# The Design of Software Control System of Intelligent Heater for College Students' Dormitory

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**Abstract:** With the progress of society, the allocation of living hardware in college students' dormitory is getting higher and higher, and the allocation of heater has become a part of college students' life. Based on the shortcomings of traditional heater, this design studies the software programming of the system on the basis of the hardware circuit of the heater control system. The functions of constant temperature heating, high temperature early warning and high temperature power-off protection are realized. The system has the advantages of low cost, easy operation, home intelligence and so on. At present, it has been widely used in the intelligent heater control system of our school students' dormitory.

## 1. Introduction

With the progress of society, the hardware configuration of College Students' dormitory life is getting higher and higher, and the configuration of heater has become a part of college students' life. In the heater series, the traditional heater has a single function, the water temperature can only be adjusted by machinery, the accuracy of system control is not high, and there are serious security risks, which cannot meet the needs of students' dormitory. In order to ensure the safety of students' bathing water, intelligent heater has become the first choice. In the composition of the intelligent heater, the intelligent control system is the key to the heater. It can not only automatically control the water temperature, timely display the working state of heater, but also stop heating immediately when the state parameters of the water heater exceed a certain threshold, and the buzzer will give an alarm. The system is not only safe and environmentally friendly, but also has high control accuracy and strong anti-interference ability [1]. Organization of the Text.

## 2. Software design architecture of intelligent heater control system

### 2.1 Design requirements of intelligent heater control system

Based on the life characteristics of college students' dormitory, the design requirements of intelligent heater control system are as follows: (1) water temperature can be displayed by LCD, and the upper and lower threshold of water temperature can be set by keys, and the heating time can also be set[2]; (2)when the water temperature is lower than the pre-set lower threshold temperature. The control system can automatically heat to the set value. When the water temperature reaches the set value, the control system automatically cuts off the power supply and stops heating; (3) When the water temperature is higher than the pre-set upper threshold temperature, the control system will give an alarm and cut off the power supply to stop heating; (4) Users can adjust the temperature by keys or remote control according to the actual situation; (5) The control system can realize intelligent Maintaining the Integrity of the Specifications.

### 2.2 Architecture of software design

As shown in Figure 1, the software design architecture is mainly composed of the main program module and temperature detection subprogram module, relay control subprogram module, LCD

display subprogram module, timer interrupt subprogram module, etc. the function of the main program is to initialize the working parameters of the system, call the subprogram of each functional module through the main program, the system calls the subprogram by flag bit [3].

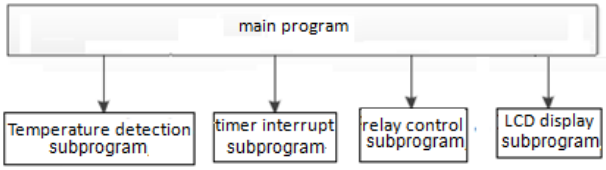


Fig. 1. Software design architecture

## 3. Design of system main program

As shown in Figure 2 is the main program flow chart of the system. After the system starts to run, when the temperature control key is not pressed, the circuit will check whether the water temperature of the water heater is normal according to the initial temperature (default value) set by the system. When the temperature key of the system is pressed and the user resets the temperature range, the system will cycle according to the new temperature setting range until the temperature key sets the new temperature value again[4].

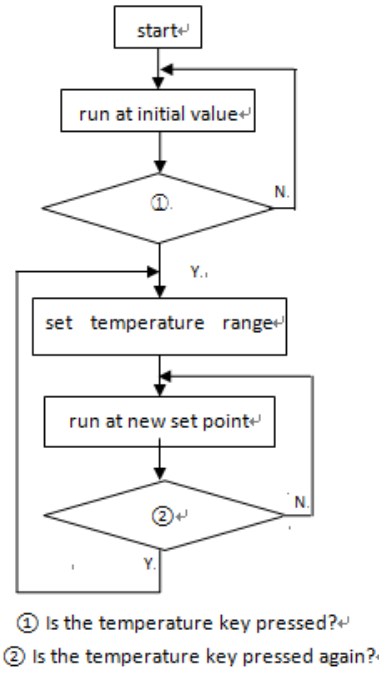


Fig. 2. System main program flow chart

## 4. Design of system subprogram

### 4.1 Design requirements of intelligent heater control system

As shown in Figure 3 is the flow chart of temperature detection subprogram. When the system detects the temperature, the single-chip microcomputer first performs the reset operation, and then detects whether the temperature sensor is connected. Because only one temperature sensor is used in this design, the ROM matching of DS18B20 can be skipped directly when the system works.

