

Research Article

Practical Curriculum Design Based on Food Motoring System of PLC

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Abstract: The study designed a kind of stepping food motoring control system based on PLC and touch screen, complete the secondary design and renovation based on PLC technology. According to the trend that the PLC new technology is widely and deeply applied into modern food industrial production, combining students electrician, maintenance electrician basic skill training needs to make a reformation of the food motoring system of student training curriculum. This system has simple structure, stable performance, economic value, outstanding using effect, remarkable specific design example and expected effect.

Keywords: Design example, design strategy, food motoring system, PLC

INTRODUCTION

PLC system has a very important role in the field of industrial control due to the powerful function of PLC, resistant to strong interference, high reliability and simple programming as well as easy to operate, therefore, its application in food industrial control is more and more profound. At present, with the constant progress of science and technology, automatic control technology has been applied to all walks of life gradually. The electric control machine of Siemens, based on PLC automatic control system of motor, uses the international standard PROFIBUS field bus standards to ensure the efficiency and instantaneity of the system, which can not only realize the independent complete data acquisition of the equipment, but has strong anti-interference ability, high reliability and high control precision. PLC has the advantages of high control speed, high reliability, strong flexibility, functional maturation compared with the traditional relay control when applied in the three-phase asynchronous motor control. PLC can provide a safe and reliable and a more perfect solution for automatic control applications that suitable for the current industrial demand for automation control. Therefore, it plays an important role in control field of modern industry.

The food motoring system training is the core module of food electrical technology training, our main electrical, thermal professional practice basic course for professionals (Hu, 2003). It embodies the comprehensive, modernity and the scene of electric engineering and has an extremely vital significance to the promotion of basic skills for higher vocational students' majoring in food professional electrician knowledge learning and electricians. Motor control that

based on PLC is widely used in industrial control field, it is necessary to conduct secondary design and improvement for the existing low voltage power distribution motor control training screen. On the basis of electrical skills module, introducing the PLC module and adopting PLC small switch logic control instruction is convenient to realize the function of the relay and motor control. The realization of modular design, combination of unit, strong visibility can build a practical, open electrical technology training platform for students majoring in food manufacture and build a bridge from school (basic theory) to society (engineering practices).

MATERIALS AND METHODS

The structure of the PLC: There are many kinds of structures of the PLC, every kind of PLC in function and command system is different, however, the structure and working principle of each kind is the same. PLC is usually made up of the host, input/output interface, power supply, programming expander interface and peripheral equipment.

The working principle of the PLC: "Sequential scan, constant cycle" is the main working way of PLC and each working cycle will go through three stages: the input sampling, program execution and output refresh. First of all, in the input sampling stage, PLC will scan and read according to the order temporarily existing in the input latch in the on-off state of the input terminals or the input data, then write in the corresponding input status register (Chen, 2009). Second, execution, each instruction needs to be executed scanning, the order will be carried out in accordance with that of the stored program instructions by user, the results of the program

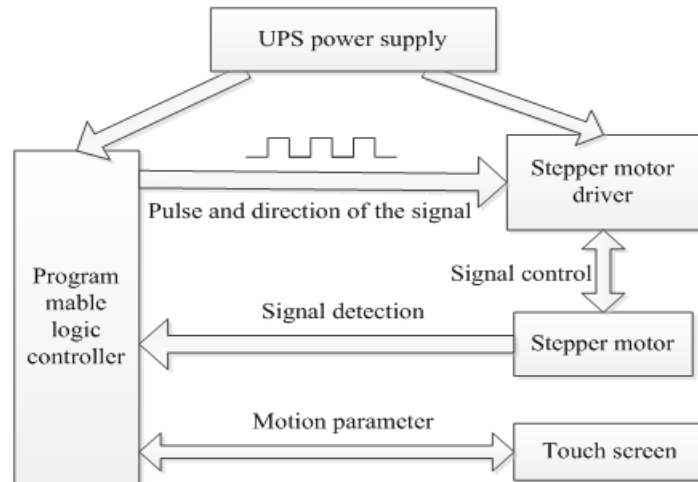


Fig. 1: System structure diagram

is also need to be written in the output status register, its content will also change with the execution of the program. In the end, the output refresh, after all the commands are performed, the output status register of the on-off state will be sent to the output latch and then output through the relay and the SCR and driver the corresponding output device into the working state.

The design step of PLC control system: To analyze the controlled object:

- The analysis of the content of the controlled object is mainly aimed at the technological process and the characteristics of the work. It also demands for a detailed understanding between the mechanical and the electrical of the controlled machine and clears out the requests that PLC control system need to be met at work.
- **To determine the input/output devices:** System input devices, such as button, position switch, change-over switch etc, as well as the system output device, such as the contactor, solenoid valve and signal lamp, etc, play an important role in the system. Identifying the required input and output devices reasonably according to the demand of system control and determine the PLC I/O points.
- **The selection of PLC:** It includes PLC models, capacity, I/O module and the power.
- **The distribution of I/O points:** Allocation of PLC I/O points, draw of the PLC I/O terminals are connected to the input/output devices or the corresponding table.
- **Software and hardware design:** PLC software design, complete of the control cabinet (console), other hardware design and site construction.
- Online debugging and organization of technical documents.

