The Application of PLC and HMI in Rotary Switch Detection System

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ABSTRACT
In order to achieve high-speed automatic detection, PLC and HMI was adopt to develop a kind of rotary switch detection system. The control system adopted the programmable logic controller (PLC) as the control center. Through the man-machine interface of HMI, the real-time monitoring and centralized management of the rotary switch detection system was realized. The rotary switch detection system realizes automatic detection of the rotary switch, and greatly improves the detection efficiency and automation. Actual application proved that the system is safe, stable and high integration.

## Keywords
PLC; HMI; Detection System.

1. INTRODUCTION
Low voltage electrical apparatus is an important part of the electrical equipment industry, which can be used to control, protection, detection, indication and alarm in manufacturing process. The performance and quality of the products directly affect the reliable operation of power system and industrial control system, which directly reflects the advanced manufacturing and equipment automation level of a country. However, the current low-voltage electrical detection system is generally relatively backward, and the operating mechanism of the low-voltage electric endurance test commonly used manual operation. However, with the increasing variety of low-voltage electrical detection requirements and increasingly stringent, traditional manual detection methods obviously can't meet the requirements. Therefore, research and development of advanced automated detection system, not only can expand the equipment of detection of varieties and specifications, greatly reduce detection equipment purchase costs, but also can avoid the randomness of human operation in the detection process, effectively improve the product protection characteristics of the correctness, reliability and stability.

An intelligent detection control system was developed based on Programmable Logic Controller (PLC) and Human Machine Interface (HMI), which can be used to realize the intelligent detection of low-voltage electric endurance test. The electric rotary switch detection system can set parameters according to the requirement in the process of detection, such as rotational speed, operating torque, power-on time and interval time. At the same time, the Human Machine Interface can display the operating state and the system parameters in real time [1-2].

2. THE SYSTEM WORKING PRINCIPLE AND CONTROL REQUIREMENTS
The rotary switch detection system is composed of human machine interface, programmable logic controller, electric slide, servo motor and other components. The rotary switch detection system can centralized control and monitoring the operation state in real time in order to keep the system stable operation. The human machine interface is the man-machine interactive information platform. PLC as control core of the control system control three servo motors and three electric sliding. The block diagram of the rotary switch detection system is shown in Figure 1. Test items were mounted on clamping mechanism. The rotary detection mechanism is driven by the rotary switch detection system. When it reached the set position, the rotary detection mechanism stopped automatically. Then the rotary switch detection system controlled the servo motor rotation to detect the rotary switches.
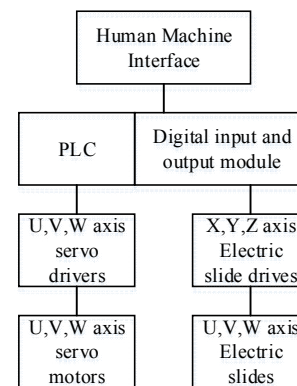
Figure 1.The Block Diagram of the Rotary Switch Detection System

3. HARDWARE DESIGN AND IMPLEMENTATION
According to the working principle and control strategy of the rotary switch detection system and in line with the principle of compact control system structure, the rotary switch detection system adopted Siemens S7-200 CPU224XPSi PLC as the control center to form the control system. Among them, pc/ppi

communication mode was adopted between PLC and human machine interface.

Rotary switch detection system used EM223 module as input and output extension module, used Taiwan Li-ming reducer and Mitsubishi J2 series servo motor as the drive mechanism. The reduction ratio of Li-ming reducer is 50:1. The kinco MT4300 touch screen was adopted to develop the man-machine interface. The touch screen has the function of scrolling, zooming, text display and graphics display. It is stable and reliable, and has good electromagnetic compatibility and seismic performance.

4. THE CONNECTION BETWEEN PLC AND THE TOUCH SCREEN

The serial communication is a frequently used method to connect industrial computer and other intelligent terminal equipment for data exchange. It is simple, flexible and convenience, which is widely used in industrial control, data acquisition and real-time monitoring. With the development of science and technology, RS232 serial communication equipment is more and more simple, integrated and easy to use, so it is more and more widely used.

RS485 network which belongs to the serial communication is widely used in industrial area. It is developed rapidly for the advantage of long distance transmission and anti-noise. The RS-485 serial communication is a typical no-protocol communication without fixed protocol and data conversion. Data and instructions are sent and received through the communication port of RS485. At present, the maximum transmission distance of RS-485 is 1200 m, and the maximum speed is about 10Mb/s.

The touch screen is connected to the programmable logic controller 224XPSi through the RS485 communication interface [3-4]. The hardware configuration of the control system is shown in Figure 2.
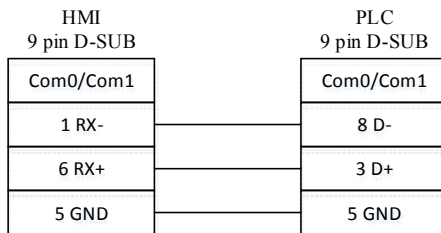

Figure 2: The hardware connection diagram of the PLC and Touch screen

5. THE DESIGN OF CONTROL SYSTEM

5.1 The design of PLC control system

STEP7 programming software is adopted to program the PLC control system. STEP7 is the standard software package used to configure and program SIMATIC programmable logic controller. It provides three programming languages and a range of applications. STEP7 programming software not only supports structure design in different levels, but also simplifies the complexity of structure design.

In order to improve the efficiency of STEP7 programming, it is an effective method to make use of the modular programming method. PLC program including reset procedures, manual adjustment program, automatic positioning program and etc. is called in the main program as a subroutine.

The rotary switch detection system would detect whether the operating mechanism is in a safe state or not when the system is powered on. If the operating mechanism is in a dangerous state, reset program would be called to reset the operating mechanism. The flow chart of control program is shown in Figure 3.

5.2 Human-machine interface design

According to ergonomics principle, the standard design pattern was used in the man-machine interface the human-machine interface of rotary switch detection system. The system used Kinco MT4300 as the touch screen of human-machine interface.

Through function control which was provided by ev5000 configuration editing software, it is convenient to design the monitoring and control interface for the system, real-time monitoring field equipment status and actual detection condition, and production data offline management production advanced development management functions. Production data can also be managed off-line.

According to site requirements, the human-machine interface can be used to set parameters, display equipment working state and alarm information and so on. The human -machine interface mainly includes login interface, main monitoring interface, electric cylinder setting interface, action setting interface, state monitoring interface, system setting interface, alarm and fault handling interface.

6. CONCLUSION

This paper introduces the application of PLC and touch screen in the low voltage electrical apparatus testing system, and realizes the automatic detection of low voltage electrical apparatus. The field-application shows that the design of the rotary switch detection system is feasible. The control system has run stably and credibly, satisfied field real control need and proved to have good effect. Data transmission communication system is stable, reliable, and have high degree of integration and strong anti-interference ability. The rotary switch detection system has been put into actual production, which greatly improves the detection efficiency of low-voltage electrical switch, reduces the labor intensity of the workers, and effectively improve the correctness, reliability and stability of the protection characteristics of the product.

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