

Analysis of the Application of PLC Technology in Electrical Automatic Control

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Abstract: This paper discusses the wide application of programmable logic controller(PLC)technology in the field of electrical automatic control.Firstly,the basic principle and components of PLC technology and its comparison with traditional electrical control methods are introduced.Then,the application of PLC in industrial automation,production line control,process control,building automation and traffic system is discussed in detail.The paper also covers the content of PLC programming and communication,and emphasizes its key role in practical application.Finally,the paper emphasizes its importance in electrical automatic control.

Keywords: Programmable logic controller;Electrical automatic control;Industrial automation

1. Introduction

In the field of modern industry and automation,electrical automatic control technology plays a vital role.With the continuous progress of technology,programmable logic controller(PLC)technology,as a flexible,programmable and reliable automatic control tool,has been widely used in various industrial and commercial applications.The application of PLC technology not only improves the production efficiency,but also improves the product quality,reduces the cost,and enhances the maintainability and scalability of the system.With the continuous improvement of industrial automation and intelligence,the demand for electrical automatic control systems is also growing,which makes PLC technology a key area of research,contributing to a better understanding of its applications,advantages and challenges in various fields.

2. Overview of PLC Technology

2.1 The Definition and Development History of PLC

A programmable logic controller(PLC)is an electronic device specifically designed to control industrial automation processes.It first appeared in the 1960s and was initially used in the automotive industry as a replacement for traditional relay control systems.The main function of PLC is to receive the input signal and generates the output signal after logical calculation and programming,so as to achieve the control of the machine,equipment or industrial process.With the continuous progress of technology,PLC technology has gone through multiple stages of development.The initial PLC was based on hard wiring,and its programming method was relatively complex.Over time,however,PLCS evolved into software-based programmable controllers,which made programming more flexible and easier.Modern PLC equipment has powerful processing power,large capacity memory and a variety of communication interfaces,so that it can cope with complex automated tasks.

2.2 The basic composition and principle of PLC

The PLC system consists of several key components.Among them,the central processing unit(CPU)is the brain of the PLC and is responsible for executing the control program written by the user.The input module is used to receive signals from external sensors and switches,while the output module is used to control actuators and devices.In addition,the PLC also includes a memory unit for storing control programs and data.The working principle of PLC is based on the state change of the input signal.The CPU executes the predetermined control program,and then generates the corresponding output signal.The process is cyclic to continuously monitor and control the operation of the automated system.

2.3 Comparison between PLC and traditional electrical control methods

Compared with the traditional relay control system, PLC technology has obvious advantages. A PLC system is more flexible because it can change the control logic through simple program modifications without physically changing the circuit. In addition, the PLC system is more reliable because it reduces the possibility of relay failure and provides a self-diagnostic function that quickly detects problems and alerts them. PLC systems are generally more compact, take up less space, and are easier to maintain. Traditional relay systems require a lot of wiring, while PLC systems can be done with a simple cable connection. These advantages make PLC technology the preferred control method in the field of industrial automation.

3. The Application of PLC in Electrical Automatic Control

Industrial automation is a method of managing and controlling industrial processes through the use of automatic control systems. It aims to increase production efficiency, reduce costs, improve product quality and ensure the safety of the working environment. In industrial automation, PLC technology is widely used to control various machines, equipment and processes to meet different industrial needs.

Production line control is one of the core applications of industrial automation. The PLC system is used to manage and monitor various processes on the production line, including the supply, processing, assembly and packaging of raw materials. PLCs can coordinate different production steps to ensure that products are manufactured according to precise specifications and schedules. This fine control helps to improve the efficiency of the production line, reduce scrap rates, and reduce production costs. Process control involves monitoring and adjusting various parameters in industrial processes, such as temperature, pressure, rate of flow, and liquid level. PLC technology is widely used in this field, which can collect sensor data in real time and adjust process parameters according to predetermined control strategies to ensure the stability and consistency of industrial processes. It is particularly important for chemical, pharmaceutical, food processing and other fields. Building automation aims to improve the energy efficiency, safety and comfort of buildings. PLC technology plays a key role in building automation, which is used to control lighting, air conditioning, heating, ventilation, security systems and so on. The PLC system can automatically adjust the operation of building equipment according to different environmental conditions and needs, thus achieving energy saving and improving comfort. Traffic system includes traffic signal control, subway system, airport automation and many other aspects. PLC technology is widely used in these fields for traffic signal control, elevator and escalator control, baggage handling systems, etc. PLC systems can ensure the safety, reliability and efficiency of the traffic system and help to reduce traffic congestion and accidents.

4. PLC Programming

4.1 Overview of PLC programming language

The PLC system supports a variety of programming languages for defining control logic. The most common PLC programming languages include Ladder Logic, Structured Text, Function Block Diagram, Sequential Function Chart, etc. Each language has its own unique characteristics and application scenarios. Ladder Logic is one of the most commonly used PLC programming languages that mimics the look of relay logic and is easy to understand and use. Structured Text is more flexible, similar to traditional programming languages, and is suitable for complex control algorithms. Function Block diagrams use graphical symbols to represent functional blocks, which facilitates modular programming. Sequential Function chart is useful for describing state machine control and sequential logic.

4.2 PLC programming methods and tools

PLC programming methods and tools depend on the chosen programming language and PLC model. Usually using PLC programming software, engineers can write control logic through a graphical interface or text editor. These programming tools often also provide simulation and debugging capabilities to ensure the correctness and reliability of the program. PLC programming generally follows the following steps, engineers need to clearly define the control tasks and objectives, and then choose the appropriate programming language, write the control logic, including the definition of the input and output variables. They then use simulation and debugging capabilities to verify the program's performance. Once the program is verified, it can be downloaded to the PLC device and the program can be run on the device while monitoring and recording the behavior of the system. These steps are the key to ensure that PLC programming successfully realizes electrical automatic control.

5. PLC Networking and Communication

5.1 PLC network architecture

The PLC network architecture defines the connection mode and communication protocol between different PLC devices. In an

automated system, there may be multiple PLC devices that need to communicate with each other to achieve coordinated control. Common PLC network architectures include bus, star, ring and distributed control systems. The bus architecture uses a shared communication bus through which PLC devices transmit data and commands. In a star architecture, all PLC devices are connected to the central controller or switch. In the ring architecture, the PLC devices are connected into a loop, and data is transmitted along the loop. The distributed control system uses multiple PLC devices, each responsible for a specific subsystem, which communicates with each other through the network.

5.2 PLC communication protocol

PLC communication protocol is the rules and standards for data exchange between devices. PLC devices from different manufacturers usually use different communication protocols, so compatibility needs to be considered when establishing cross-vendor communication. Some common PLC communication protocols include Modbus, Profinet, EtherNet/IP, CAN (Controller area Network) and so on. These protocols define details such as the format, rate, error detection, and correction of data transfers to ensure reliable communication. Choosing the right communication protocol is crucial to ensure effective communication between PLC devices, especially in large-scale automation systems.

6. Conclusion

PLC technology has a high degree of flexibility, programmability and scalability, which makes it widely used in many fields such as industrial automation, production line control, process control, building automation and transportation systems. It provides a powerful control tool for automated systems, which helps to increase efficiency, reduce costs and improve product quality. However, PLC technology also faces some challenges, including safety, reliability and maintenance difficulties. In order to ensure the stable operation of the PLC system, appropriate safety measures, regular maintenance and backup strategies must be taken. PLC network and communication is a key extension of PLC technology, they support the coordination of work between multiple PLC devices, and provide remote monitoring and control functions to adapt to the needs of modern automation systems.

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