During the reset operation, the single chip microcomputer needs to wait for the pulse signal input from the DS18B20 temperature sensor. When the single chip microcomputer receives the pulse signal input from the DS18B20 temperature sensor, it indicates that the system reset operation is completed. AT89S51 single chip microcomputer will carry out the instruction of temperature detection and temperature conversion. After reading the temperature data, the system will calculate the collected

temperature data. In the process of calculation, when symbol bit s = 0, binary data will be directly converted to decimal. When the symbol bit s = 1, first carry out complement transformation, then carry out original code transformation, and finally convert the original code to decimal number[5].

The program of this module is mainly implemented by the defined read temperature function. At first, the function skips to read the serial number, then starts the temperature conversion, finally reads the temperature register, obtains the temperature data, calculates and processes the temperature data, and the system obtains the final temperature.

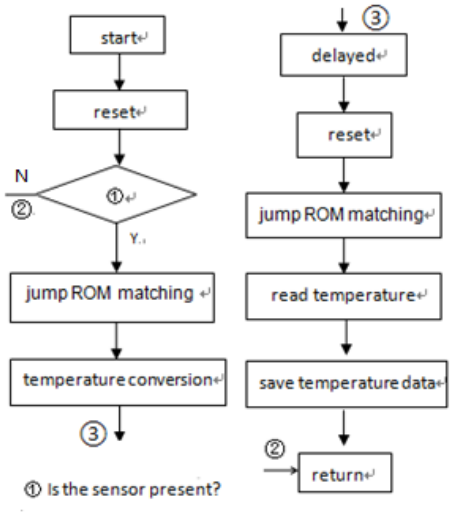


Fig. 3. Flow chart of temperature detection subprogram

### 4.2 The design of relay control subprogram

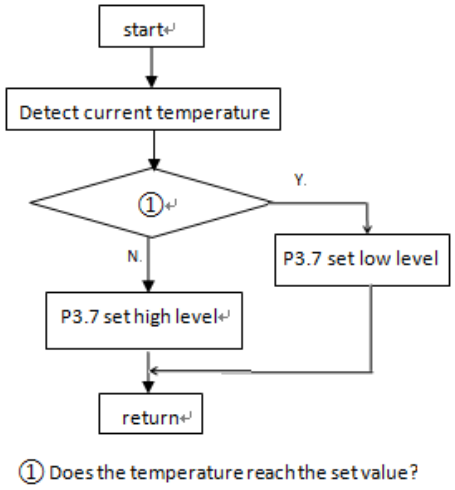


Fig. 4. Flow chart of relay control subprogram

When the control system starts to run, the single-chip microcomputer first reads the actual temperature of the current water in the temperature sensor DS18B20, and then compares it with the initial temperature set by the system. If the actual temperature of the water is higher than the initial temperature set by the system, the P3.7 port of the single-chip microcomputer outputs a low level, the relay heating control circuit is disconnected, and the system circuit stops heating; On the contrary, when the actual temperature of water is lower than the initial temperature set by the system, the MCU P3.7 port outputs high level, the relay heating control circuit is connected, and the system circuit enters the heating state[6]. The specific flow chart is shown in Figure 4.

Because the temperature of system water changes in real time, the designed module should constantly detect the actual temperature of system water, and control the temperature of system through the designed cycle program

### 4.3 The design of LCD display subprogram

After the completion of the system startup, first set the display mode of LCD1602 LCD. After the completion of the display mode setting, the system will turn off the display, and at the same time, the system will clear the screen. after the screen clearing operation of the system is completed, the system will turn on the display again. After the delay time of the system is set, the display time of the first line and the display temperature of the second line of LCD1602 display screen will be set[7], and the specific flow chart is shown in Figure 5.

