Study on the design approach of the main control program of single chip microcomputer and serial control liquid crystal display module

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ABSTRACT

The study carried out deep analysis on the main control program of SCM and serial control LCM and discussed the function of some control commands. Adopting single chip microcomputer AT89C51 as the core component, the system CPU connected to the LCD touch-display terminal and sent control commands through the RS 232 serial port. Besides, the study specifically introduced the design scheme and control method of the main control program of SCM and serial control LCM. The system mainly realizes the control of color touch LCD through special control module. The basic principles of the connection between modules and the design, implement method and main functions of critical control module are also detailedly described in the paper. The main control program of SCM and serial control LCM can resolve many software programming difficulties of the original system. Due to the rapid development and wide use of microelectronic technology as well as the increasing automatic and intelligent equipment, the system program puts out high request on operators, therefore the man-machine interaction interface of system becomes more and more important. The study also specifically introduced the practical value, characteristics, operation method, and operation process of the main control program of SCM and serial control LCM and described the application method of simulation testing software, the method of using it to produce graphical display interface and the display method.. Finally, the paper expounded the design approach and implement method of the simulation module in the main control program of SCM and serial control LCM.

KEYWORDS

Single chip microcomputer (SCM) and serial control; Master control program (MCP) of liquid crystal display module (LCM); Display terminal; Control command.

INTRODUCTION

As a kind of common display devices, LCD has the characteristics of low power consumption, small volume, light weight, and large amount of information. The computer distributed control system (LCD) has been widely recognized in the field of modern coal-fired power and thermal control with obvious effects in the process of application[1]. Today, bringing the monitoring of electric quantities into the LCD system to replace the traditional "one to one" manual operation in the electric control becomes the main work content of further improving the automation control system of power station. Combined with the practical engineering needs, this research focused on the measures of bringing electrical monitoring into the composition of LCD system, realizing the hardware and software functions and improving reliability, and carried on beneficial discussion on some technical problems. At present, the electrical control part of most control systems has been brought into the LCD system, thus the manual operation has almost been canceled, but there also are some problems existing. For example, many designs are not in conformity with the original operation habit, which will have certain impact on the traditions. In the process of system transformation, some design can not immediately realize interaction although they are good designs[2].

Generally, it is troublesome to apply the LCD design in the microprocessor system (MCS - 51, C8051F, AVR, PIC, MPS430, DSP, part of the industrial ARM), and it is especially difficult to apply the large lattice or color LCD design. Most of existing automatic test systems have protocol parsing module and adopt 103, 104 and other protocols to carry out information interaction with the device under test, so as to complete value setting of devices, pressing plate control and acquisition of wave data; use the tester control module to command the tester to complete the simulation of the process of power failure;the man-machine interaction interface mainly completes the functions including test case editing, information display of execution process of test task, and display of test report. The whole system generally uses one personal computer to install automatic test software, uses a tester to add the electric quantity of the device under test, and connects the instruments through network, thus realizing the test of the relay protection device under test[3]. The control of the system on signal input is mainly reflected in the detection of signal input. The detection can be divided into four parts. Among them, the button input detection mainly is manual control; the liquid level difference input test is used to start and stop the sewage disposal machine; high-low liquid level input detection; oxygen input detection is to maintain the content of dissolved oxygen in water, which is accomplished by controlling the speed signal of the aerator. The control of LCD on detection is realized through the estimated values, namely the feedback of the dissolved oxygen analyzer. Use the system CPU to give a few simple commands and the color and monochrome LCD can be controlled.

INTRODUCTION OF THE LJD-ZN SERIES LCD TERMINAL

The product is the color intelligent LCD terminal designed by the Beijing Blue Ocean Microchip Technology Development Co., Ltd. Comparing the data within the TABLE below, the input points and output points of the sewage treatment system can be drained, and then choose the controller and the extension module which have points higher than the sum of those two points[4]. The TABLE shows that the input points and output points respectively are 18 points and 16 points, thus when choosing the CPU model, the CPU224 programmable controller of Siemens S7-200 series having an input points of 22 and an output points of 18 points is selected. For the normal operation of the PLC controller, the digital quantity extension module EM223 of the same Siemens series is selected as its corresponding extension module. The pin configuration is shown in TABLE 1.

