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Intelligent Micro-Incubator System Design for Temperature Control and Abnormal Alarm

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Abstract: In this study, the STC89C51 microcontroller serves as the primary control unit, complemented by an LCD1602 display, a DS18B20 temperature sensor, and an active buzzer. The resulting intelligent incubator system is capable of maintaining a constant temperature and issuing real-time alerts in the event of temperature deviations. Additionally, users have flexible control over the incubator's temperature settings. The design of this intelligent incubator system is divided into two main components: hardware and software.On the hardware side, the STC89C51 microcontroller is employed to efficiently manage and drive the module circuits, facilitating the flexible acquisition and conversion of external data pertinent to the incubator system. For the software component, the control program is developed in C language, enabling the microcontroller to perform the desired functions. The overall design is systematically divided into the hardware circuitry and the software programming, with a modular design approach adopted to simplify the system's components. This method allows for step-by-step design and ultimately ensures that all functional requirements of the intelligent micro-incubator system are met.

Keywords: Intelligent incubator; single chip microcomputer control system; constant temperature control; abnormal alarm.

1. Introduction

Looking at the whole development process of the intelligent micro incubator system, before thesensor technology has been popularized, the performance of all the circulating intelligent micro incubator systems on the market is generally simple, and the functions that can be realized arevery few. Due to the lack of corresponding sensor module implantation, the intelligent micro incubator system at this time will not be able to directly put the external magnetic field of the system , pressure or gas concentration and other non electric signals are collected and converted into electric signals in a linear proportion, which can only be collected through a verycomplex analog circuit, which directly led to the failure of the intelligent micro incubator system at that time to collect non electric signals with high precision, so the overall performance of the intelligent micro incubator system at that time was relatively low. With therapid development of sensor technology in the early 21st century, the concept of sensor has gradually become popular. Most people know that sensor is an intelligent functional module, which has very high performance for signal acquisition. Designers of intelligent micro incubatorsystem constantly explore the inevitable connection between sensor and intelligent micro incubator system In the system, sensors of various types and functions are continuously implanted, which are cleverly built with high-performance microprocessor chip and controlled by program driver, so as to realize high-performance signal acquisition function, quickly collectexternal non electric signals and send converted digital signals to the microprocessor chip for processing and calculation, so as to make intelligent micro B-type incubator system can respond to external signals with high speed.

In the process of the development of the intelligent micro incubator system, the requirements for high-speed data processing are constantly improving. In recent years, the rapiddevelopment of high-performance microprocessor chip research and development technology provides the hardware foundation for the realization of the qualitative leap of the intelligent micro incubator system. In recent years, the emergence of ZigBee and the Internet of things technology also provides a budding for the development of the intelligent micro incubator system In the new direction, in the past, the single form of intelligent micro incubator system can realize the Internet of things through the concept of the Internet of things, so for the data collected by the intelligent micro incubator system, it is no longer a single data that will be used up or discarded. With the help of ZigBee or embedded Ethernet technology, the data collected by the system can be sent to the Internet or home in real time and quickly In the network, realize data sharing or cloud backup, so as to realize the integrated monitoring and remote control of the application occasions of the intelligent micro incubator system.

The intelligent micro incubator system can realize the functions of lattice display, temperature detection and sending alarm in the working process. Its important task is to comprehensively apply and process a series of different types of data in the working process, so as to provide output results for users. In the recent development of the intelligent micro incubator system, the networked intelligent micro incubator system is A kind of control system with application prospect, which not only realizes the physical connection of multiple intelligent micro incubator systems, but also realizes the software connection of each intelligent micro incubatorsystem in combination with the remote monitoring system, and realizes various kinds of communication with each other. This topic will design a relatively new intelligent micro incubator system, which uses stc89c5 As the main controller, MCU will combine a series of high- performance functional circuits and C language programs to achieve the expected functional objectives of the project.

The development of intelligent micro incubator system has formed three product grades of low, medium and high performance in the market. In the past period of time, because the new embedded technology used in the middle and high-end products has just been introduced intothis system, the R & D cost has not come down, which is at a high cost level, while the performance of the low-end products is not good It can meet the needs of the vast majority of users, so the competitiveness of low-end intelligent micro incubator system is very strong in the past period of time. With the popularity and maturity of this new technology in the research and development of intelligent micro incubator system, almost any research and development enterprise can independently develop this new technology, so in the latest period of time The cost of the middle and high-end system in the workshop has been declining, and more importantly, its intelligent elements and functions are constantly enriched, so the cost performance of the middle and high-end intelligent micro incubator system is gradually improved, and the market competitiveness is also constantly improving.

