Exploration of the Principle of PLC and Its Application to Industry

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Keywords: PLC, principle, industry, application

Abstract: In industry, PLC is an important part of its application planning. It can promote the development of industry to a certain extent. Therefore, it is necessary for us to analyze the principle of PLC and its application in industry. This paper analyzes the composition of the programmable controller, as well as the principle of PLC, and summarize the application of the PLC to industry.

1. Introduction

The full name of PLC is programmable logic controller, which belongs to an electronic system of digital operation. The programmable memory is used as the internal storage program. It can also perform logic operation and plays the roles of timing, counting and sequential control. It uses digital or analog output or input methods to control different types of machinery and production. Line control. Because it is specially used in industrial environment, we mainly need to analyze the principle of PLC and its application in industry [1].

2. Composition of PLC

PLC is a special kind of computer, with microprocessor as its core and digital control as its main function. Its composition can also be divided into two parts, that are hardware and software.

2.1 Hardware Structure of PLC

The hardware structure mainly includes central processing unit, memory, input and output unit, power supply, programmer and so on.

2.1.1 Central processing unit

Central processing unit can also be called CPU, which is the core of PLC control operation. It mainly includes calculators and controllers. It is mainly used in information processing and control, and plays a role in coordinating the whole machine. Moreover, its quality directly affects the technical indicators. That is to say, the longer the number of CPU, the faster the operational speed [2].

2.1.2 Memory

Usually, we call memory "internal storage", which mainly stores logical variables, working data, user programs, system programs and other various information. The main function of system program is to control and complete all aspects of functions of programmable controller. The manufacturer of the controller writes the program storing system software, which is called system program memory.

2.1.3 Input and output

The components connecting PLC with the field I-0 device or other external equipment are the input and output module of the interface module. Through the application of output module, PLC can read various control signals of industrial equipment or during the production process into the host computer, such as limit switch, operation button, selection switch and sensor output switch in many aspects. In addition, results can be transmitted to the output module through the corresponding operation and calculation of the user program. The output module converts the weak

point control signal output by the central processing unit, and then output the strong electric signal needed in the field, and control it by driving magnetic valve, contractor, motor and so on [3].

2.1.4 Power supply

Power supply components can convert AC power supply into DC power supply for work. They mainly provide power for the normal operation of central processing unit, input and output module and memory to ensure the normal operation of PLC.

2.1.5 Programmer

Programmer is an important part of PLC. Its main function is to program, edit, debug and monitor user programs. It also can keep in touch with CPU through communication interface to ensure the completion of man-machine dialogue.

2.1.6 External equipment

In addition to programmer, the external equipment of PLC includes the upper computer, printer, graphics monitoring system and bar code reader etc. All the above external equipment can be well connected with the host through the interface of external equipment, thus effectively completing the corresponding control and operation.

2.2 Software System of PLC

2.2.1 Software program of PLC

Software program of PLC can be divided into two aspects, system program and user program. System program is written in assembly language and solidified in ROM system program memory before leaving the factory without users' intervention. It is an important basis for the normal operation of PLC.

2.2.2 Programming language of PLC

In order to ensure the effective realization of the control function, it is necessary to use programming elements to replace the actual components and software programming logic to replace the traditional hardware wiring logic. At the same time, the programming language of PLC is not only for the operator, but also for the controlled object, so it is easier to be understood and mastered by the relevant staff, facilitating the effective control and application of PLC [4].