TABLE 1 : Pin configuration of RS 232

pin number	signal	function	pin number	signal	function
1	Not used		4	Not used	
2	RXD	receive data	5	GND	signal earth
3	TXD	send data			

The problems can not be found and solved immediately, and there is possibility of damaging the instrument. The reason is not hard to understand because it has been mentioned in the paper that when the pressure difference between the entry and exit of magnetic filter, the filtering process should be immediately stopped. But, if there is no differential pressure measuring instrument, the differential pressure will not be shown, therefore the filtering process will be unable to be stopped when problems occur. The pin arrangement is shown in TABLE 2.

TABLE 2 : Pin configuration of RS 485

pin number	signal	function
2	A	RS 485 send
3	B	RS 485 receive
5	GND	signal ground

Then come to the software debugging. In software debugging, the completed routine including each subroutine should be run in LCD for debugging, so as to see whether there are results drawn from operation. Compare the results with expected results to make sure whether they are consistent with each other and whether the corresponding function is the same as expected[5]. In addition, the software debugging can be divided according to function. And after completing the debugging of each module, an overall debugging is carried out. Because the LJD-ZN- 8400T is displayed as 640 x 480 pixel, the exceeding part will not be displayed, which will only waste the storage space. Therefore, the system not only has simple structure and high reliability, it also designs self-diagnostic program, thus the system has certain self-diagnosis function. When the system is out of order, it will give an alarm and stop working immediately, which reduces the possibility damaging the machine, and ensuring the stable and reliable operation of system. Besides, the paper adopts the delay and interlock algorithm in back-washing process, which has effectively solved the competition problem between two groups of units in the back-washing process. I t can be extended to 400.

EXPLANATION OF CONTROL COMMAND AND DATA PATTERN

The LJD-ZN-8400T display system provides rich operating commands. The designers can easily complete the design of all display functions by using these commands. The LCD system was launched by the United States from the 1960s. It is a programmable logic controller having replaced the traditional relay control device. The main control program system based on LCD system not only can complete the basic requirements for control system, but also carry out real-time monitoring on the treating process by connecting PLC through network[6]. The system is convenient for programming, and has short development cycle, besides it is easy to maintain, and can be connected to the Internet, thus it is convenient for upgrading. In general, the system has strong commonality, convenient operation, strong control function and extension ability.

The fieldbus control system is a real-time network control system based on fieldbus. It can realize the interconnection between on-the-spot control device and on-the-spot intelligent instrument in accordance with the standard communication protocol and through automatic control, thus realizing the data transmission and exchange among equipment, and between equipment and computer. The comprehensive cost and installation cost of the system is much less than that of other control system, thus having high cost performance. In addition, during operation, the system can use rich network resources, which not only can realize real-time transmission, but also interconnect different products. The purpose of designing sewage treatment system is to output reused water after processing the discharged sewage, so as to realize purification of waste water. For a long time, with the continuous development of the main control program technology, the domestic main control program has developed to a new development stage, but the processing techniques of main control program still can not keep up with the needs of the development of the city. The problems of low processing ratio and low operation rate are still existing in main control program. With the rapid development of economy, it becomes extremely urgent to solve these problems. Comparing the three listed control forms, it can be seen that adding the PLC core controller into sewage treatment system is relatively convenient and feasible, not only can achieve effective reuse of LCD, but also can effectively save costs[7].

The main control program based on PLC can simplify the design process, and can realize more functions including real-time monitoring of the system, a convenient and simple interface, thus it is convenient for the user to control the PLC system. The main control program based on PLC can realize the control of signal input and output. The system control of signal input is mainly reflected in the detection of signal input, and the detection can be divided into four parts. Among them, the button input detection mainly is manual control; the liquid level difference input test is used to start and stop the sewage disposal machine; high-low liquid level input detection; oxygen input detection is to maintain the content of dissolved oxygen in water, which is accomplished by controlling the speed signal of the aerator. The control of LCD on detection is realized through the estimated values, namely the feedback of the dissolved oxygen analyzer. The first three input signal detection are all digital input (TABLE 3), and the oxygen input detection is analog input. For example, the command "CLS00000a0a" will turn into "3044434 c53303030303304130413044" after being sent through serial port.