This intelligent micro incubator system is an intelligent control system based on the microprocessor chip as the internal core controller. Its intelligence is not only reflected in the internal use of high-performance microprocessor chip, but also in the use of many high- performance sensor modules. At the same time, for LCD1602 LCD screen, DS18B20temperature sensor And the implantation of active buzzer greatly promotes the performance and precision of the intelligent micro incubator system.

2. Scheme Design and Component Selection

STC89C51 single chip microcomputer is a kind of main control microprocessor with a long history of development. At the same time, its development materials are very rich. It can be said that STC89C51 single chip microcomputer can be seen in any kind of electronic control system,and the performance of the system controlled by STC89C51 is very excellent, which is mainly due to its internal MCS-51 core, which is the core of Intel company A high-performance CPU developed in the th century can process the data of a byte width at the same time, with high operation speed. At the same time, its CPU is also equipped with a wealth of timer modules, interrupt resources and various bus interfaces. Therefore, users can complete the control system with complex functions through a single chip STC89C51.

The expected design goal of the intelligent micro incubator system includes the function of realizing the display parameters through the display part. Therefore, it is necessary to choose a LCD screen which is suitable for the system and rich in information. The working principle ofLCD1602 LCD screen can be described as follows: after applying the correct voltage, the controller inside LCD1602 can continuously receive the instructions and data sent by the external main control device, and display the characters on the screen in the form of lattice by fetching the internal font data.

Through browsing the vast amount of materials in the Internet and library, the intelligent micro incubator system finally decided to use DS18B20 temperature sensor as the temperature detection part of the system, which is mainly because if the DS18B20 sensor is embedded in the hardware framework of the intelligent micro incubator system, it can greatly improve the performance of the intelligent micro incubator system.

The active buzzer can be flexibly controlled by STC89C51 single chip microcomputer. In addition, it needs to consume two pins of STC89C51 single chip microcomputer in this system. Considering the rich GPIO pin resources of STC89C51 single chip microcomputer and the connection of other functional modules to the pins of single chip microcomputer, its package can meet the needs of this intelligent micro incubator system.

The minimum system circuit structure of STC89C51 is relatively fixed. Because there is no need to configure the special power processor part, JTAG debugging interface and other parts, it is only necessary to connect the reset circuit or crystal oscillator circuit and STC89C51 single chipchip. The following is the design of the circuit structure of these two parts. The reset circuit is mainly used to realize automatic reset and manual reset at the initial stage of system power on. According to the configuration scheme of reset circuit structure provided in the official data ofSTC89C51 single chip microcomputer, the reset circuit in the figure below is designed, which only requires mechanical keys, resistors and capacitors. After the intelligent micro incubator system is powered on, the voltage at both ends of the resistor can reach High level can make the system reset automatically at this moment. In the process of operation, pressing themechanical key shortens the capacitance, and also makes the resistance reach high level, whichmakes the system reset manually.

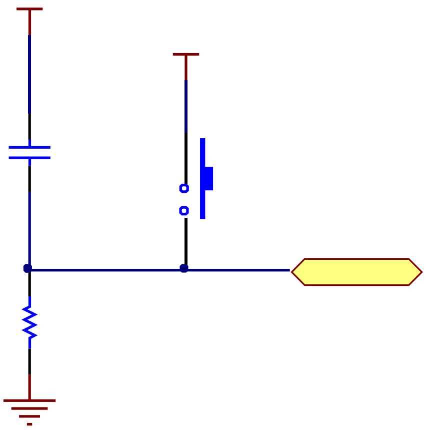

Fig 1. Reset circuit design

The key point of the design of the clock circuit is the selection of crystal oscillator parameters. After the query of data, the clock frequency of 12Mhz can achieve the most stable control. In the clock circuit in the figure below, two 30pf capacitors are connected at both ends of the crystal oscillator, which makes it easier to realize the start-up of the clock signal.

