The Work Piece Processing Monitoring System Based on Mitsubishi PLC and MCGS

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ABSTRACT

A monitoring system for workpiece processing based on Mitsubishi PLC and MCGS is designed. The hardware configuration is completed. The login interface, the processing interface and the alarm interface are designed. The corresponding PLC monitoring program is compiled, and the real-time monitoring of the whole process of workpiece processing is realized.

Keywords: MCGS; Mitsubishi PLC; monitoring system; work piece processing

1. INTRODUCTION

With the continuous development of science and technology, the degree of industrial production automation is getting higher and higher. In order to improve the production efficiency and ensure the safe and reliable operation of the system, PLC and MCGS have been widely used in various control systems in recent years [1-4] .In this paper, the workpiece processing monitoring system based on PLC and MCGS is designed.It not only can control the stable operation of the system, but also can achieve real-time monitoring of the process.

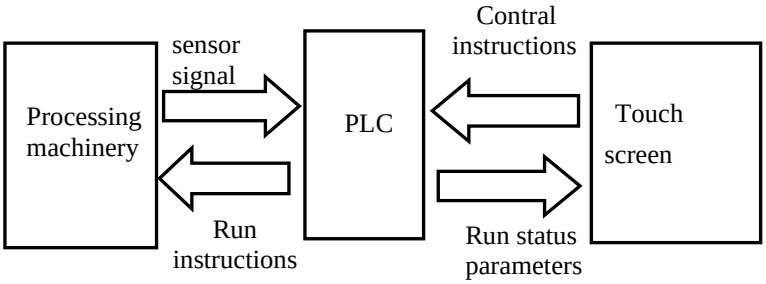

Figure. 1 System block diagram

The work piece processing monitoring system is composed of three parts: processing mechanism, PLC and touch screen. As the executive component, the processing mechanism receives the PLC output instruction and completes the workpiece processing. PLC not only receives the control signal from the touch screen, but also receives the signal from the sensor. After analysis and processing, it outputs the motor driving signal and the system running state signal. The former is used to drive the machining mechanism, and the latter is sent to the touch screen. The touch screen transmits the control instruction to the PLC, then the control system runs. Touch screen can realize human-computer interaction. It receives instructions from people, and transmits them to the PLC. It can display the running status signal of the system in real time.The block diagram of the workpiece processing monitoring system is shown in Figure 1.

This system can realize the functions of safe login, equipment running state monitoring, workpiece processing monitoring, fault alarm. It can improve the production efficiency, the security and the reliability.

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2. INTRODUCTION OF SYSTEM HARDWARE

2.1 MCGS TPC1061Ti touch screen

There are many kinds of MCGS touch screen. The MCGS TPC1061Ti touch screen used in this system is a high-performance embedded integrated touch screen, which has certain representation.With the relevant knowledge,it will be very easy to use other touch screens in this series.

This touch screen takes an advanced Cortex-A8 CPU (600MHz) as the core.It has a 10.2-inch, high-brightness TFT liquid crystal display with a resolution of 1024x600. As a four-wire resistive touch screen, it is pre-installed with MCGS embedded configuration software (running version) , so it has powerful image display and data processing functions [5] , and it is widely used in the field of industrial automation.

2.2 FX3U-48M PLC

According to the different industrial field signals, the PLC has the corresponding I/O module which is directly connected with the device or equipment in the industrial Programmable logic controller. It can communicate with the host computer and other intelligent devices to realize the real-time monitoring of the working state of the field equipment[6]. This system selects Mitsubishi FX3U-48M PLC to collect and process the field signal, and realizes the real-time information exchange with MCGS.

FX3U-48M PLC is composed of basic unit, expansion unit, expansion module and special adapter. It can realize RS232C, RS485, USB and RS422 communication. It can process the input signal and carry on the data exchange with the touch screen .

2.3 Processing machinery

The processing mechanism is composed of a two-dimensional feeding mechanism and a turret. The former is driven by two servo motors and the latter by a stepping motor. This part is the executive body。It receives the drive signal from the PLC. Position detecting sensors are arranged on each mechanism for transmitting a position signal to the PLC.

3. HUMAN-COMPUTER INTERACTION INTERFACE

3.1 Hardware configuration

Before designing the human-computer interface, the hardware configuration should be carried out. Open the MCGS configuration software and create a new project，then determine the type of touch screen. TPC1061ti touch screen is used in this system.