TABLE 3 : Description of VLCMI2864 command

command format	function description
BMPnxy	Show the bitmap n at the place taking point(x,y) as vertex
CLR	Eliminate all show on display
CLSxywh	Eliminate the rectangle taking point (x,y) as vertex and having a width of w and a height of h
INVxywh	Inverse the rectangle taking point (x,y) as vertex and having a width of w and a height of h
SDTxy	Create point at the position (x,y)
HZAxy	Set the point(x,y) as Chinese character or the display starting point of ASCII character
HZD	Show the Chinese character or ASCII character
ASD	Rapid display of ASCII character string with an input of up to 64 characters every time
BLO	Turn on the backlight
BLF	Turn off the backlight

THE PROGRAM DESIGN OF SCM AND DISPLAY TERMINAL INTERFACE

The initial setup of SCM serial port

After power-on initializing the main control unit, firstly set the working model of serial port controlling core single chip microcomputer at mode 1 with a rate of 9,600 b/s. The detailed structure is shown in Figure 1. The input points and output points of sewage treatment system can be drawn from the initialization routine of serial port. Then choose the controller and the extension module which have a points higher than the sum of those two points. The TABLE shows the input and output points respectively are 18 points and 16 points, thus when choosing the CPU model, the CPU224 programmable controller of Siemens S7-200 series having an input points of 22 and an output points of 18 points is selected. For the normal operation of the PLC controller, the digital quantity extension module EM223 of the same Siemens series is selected as its corresponding extension module. The pin configuration is shown in TABLE 1.

After selecting the PLC controller, the next is differential pressure testing instrument. It is necessary to install differential pressure detection instrument in the main control program. The main control program without differential pressure detection instrument will be unable effectively control the display process and when the filtering process goes wrong, it will be unable to quickly find problems and solve them. Besides, the instrument may be damaged. The reason is not hard to understand as it has been mentioned in the paper that when the pressure difference between the entry and exit of magnetic filter is too high, the display process should be immediately stopped, and if there is no pressure differential detection instrument, the pressure differential will not be shown, thus when problem occurs the filtering process can not be immediately stopped. Pay particular attention to the subroutines of fault diagnosis. In this main control program, the external devices which have a main function of outputting signal usually more easily go wrong compared with software. If those faults of external devices can not be solved timely, it will be easy to cause the abnormal operation of system or even damage the system. Therefore, it is necessary to design the subroutines of fault diagnosis to ensure that when the main external output device fails, the system will stop working and give an alarm.
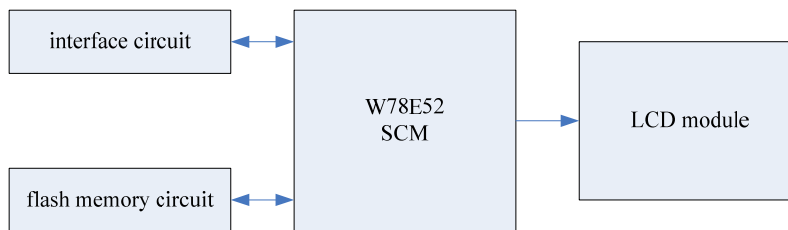