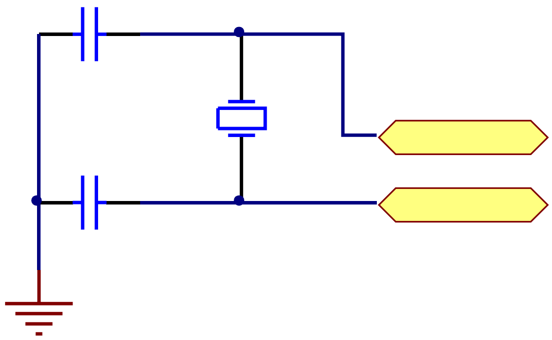

Fig 2. Crystal oscillator circuit design

The GPIO pin connection between STC89C51 single chip and LCD1602 LCD is the design focus of this project. This project adopts STC89C51 single chip chip to provide 32 GPIO pins for users. In addition to the used pins, this project will connect the 4 ~ 14 pins of LCD1602 dot matrix screen with STC89C51 single chip according to the electrical circuit connection relationship in the figure below In the way of direct connection, there is no need for isolation protection or coupling between the two. LCD1602 display device has been designed with LCD main controller,parallel bus interface, word bank memory, LCD dot matrix and voltage processor before leaving the factory. In the design task of this project, we can directly drive and control each function module inside LCD1602 LCD screen through the common GPIO pin of STC89C51 single chip microcomputer, and through the interaction of these function modules Finally, the display function of important parameters can be realized through connection and interaction. The working principle of LCD1602 lattice screen's important parameters display can be explained in terms of hardware through the circuit connection relationship shown in the figure below. After the LCD1602 LCD screen is correctly powered to enter the working state, STC89C51 single chip microcomputer intends to send the command data output through GPIO pin to pin 4 ~ 14 of LCD1602 display, or from these pins of LCD1602 lattice screen Read out the instruction signal from the internal controller of the device, through the operation of the two, realize the data processing, and finally achieve the function of displaying parameters.

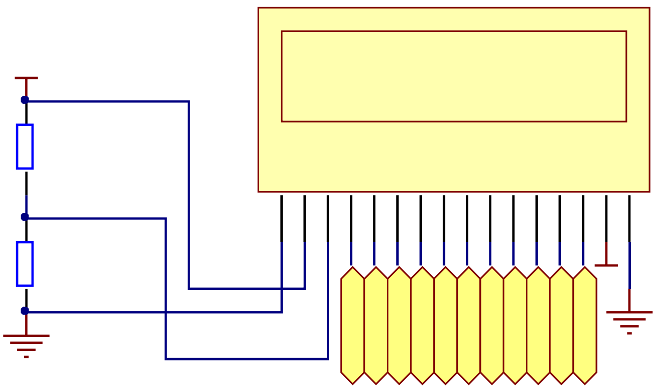

Fig 3. LCD1602 LCD circuit design

This intelligent micro incubator system mainly refers to the recommended circuit in the official materials provided by Dallas company in the design method of hardware circuit of DS18B20 temperature measuring device, and copies its general topological framework as a whole. The only thing that needs to be changed is the connection relationship with STC89C51 single chip microcomputer. In order to control DS18B20 temperature sensor by STC89C51 single chip microcomputer and mobilize its internal functional modules, such as intelligent micro incubator, etc., this paper uses the connection relationship in the figure below to directly connect the common GPIO pin of STC89C51 single chip microcomputer with the No.2 pin of DS18B20 temperature measuring device, because the signal IO pin of the device is important for the input and output current of the single chip microcomputer It is very low, so the intelligent micro incubator system does not need to be isolated between the No.2 of DS18B20 temperature sensor and the GPIO pin of single chip microcomputer. Through the above introduction of the basic parameters of DS18B20 sensor, we can know that this temperature sensor device has three functional pins, among which the power pin uses DC5V DC voltage for power supply, because it can use the same + 5V DC voltage with STC89C51 single chip microcomputer for power supply, so this intelligent micro incubator system does not consider the power supply circuit design of DS18B20 temperature sensor. The circuit connection diagram in the figure below is the hardware circuit design of DS18B20 temperature measuring device.

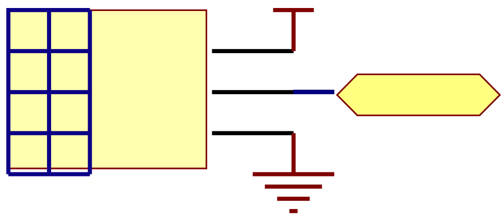

Fig 4. Schematic diagram of DS18B20 temperature detection circuit

In order to realize the real-time temperature control in the incubator, so as to stabilize the temperature near the set temperature value, the heating control circuit in the figure below is configured in this subject. The temperature control is realized by the opening and closing control of the heater by the relay. The interface of the control circuit is directly connected with P1.7 pin of the single chip computer. In the aspect of module power supply of active buzzer, through consulting the data documents provided by the manufacturer of the device, it can be found that the device has the characteristics of wide voltage input, and can work stably in the DC voltage range of + 3.3-6v, which is mainly due to a high-performance internal voltage stabilizing module, which can reduce and stabilize the DC voltage input from external power supply and reduce the voltage The AC interference components carried in the system are effectively filtered out. Because the intelligent micro incubator system designed in this project uses + 5V voltage for power supply, it can be directly applied to pin 1 of the active buzzer. In the design of pin drive circuit of the high-low level driving single-chip microcomputer, the pin 1 and pin 2 of the active buzzer device (2 in total) are its For the control pin, the system needs to assign two different GPIO pins to connect with the active buzzer device.