Open a device window for configuration. Select the universal serial port parent device 0 and Mitsubishi FX series serial port from the Device Toolbox. Set the device property values for the universal serial parent device. The information transmission adopts asynchronous serial communication. The byte format starting bit is 0 bit and the data bit is 8 bits. The stop bit is 1 bit. The check mode is even check.

The values of the device property of Mitsubishi communication serial port are set. The initial working state of the device is 1-start. The minimum period for data collection is 100ms. The protocol format is Protocol 1. Verification is required during data collection. The type of the PLC is FX2N. In order to Determine the nature, name, and number of system variables, You can define channels before setting properties. 26 channels are defined in this project. Among them, 20 channels are switching quantity, denoted by M0-M19, and the remaining 6 channels are numerical quantities, represented by D0-D6.

3.2 Software design

3.2.1 Login interface design

The login interface is shown in Figure 2. In order to ensure the security of user information, the system login screen is design. The login password is set. Click on the user login button to display the user login window. IF the password is right, the user can enter the processing interface. If the password is wrong, you need to re-input. This function is implemented through a button script program. The script program is:

IF !LogOn( )=0 THEN !SetWindow(Processing interface,1)

Before using this function, user permissions must be set . The purpose of setting user permissions is to give the user a login password. when the correct login password is entered , the system can be up and running.

Figure. 2 Login screen

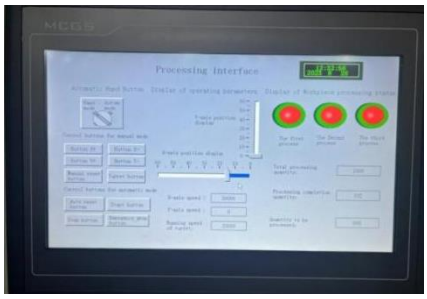

Figure.3 Processing interface

3.2.2 Processing interface design

The workpiece processing system includes two parts: the feeding mechanism and the processing mechanism. The feeding mechanism is a two-dimensional table including X-axis and Y-axis. X-axis and Y-axis are driven by two servo motors. The machining mechanism is composed of a rotating tower driven by a stepping motor and a pneumatic stamping cylinder. The machining interface is shown in Figure 3. The interface consists of eight parts, such as time display, processing mode selection button, six manual control buttons, three automatic control buttons, working process indicator, running speed display box, number of workpiece statistics box, two-dimensional running distance display.

There are two processing methods: manual control and automatic control. In former mode, the button (x + , x -) controls the two-dimensional X-axis point motion and the button (y + , y -) controls the two-dimensional Y-axis point motion. The button turret controls the stepping motor to drive the turret point motion. Pressing the reset button can reset each mechanism manually. This mode is mainly used to debug the components before running. In the latter mode, when the reset button is pressed, the mechanism automatically reset. When the Start button is pressed, the system automatically run processing procedures to complete the workpiece processing. When the stop button is pressed, the system stops.

In order to distinguish the different processes, there are three process indicator lights, whose color are green, red and yellow. The running speed of the two-dimensional worktable and turret is displayed by real-time digital , and the actual position of the two-dimensional worktable is displayed by image. In addition, the processed and non-processed parts are also displayed by digital.

The interface is used in conjunction with the PLC program. The variable names of the components are shown in Table 1. M is the switching quantity. There are two states of switching. The switch closes in 1 state and the switch opens in 0 State. D is the digital quantity. In the PLC program you can carry out mathematical operations on the digital quantity D to complete display of speed and position and count.

Table 1. Component variable name

Component-	Variable name	Component	Variable name
Automatic Hand Button	M0	Green Light (process 1 indicator)	M14p
Button X+	M1	Red Light (process 2 indicator)	M15
Button X-	M2	Yellow Light (process 3 indicator)	M16
Button Y+	M11	X- axis speed	D0
Button Y-	M12	Y-axis speed	D1
Manual reset button	M3	Runningspeed of turret	D2
Turret button	M4	Processed quantity	D3
Autoresetbutton	M13	Unprocessed quantity	D4
Start button	M5	X axis position display	D5
Stop button	M6	Y-axis position display	D6
Emergency stop button	M7	Malfunction Indicator Lamp	M8
Fault prompt language	M9	Fault resolution prompt	M10

3.2.3 Alarm interface design

The alarm interface is shown in Figure 4.

