Design of Intelligent Heater Control System 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 intelligent heater control system. Through the hardware circuit design and software design of the intelligent 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.

2. Design Scheme 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) 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 adjustment, short heating time and low power consumption.

2.2 System Design Scheme

Based on the design requirements of intelligent water heater control system, it is necessary to design the hardware and software of the system. For software design, it is mainly realized by programming in C language. For the hardware system, it mainly takes the minimum control system of STC89C51 as the core, uses DS18B20 sensor to collect water temperature, displays the working

state of the system with LCD1602, sets the working state of the control system with key input circuit, and completes the timely alarm of the system with buzzer. The block diagram is shown in Figure 1.

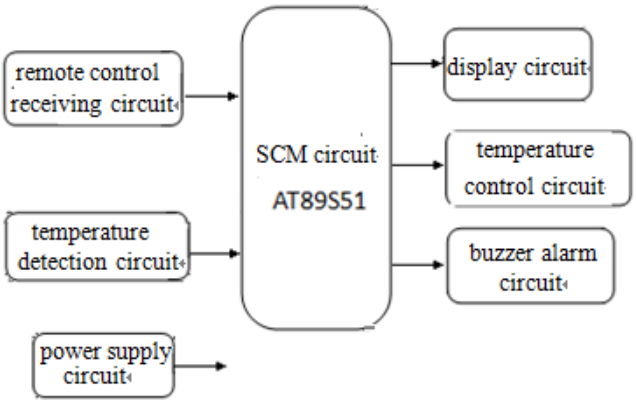

Fig.1 Block diagram of intelligent heater control system

3. Design of Hardware Circuit of Intelligent Heater Control System

3.1 Minimum System of Single Chip Microcomputer

As shown in Figure 2, the minimum system of AT89S51 MCU is composed of AT89S51 MCU, clock circuit, reset circuit, etc. For the clock circuit, it is composed of crystal oscillator Y1 and capacitors C1 and C7 (usually 30PF). It generates timing pulses for microprocessors. All operation and control processes of microprocessor are driven by timing pulses. For reset circuit, it consists of key S1, tantalum capacitor C3, resistance R1 and R2. When S1 is pressed, reset the whole system, the microcontroller starts the program from 0000H unit and initializes the special register to reset state [1].

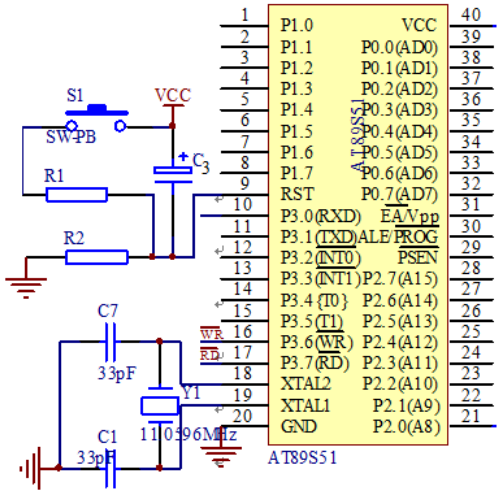

Fig.2 Minimum system of single chip microcomputer

3.2 Design of LCD1602 Display Circuit

In this design, LCD1602 display circuit is used to display the temperature of water heater, as shown in Figure 3. LCD1602 is an industrial character LCD, which can display 32 characters at the same time. In the character generation memory of LCD 1602 module, there are 160 types of characters, including Arabic numerals, capitals and lowercase letters, commonly used numerals, various symbols and Japanese characters. Each character code of LCD 1602 module is fixed. And it can be invoked directly by writing software programs. LCD1602 is characterized by clear display and low price [2].