Figure 1 : The basic structure of the hardware of the VLCM12864 LCD module

Control command sending program

The LJD-ZN-8400 display system provides operation command, through which the designers can easily complete the design of each display function. Make sure whether the control is normal, whether the valves can open and close normally, and whether instrument and control system is normal. The test results show that hardware is under normal operation. Then come to the software debugging. In software debugging, the completed routine including each subroutine should be run in LCD for debugging, so as to see whether there are results drawn from operation. Compare the results with expected results to make sure whether they are consistent with each other and whether the corresponding function is the same as expected. In addition, the software debugging can be divided according to function. And after completing the debugging of each module, an overall debugging is carried out. The testing result of the sewage treatment system shows that: the hardware configuration is normal, and it can not only meet the needs of operation, but also can give play to the control function of PLC. Each module program also can realize the control on corresponding function during debugging, which basically achieves the function design of the sewage treatment system. The connecting circuit between PLC and LCD module is shown in Figure 2.
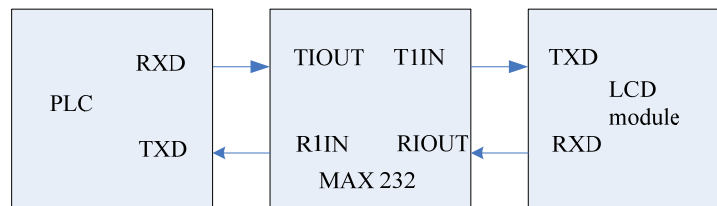

Figure 2 : The connecting circuit between PLC and LCD module

Design of the detection program of touch location

The LJD-ZN-8400 display terminal can output the coordinate through serial port based on external touch location. The control system scheme as well as the software and hardware configuration has realized the automatic control based on

the main control program of PLC. The sewage treatment system based on PLC controller is easy to use and convenient for maintenance, thus having a broad prospect of promotion. But there is still a long way to go in order to realize intelligent sewage treatment and optimization of the operation of processing system, which requires for in-depth study on the principle of main control program, continuous study of advanced technology, and constantly increasing ability of processing and controlling. All of these will promote the realization of energy conservation and emissions reduction. Adding the pressure differential detection instrument into the hardware design can guarantee the normal operation of the filtering process; apply structured program design in software design, and present the sequence function diagram of the control system. Because of taking PLC as the controller, the main control program not only has a more simple structure, but also has higher reliability. Besides the system designs self-diagnostic program, endowing the system with certain self-diagnosis function. Therefore when the system is out of order, it will give an alarm and stop working immediately, which reduces the possibility of damaging the machine, and can guarantee the stable and reliable operation of the system. Besides, the paper adopts the delay and interlock algorithm in back-washing process, which has effectively solved the competition problem between two groups of units in the back-washing process. The flow chart of the subroutine detecting the touch location is shown in Figure 3.
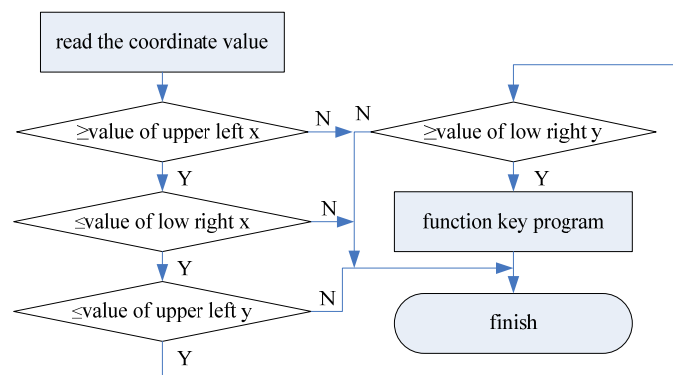

Figure 3 : The flow chart of the subroutine detecting the touch location

It has mentioned in the previous function analysis section that the test system mainly supports the following test types: protection logic test, pressing plate test, fixed value test, remote communication test, telemetry testing, remote control test. Among them, the protection logic test is the core module of this system because the device protection test is mainly to test its protection logic. The pressing plate test and fixed value test are basic tests. These three types of test accounts for more than 80% of protective device test. And because the pressing plate test and the fixed value test are exactly similar, the paper here only introduce the design and implementation of protection logic test and pressing plate test in detail, and will not give details on other types.

CONCLUSION

The study carried out deep analysis on the main control program of SCM and serial control LCD module, and discussed the function of some control command. Adopting single chip microcomputer AT89C51 as the core component, the system CPU connected to the LCD touch-display terminal and sent control commands through the RS 232 serial port. Besides, the study introduced the design scheme and control method of the main control program of SCM and serial control LCM. The system mainly realizes the control of color touch LCD through special control module. The basic principles of the connection between modules and the design, implement method and main functions of critical control module are also specifically described in the paper

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