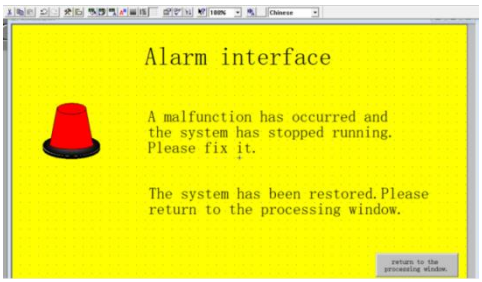

Figure.4 Alarm interface

In the configuration environment, the colors of the lamp is set. When the fault happens ,the light turns red. After troubleshooting, the light turns green. The light's variable name is M8. When M8 is in 1 status, it means the fault happens. When M8 is in 0 status, it means the fault elimination. Variable names of two Labels are M9 and M10.When M9 is in 1 status, system has faults. System failure label is displayed. When M10 is in 1 status, System recovery label is displayed. In the configuration environment, an event policy is set to open the alarm window. The execution condition of the strategy is generated by PLC program. When the system malfunctions, the alarm interface is shown in Figure 5. When the fault is resolved, the interface is shown in Figure 6.

Figure.5 Alarm display window

Figure.6 Fault removal

4. PLC PROGRAM DESIGN AND SYSTEM DEBUGGING

4.1 PLC programming

4.1.1 Program flow chart

The status of the button is transmitted to the PLC as an input signal. After the PLC processes the received signal, the output signal will control the operation of the actuator. Running speeds and positions of X axis and Y axis are displayed in real time on the touch screen. The speed of the turret is also displayed on the touch screen. If the process is not completed, the indicator light is not on. If the process is in progress, the indicator flashes. If the process has been completed, the indicator light is on. D3 automatically adds1and D4 automatically subtracts 1 for each workpiece processed.

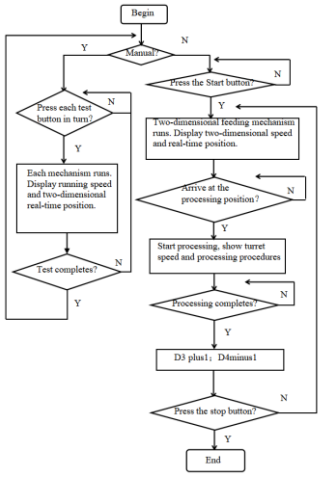

Figure.7 Monitor program flow chart

The flow chart of the workpiece processing monitoring program is shown in Figure 7.The alarm program is written in the trapezoidal block. As long as a fault occurs, the system can immediately stop and open the alarm window.

4.1.2 Programming language selection

There are five PLC programming languages specified by IEC, which are ladder diagram, instruction statement table, SFC, St and structure text [6] . The sequence function diagram, also called state transition diagram, contains three elements: step, transition condition and action. It is suitable for sequence control system.

GX Works2 is the user programming software of FX3U Series PLC. It is a new PLC software of Mitsubishi Company, which runs on Windows. It supports ladder diagram, instruction statement table, SFC, St, structured ladder diagram and other programming languages. It has the functions of programming, parameter setting, network setting, program monitoring, debugging, on-line modification and intelligent function module setting. It can realize the data sharing among the human-computer interactive interface and PLC and motion controller[7].

The processing sequence of the system is picking, feeding, the first process, the second process, the third process. The above actions is in turn, so the sequence diagram is chosen as a programming language. The program was written in GX Works2, and it was run and debugged.

4.2 System debugging

Before System debugging, communication among PC and PLC and touch screen should be finished ,that includes hardware connection and parameter setting.

4.2.1 Hardware connection

FX3U-422-BD Communication Board and Mitsubishi Special Programming Download Line are used for hardware connection between PC and PLC. The touch screen is connected to the PC through a network cable. The touch screen and PLC are connected by TPC-S7-200 ordinary communication data line.

4.2.2 Parameter settings

The IP address of PC is 200.200.200.188. PLC and PC communicate by RS-232C protocol. The communication port addresses of PLC and PC are the same, which is com1. The transfer speed is 115.2 kbps.

When the PC and PLC and touch screen communicate, Special communication protocol is used. Data length is 7bits and stop bit is 1bit.The data check mode is even-check. Transfer speed is 9600bps.

Download parameters of the touch screen should be set. The communication connection method is TCP/IP network connection. The target machine name of the configuration environment is the same as the IP address of the touch screen. Both of them are 200.200.200.190. This IP address is not be the same as the PC's.

4.2.3 System debugging

After the above settings take effect, the PLC program and touch screen Project can be downloaded and debugged. The results show that the system can reliably monitor the operation of the machining system.

5. SUMMARY

In this paper, a monitoring system of workpiece processing based on Mitsubishi PLC and MCGS is designed. The PLC program is programmed. The parameters for communication are set. The system debugging is completed. The security and reliability of the system are verified. The reference for engineering designers is provided.

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