Design example of food control system: Food Control system is mainly composed of PLC Hardware, touch screen display module, step motor module and related

circuit. The whole power supply systems employ the UPS power supply to ensure the continuity and stability of it. Structure diagram is shown in Fig. 1.

The hard ware design of PLC food control system:

On the basis of the design step of PLC food control system, it will enter the control cabinet (such as low voltage distribution panel) hardware design phase after the design process of PLC system. Based on the characteristics of PLC food control system, programming and hardware design can also be implemented at the same time. Motor and reversing control low-voltage distribution training screen PLC hardware PLC (FX series) integrates a microprocessor, an integrated power supply and digital I/O point in a compact package, thus formed a powerful miniature PLC. The CPU is responsible for executing programs and storing data so as to get control of the system or process (Gao and Zhang, 2007). Control points of system at the time of input and output: input part (sensor or switch) collects signal from the field device, the output part controls motors, lights and other equipment in the process of control. The power supply provides power support to the CPU and any connected module. Communication port is used to connect with the CPU and the upper machine or other device. State light shows the CPU working mode, the current state of the native I/O and the check of the system error.

Display module of touch screen: Touch screen chooses Pro-face ST402 type, using ProPB OC-Package software configuration at PC, downloading to PLC through on-line PPI and PLCRS485 interface and PLC will transform the input motion parameters through the program instructions touch screen into control instruction to control real-time motion of stepping motor. It mainly includes the following graphical interfaces:

- **Start interface:** To start or stop the system through the touch screen button.
- **Initialization interface:** To set up the initial point of the system.
- **Control mode selection interface:** Select automatic or manual control mode.
- **Data input interface:** To input speed, the direction of motion parameters by calling the small hidden keyboard.
- **Process display interface:** Display the movement speed and displacement of the real-time.
- **Detection alarm interface:** Detect the real-time system by stepper motor feedback signal.

The motor module: Stepper motor is selected from Germany company BERGER LAHR VRDM397/LWB three hybrid stepping motor, auxiliary drive WD3 BERGER LAHR company-007. The stepper motor adopts ac servo control principle and has the characteristics of ac servo motor operation. The stepper motor shaft end converts stepping motor rotating angular displacement to linear scale by gear transmission mechanism.

RESULTS AND DISCUSSION

Principle of stepping motor: Stepper motor is a kind of digital electromagnetic actuators that transform the pulse signal into angular displacement (Liu, 2007). Angular displacement of stepper motor is proportional to the number of input pulses and its speed is proportional to the pulse frequency, the steering and pulse distribution to the stepper motor is related to the phase sequence of each phase winding. It can be directly controlled by digital signal, open ring work without feedback, with no accumulation position error, high control precision, thus is widely used in digital control and precision positioning control system, like computer control. External pulse signal and direction control signal realize the control process by controlling the driving power, power supply and sequence of each phase winding. Each pulse signals can make the stepping motor rotate a fixed Angle, called interval Angle. The number of the pulses determines the total rotation angle; the frequency of the pulse determines the speed of rotation; the direction of signal determines the direction of rotation. In addition, stepping angle of the stepping motor can be divided into some small steps through the subdivided control so as to realize higher precision control (Mayers Steward, 2007).

Parameter description: In the design of the system, the following transformations of the parameters need to be taken into account:

$$\omega = f \times \varphi$$

$$d = \frac{\varphi \times n}{360 \times n_o}$$

$$l = P \times d$$

$$v = \frac{l \times f}{P} = f \times d$$

Among them:

ω = Motor speed

f = Output pulse frequency

ϕ = Stepping/motor Stepping angle

d = Pulse equivalent

n_o = The motor gear ratio

l = Linear displacement

P = Output pulse count

v = Linear displacement speed

The expected effect after the improvement design: It enriches the content of the food electrical technology training, connects the electrician basic device (relay, contactor, circuit breaker, transformer, switch, button, etc.) with industrial control unit (PLC control module, data transmission and communication module, etc.) and electrical instrument measurement tools (voltmeter and ammeter, etc.) well, carries out the implementation of modular design, unit combination and good visibility; students combine graphic symbol in books with the physical device through practice and control or manipulate any device according to their own design to stimulate their practice and innovation; the students integrate the knowledge and skills in the electrician practice to the engineering practice so that they can really use what they have learned.

CONCLUSION

The improved design based on the food electrical training screen of PLC has actually constructed a significant open electrician practice operation platform for the students, built a bridge from basic theory to engineering practice, which opens the door for the students who contact the engineering practical project for the first time to be engaged in food industrial automatic control by computer.

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