system a closed-loop system with feedbacks, in charge of final control through decreasing and removing controlled variables and presets if degenerative feedbacks occur.

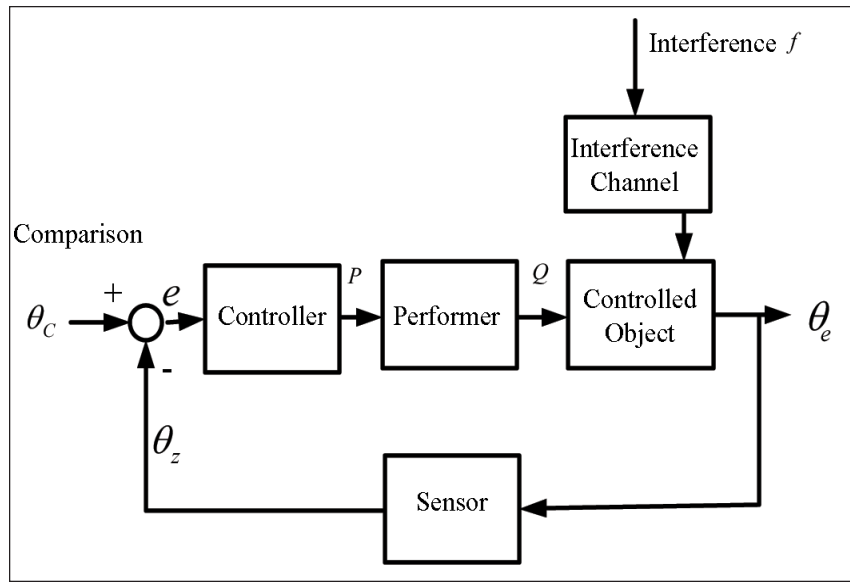


Figure 2 . Automation control system

4.3. Generating System

To begin with, power plant control system includes a set of distributed control system (DCS), consisting five operation stations, a data file station, and five processing centers; while I/O (input/output) includes two beltlines, generator set, low voltage apparatus system and public system. Besides, the whole production is under monitoring. I/O point system of DCS has 2303 points, including 3100 points real volume of the system. Detailed distribution is shown in table 1.

Signal type	AI	AO	DI	DO	Total
Beltline 1	88	35	231	132	486
Beltline 2	88	35	231	132	486
Turbo-dynamo system	150	14	210	120	494
Medium and low voltage apparatus system	6	2	185	12	205
Public system	64	38	320	310	602

Table 1. Systematic Distribution of I/O Points in DCS

Secondly, operator station has five rounds, such as data collection and processing, operation control, trouble warning, system diagnosis, and system maintaining. Thirdly, as for Ethernet system, its system network is consisted of upper and lower-layer control networks. Finally, the main processor of process center is AS417-4-2H.

5. Conclusion

To be concluded, electric automation technology tends to be matured and is widely applied in daily life and modern industrial development. Though the technology needs improvement, its practicability and security is widely accepted. Electric automation technology always plays its function in the field of agriculture, industry and national defense, even occupies more and more critical position in national economic development. Therefore, the priority now is to fully understand and master electric automation control system, to further improve and develop the technology.

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