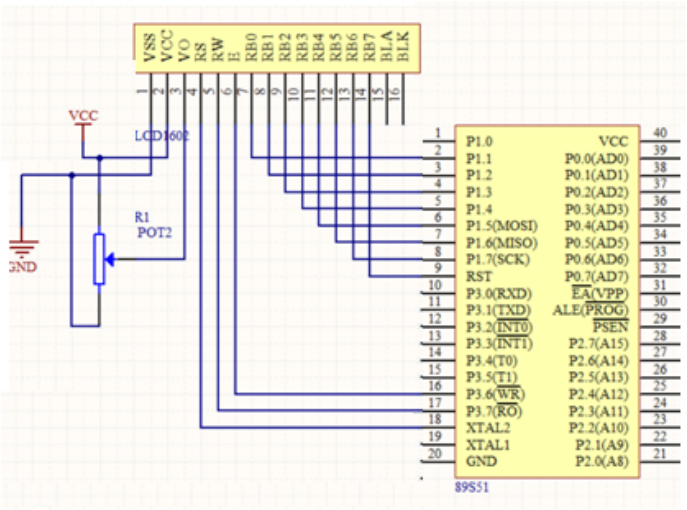

Fig.3 LCD1602 display circuit

3.3 Design of Temperature Control Circuit for Heater

The temperature control circuit of water heater is composed of single chip computer, driving triode, relay and heating resistance wire. It realizes the control of relay through the high/low output level of P1.1/T2 port of single chip computer. In order to facilitate observation, this design uses light-emitting diode D1 to simulate the heating process of resistance wire of heater. The specific principle is as follows: when the water temperature measured by DS18B20 temperature sensor is lower than the threshold temperature, the PI.1/T2 port of the single chip computer outputs low level, drives the transistor Q2 to turn on, the switch contacts of the relay are connected, the power supply of the water heater is turned on, and the light-emitting diode D1 of the analog resistance wire is lit up at this time. When the water temperature measured by DS18B20 temperature sensor is higher than the threshold temperature, the P1.1/T2 port of MCU outputs high level, drives the transistor Q2 to cut off, and the relay contacts are disconnected, which makes the water heater resistor wire power supply disconnected [3]. At this time, the light emitting diode D1 of the analog resistor wire is extinguished. The specific control circuit is shown in Fig. 4.

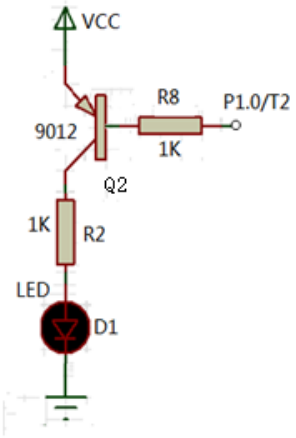

Fig.4 Temperature control circuit of heater

3.4 Design of Buzzer Alarm Circuit

As shown in Fig. 5, the buzzer alarm control circuit is composed of a single chip computer, a driving triode and a buzzer. The P 2.6 ports of a single chip computer are connected with the base of the driving triode Q1 through resistance R4. he specific working principle is: when the water temperature measured by DS18B20 temperature sensor is higher than the maximum temperature initially set, the pulse control signal is output at the P2.6 port of MCU, which controls the continuous

Q1 turn-on and cut-off of the driving transistor, and makes the buzzer give an alarm. At the same time, in Figure 4, the MCU P1.1/T2 output high level, so that the transistor Q2 cut off, the contact of the relay disconnected, cut off the power supply of the heater resistance wire and stop heating the water [4].

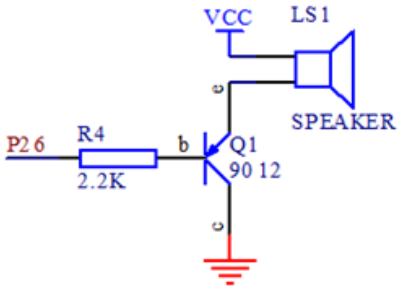

Fig.5 Buzzer alarm circuit

3.5 Design of Water Temperature Detection Circuit

As shown in Figure 6, the water temperature detection circuit is mainly composed of single chip computer, DS18B20 temperature sensor, current limiting resistance and so on. In this circuit, DS18B20 temperature sensor is the core. Its characteristics are as follows: (1) It only needs a connecting line to connect with the P2.2 port of the single-chip computer to realize the communication between DS18B20 and the single-chip computer; (2) Its temperature measurement range is -55℃~+125℃, and the initial temperature measurement resolution ratio is 0.5℃; (3) Its starting voltage is: 3-5V/DC, without external components; (4) Its specific measurement results can be transmitted by 9 to 12-bit serial data. In this design, DS18B20 temperature sensor is used to monitor the water temperature of water heater in real time, and the monitored data is input into AT89S51 single chip computer through P2.2 port. The monitored results are displayed on LCD1602 through software programming. At the same time, AT89S51 outputs control instructions based on the results of DS18B20 temperature sensor detection, the heating state of the resistance wire of the water heater is controlled, Thus, the water temperature of the water heater can be adjusted automatically [5].