3. Principle of PLC

PLC needs the support of hardware to complete various control tasks. Since user programs can reflect control requirements, PLC also needs to cooperate with user programs. In essence, PLC belongs to a computer control system. But compared with ordinary computers, it has a more powerful special interface applied to industrial processes, so that it can adapt to and apply the programming language of control requirements more effectively. In the process of PLC's work, it mainly adopts sequential scanning and continuous circulation. That is to say, under the control of system software, PLC takes the corresponding clock rhythm as the main basis to carry out cyclic work. The work content is to execute and follow three stages of input signal sampling, program execution and output refresh in each scanning process.
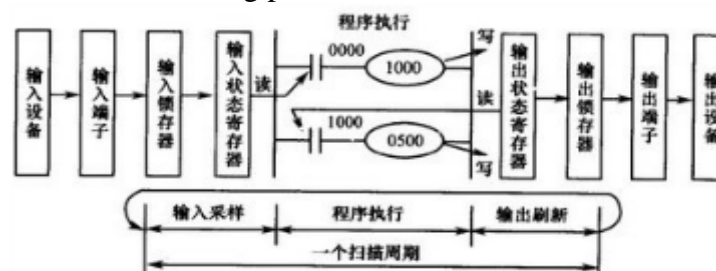

Fig. 1 Scanning Process of PLC

3.1 Input Sampling Stage

In the input sampling stage, CPU in PLC can scan every input terminal, convert the switching state of the field, analog signals and so on into corresponding data, and input the above data into the state register. This process is generally referred to as the sampling stage.

3.2 Procedure Execution Stage

In the program execution phase, CPU can scan each instruction in user order, and the required execution conditions can be read into CPU from the programmable elements or input state registers. Then, according to the program arrangement, the input data are processed logically and numerically, and the operation results can be input after the operation.

3.3 Output Refresh Stage

In the output refresh stage, when all the instructions in the program have been executed, CPU transmits the latest results in the state register to the output latch in time, and then output the results in a certain way to control the switching action accurately and effectively, so as to ensure that the corresponding work can be executed outside the driver [5].

The above is the three important stages of PLC work. On the basis of these three important stages, after adding the system automatic control process of PLC, it can be called a scanning cycle. When PLC completes a scanning cycle, it automatically re-executes the above process, thus forming the cycle working form in the previous paper. But in the process of PLC working, its scanning period can be estimated roughly. For different types of PLC, through reading the instructions, self-checking and input sampling, it can output the time needed for refreshing process. In general, the whole process of input sampling and output refreshing only needs 1ms-2ms. This shows that the time required for scanning is mainly determined by the execution time of the user program. Moreover, the execution time of the user program is mainly determined by the length of the user program. That is to say, the process complexity of the control object and the operation speed of CPU are able to determine the execution time of the user program, which refers to the time required for the entire process of input sampling and output refresh. Under normal circumstances, the control system of PLC can scan dozens of times in a second, so its applied to industry fully meets the needs of various industrial control execution.

4. Industrial Application of PLC

From the point of view of structure and function, PLC is a new type of general-purpose electrical controller, which takes computer as the main core. In fact, the "electrical controller" is a more traditional name that can be defined as "devices formed by electrical and circuit components for electrical control". As with ordinary computers, the basic form of PLC is to process the data in memory according to the program requirements. When it is applied to industrial control work, data is mainly fed by the input port. The data contains both digital and analog quantities, which comes from the sensor and the main electrical equipment in system. After being processed by PLC, data will be sent out of the computer through output port and be applied to the control of motor and solenoid valve and other actuators, while the output can also be used in the digital and analog quantities of other industrial control equipment. At the same time, sensors, main control devices and actuators on the input and output ports of PLC reflect all kinds of events in the control system in time, so they are also indispensable in the delay system. For example, when the start button is pressed, it means that there are start-up events. Thermal relay actions refer to the existing of overload events. Contractor actions indicate the existence of power connection events. So it can be seen that PLC is a machine which can effectively process all kinds of events and data in the field according to corresponding procedures. Based on this, if PLC is expected to complete various control tasks, it is essential to firstly connect the programmable controller to the circuit of control system, so that sensors, master appliances and communication equipment etc. can be connected as a whole. Secondly, after connecting PLC to enter the system, the application program must be

programmed according to the control requirements, so that the input events and output events have certain relevance, enabling programmable controller to successfully complete the established tasks.

5. Conclusion

As an important part of industrial planning, PLC plays a certain role in guaranteeing the normal operation of industry, and can promote the overall development of industry, so it is of great significance to have a deep understanding of PLC. Through this paper, we know that to complete various control tasks, PLC needs the corresponding hardware and software to support it together.

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