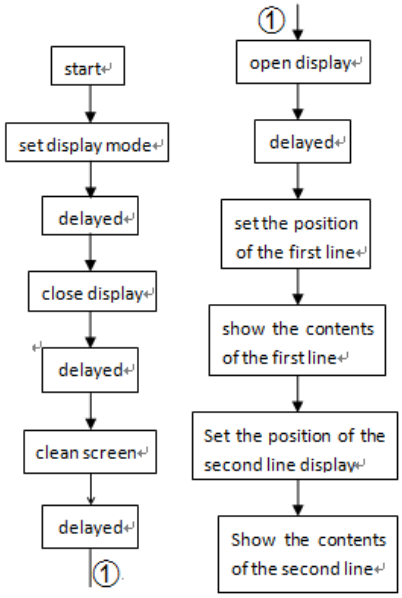


Fig.5. Flow chart of LCD display subprogram

### 4.4 The design of timer interrupt subprogram

In AT89S51 single chip microcomputer, its internal timer is mainly used to realize the function of counting and timing. The related registers are TMOD (working mode register) and TCON (control register). TMOD register is mainly used to determine its working mode. It has both timing function and counting function. TCON control register is mainly used to control the operation and stop of its timer. It is mainly realized by setting flag bits. The design flow chart is shown in Figure 6, and its specific functions are as follows: (1) select the operation mode of interrupt; (2) set the timing constant and its initial state mode; (3) set the count value, when the count or timing meet the requirements, the system will generate the interrupt signal; (4) output the status bit to wait for the interrupt operation[8].

The program of this module is mainly implemented by intersvr1 function. The input formal parameter is null. When it works, the system first extracts the size of interrupt interval, then sets zero, and finally reads code.

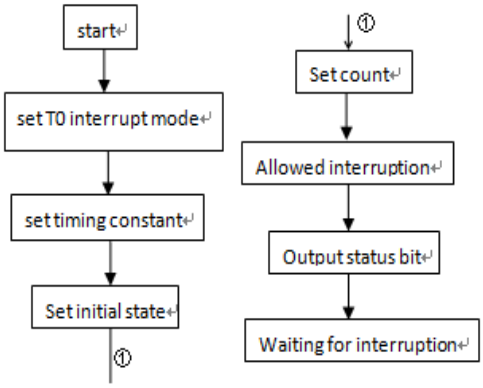


Fig.6. timer interrupt subprogram flow chart

## 5. System simulation

After the designed hardware circuit modules are cascaded, the software program of the system is imported into the single chip microcomputer, when the key is pressed, LCD1602 can display the current time and temperature, as shown in Figure 7. In Figure 7, the first line of the display screen is to display the current time of the system, and the second line is to display the hot water temperature value detected in real time by the temperature sensor. When the user presses the heating key, the system starts to heat the water in the heater. The water temperature of the heater keeps increasing. When the water temperature reaches the set threshold, the buzzer will give an alarm. The relay in the MCU control circuit is disconnected and the system stops heating. The LCD screen will display the whole process of water temperature change in the system. At this time, the first line of the LCD screen will display the maximum and minimum temperature of hot water. If the system is in the working state of setting interface, the system temperature can be set by adding and subtracting keys, and the time of timer can also be set by corresponding ways[9].

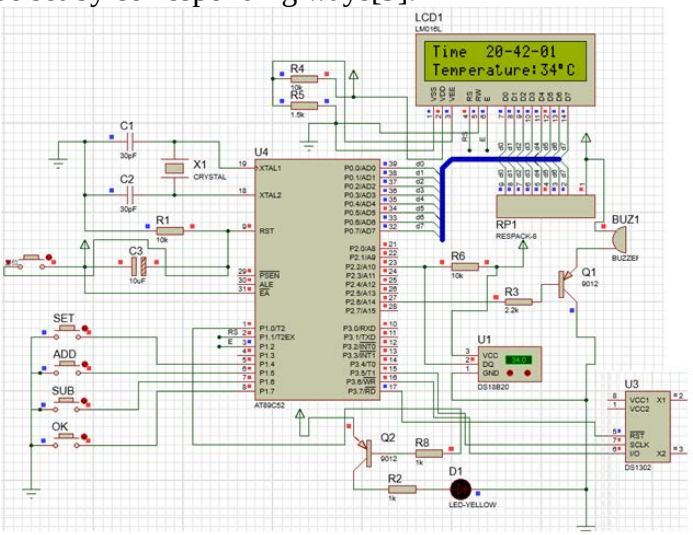


Fig.7. System simulation

## 6. Conclusion

From the above discussion, we can see that: the intelligent water heater control system of university students' dormitory is divided into hardware circuit design and software programming design. Based on the design of hardware circuit, this research mainly focuses on the software design of intelligent water heater control system. In the process of software design, the architecture of system software design is put forward. Through the design of main program, temperature detection subprogram, relay control subprogram, LCD display subprogram, timer interrupt subprogram, etc., the functions of system display, alarm and real-time protection are realized. The system has the characteristics of low cost, easy operation, safety and reliability. At present, it has been widely used in the intelligent heater control system of the student dormitory in our university

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