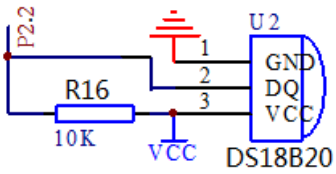

Fig.6 Water temperature detection circuit

3.6 Design of Key Input Circuit

As shown in Figure 7, the key input circuit consists of four independent keys. Their functions are: (1) setting temperature; (2) adjusting temperature; (3) determining temperature. The four independent keys in the circuit are connected with the P1.4, P1.5, P1.6 and P1.7 terminals of the MCU through I/O ports respectively. Its characteristics are: good circuit stability, strong anti-interference ability.

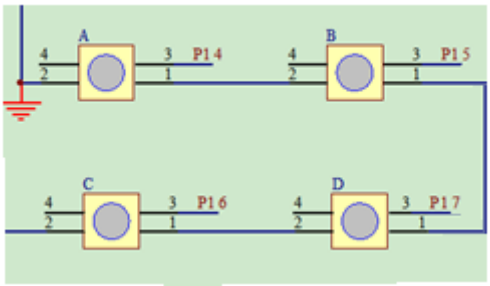

Fig.7 Key input circuit

4. Design of System Software

The software design of the intelligent water heater control system in college dormitory is mainly composed of the main program, key scan subroutine and multiple functions module subroutines. Among them, multiple function subroutines are composed of temperature measurement subroutines, keyboard processing subroutines and display subroutines. The function of the main program is to initialize the working parameters of the system, and call each functional module subroutine circularly. In the whole working process, the system is realized by markers.

5. Design of System Software

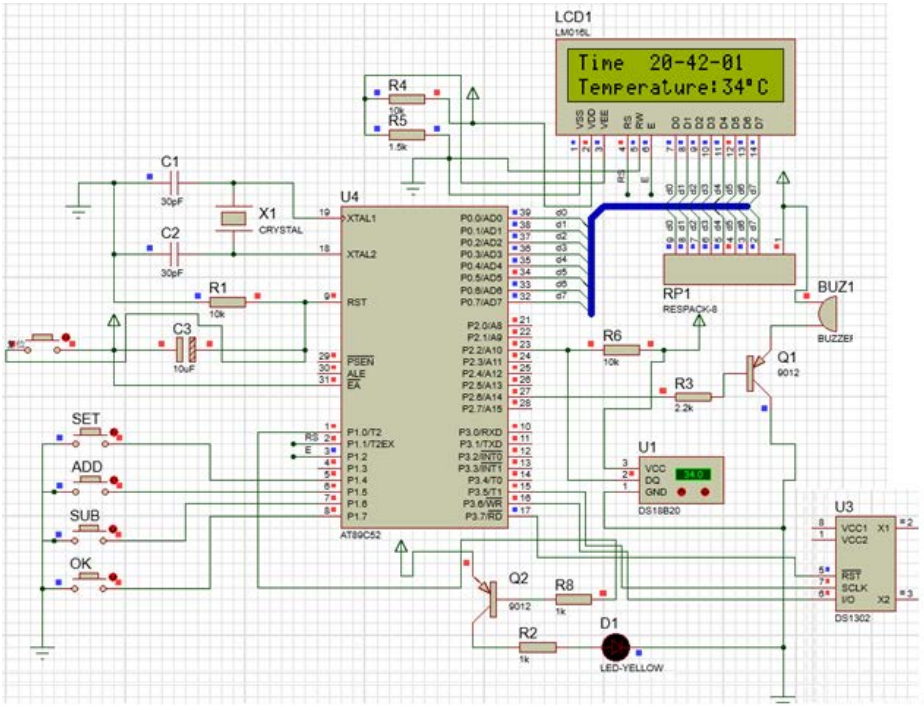

Fig. 8 Circuit of heater control system

After the hardware circuit module is cascaded, the software program of the system is imported into the MCU. 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 [6].

6. Conclusion

The above is the design of intelligent heater control system. From the point of view of the whole design process, the system has carried out the design of hardware circuit and software programming. In the process of hardware circuit design, the system realizes the design of MCU control circuit, keyboard and display circuit, temperature control circuit, buzzer circuit, power supply circuit, water temperature detection circuit and so on. In the process of software design, the main program, temperature detection subroutine, relay control subroutine, LCD display subroutine and timer interrupt subroutine of the system are designed. Through the above design process, the heater realizes the functions of temperature regulation, parameter display, alarm and real-time protection. 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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