The software design part of the intelligent micro incubator system is mainly divided into the main program and each subprogram part. The design of each program module will be carried out on the basis of the hardware circuit, which is mainly reflected in the connection relationship between the STC89C51 single chip computer and each sensor and functional circuit. The corresponding pin number will be controlled in the program code. In addition, in order to be more clear about the The implementation scheme of each program module is introduced, which will be displayed in the form of multiple flow charts.

When the intelligent micro incubator control system enters the working state, firstly, the temperature value set by the user is detected by the key, then the single-chip microcomputer saves the temperature value, and then enters the formal working state. At this time, the single- chip microcomputer drives the DS18B20 temperature sensor through the single bus constructed by p2.1 pin, so as to obtain the real-time temperature value T1 in the incubator, and at the same time, the user The set temperature value T2 is read and compared. If the real- time temperature value T1 is less than the set temperature value T2, the MCU will output the high level through P1.7 pin to close the relay, so as to start the heater to heat the incubator. When the real-time temperature value exceeds the set temperature value, P1.7 will output the low level to disconnect the relay and stop the heater operation At the same time, p2.0 pin outputs high level to start the buzzer for alarm.

The subprogram design of LCD1602 lattice screen mainly involves two procedures: writing data and writing instructions. This requires building program code through C language and sending and receiving instructions according to the time sequence given in the materials provided by the manufacturer. Next, the implementation method of the whole process is illustrated by an actual driving process (displaying the number 1 on the LCD1602 LCD screen), as shown in the flow chart below As shown in Figure 3, the actual display process of characters on LCD1602 LCD is very simple. Firstly, the position coordinates (0x80-0x8f or 0xc0-0xcf) are encoded to the inside of LCD1602 LCD so that the internal controller can locate the cursor at this position. Then, STC89C51 MCU sends the ASCII code corresponding to the characters to be displayed to the inside of LCD to automatically retrieve the internal font information, The characters are then displayed by applying a voltage to the liquid crystal lattice.

In the form of software flow chart, the function of STC89C51 single chip microcomputer controlling DS18B20 temperature detector to detect temperature is described in detail. This process mainly involves two working processes: output read data and write data through STC89C51 single chip microcomputer combined with C language, and the realization of some functions such as initialization of internal register, instruction input and temperature data readout All of them depend on STC89C51 single chip computer to output different forms of read data and write data combination to realize. This paper focuses on these two aspects in the software design of DS18B20 temperature measuring device.

STC89C51 single chip microcomputer will read the temperature data of ds1b820 do pin through p2.1 pin, and repeat the same process eight times each time. As shown in the functional flow chart below, p2.1 pin will first output a rising edge and send it to do pin, then do pin will output 1 bit of data, and repeat the process eight times in total, STC89C51 single chip microcomputer will obtain a complete temperature data reading Take the result. The process of writing data is relatively simple. STC89C51 only needs to send out the clock signal and data signal in time according to the flow chart in the figure. Firstly, p2.1 pin of STC89C51 sends out the low-level clock signal first, and do pin starts to start the writing mode after receiving the level signal, and then receives 1 byte of data to be written out of p2.1 through do, with a short delay After p2.1 pin remains high, DS18B20 ends the write mode.

3. Conclusion

The intelligent micro incubator system designed in this subject has gone through a series of verification links above, and the design results of all functional indicators are satisfactory. As a prospect link, this subject also needs to put forward some improvement points and measures for the design results of this system, first of all, the parameter configuration of the intelligent micro incubator system in the main control, Due to the premise of high cost performance, the two parameters of performance and cost are integrated in the selection of the main control chip at the initial stage. Therefore, in order to achieve higher performance control performance, we need to release the cost restrictions and choose a higher-end main control microprocessor, which can improve the performance of this intelligent micro incubator system in terms of processing speed and internal resources One level higher. The intelligent micro incubator system designed in this project uses the mature cases on the Internet and in the library books in the overall scheme. Through the excerpt and integration of these mature case design ideas, and adding some ideas of their own, a large number of design links show the concept of portability, miniaturization and high cost performance advocated by the current embedded system A large number of sensors and functional modules with low power consumption characteristics are used in the hardware system, replacing a large number of traditional circuits, which greatly improves the working performance of the hardware system. In terms of the selection of the main control scheme, the implantation of STC89C51 single chip chip chip makes the performance of the whole intelligent micro incubator system greatly improved, and in the configuration of software program code On the one hand, through the flexibility of C language, all expected functions and indexes are transformed, and each function is realized by a series of subprograms, which fully embodies the design process from idea to realization.

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