Intelligent Home Security System Based On Single Chip Microcomputer

Yanxuan Wang*

School of Electrical and Computer Science, Jilin Jianzhu University, Changchun City, 130118, China

* Corresponding Author Email: wangyanxuan@stu.cpu.edu.cn

Abstract. This paper designs a microcontroller-based intelligent home security system, mainly through the detection and display of ambient temperature signals, human body sensing signals, toxic gas signals, and real-time determination of whether the user set the acceptable range. Wwhen the situation exceeds the acceptable range, through the program to contact the corresponding hardware to alarm and take appropriate processing measures on site, such as fire extinguishing, buzzer alarm. All the software and hardware within the system designed in this paper have passed software testing, hardware testing and system functionality testing and according to the test results, the designed security system functions can be achieved and runs well, meeting the design objectives.

Keywords: Intelligent home security system; Single Chip Microcomputer; software testing; hardware testing; system functionality testing.

1. Introduction

At present, with the development of the Internet, the technology of the Internet of things is becoming more and more mature, and the types of smart home are also becoming more diverse, which is also a hot field for people to do research. But with more and more people in the experience of new intelligent experience at the same time, the potential security problems are gradually now people in our line of sight, so the design and application of intelligent security system is particularly important.

In this paper, the main research content of intelligent home security system based on single chip microcomputer is temperature detection, human body detection, CO gas detection. The second chapter mainly describes the overall design scheme of the security design. It receives the data returned by the three types of detection in real time, processes and displays it, and takes timely measures when the data exceeds the limit: start the buzzer to alarm, SMS and call to prompt the owner and the linkage relay to extinguish the fire. It also explains the hardware models and the performance and advantages of various hardware models to realize the function. The third chapter explains the software system design. Will be divided into three subroutines to achieve the function, using the main program flow chart to explain the design of the system function process, which can be divided into temperature acquisition subroutine, liquid crystal display subroutine, and short message prompt subroutine three subroutine clear process of each function.

Due to the frequent occurrence of dangerous situations such as kitchen gas leakage, invasion robbery and indoor fire, and the phenomenon of false alarm and false alarm and high cost in most security systems, this system can better optimize the scheme and achieve higher requirements.

2. Hardware circuit design

2.1. Overall design scheme

In this paper, the SCM security system is divided into four parts, including: SCM as the core of the data analysis and processing part, in order to achieve the environmental temperature detection, human detection, environmental combustible gas concentration data input and output, control signal receiving and sending; Environmental temperature detection, human detection, environmental combustible gas concentration data collection part, to achieve real-time data collection; In the data display part, the visual display of environmental temperature detection, human body detection and

environmental combustible gas concentration data is realized. When the data exceeds the limit, the buzzer alarm, the linkage relay fire extinguishing, the short message, and the call prompt are realized. The overall design block diagram is shown in the figure 1 below.

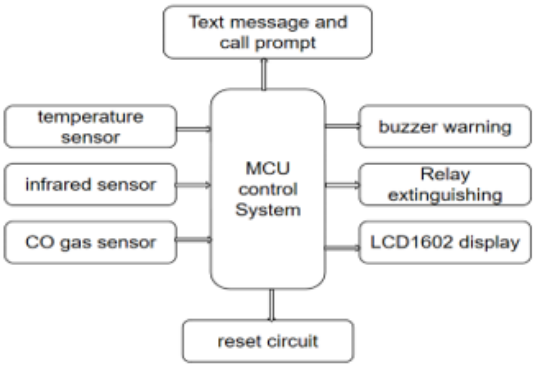

Figure 1. Figure with overall design block diagram.

The overall design of SCM security system has achieved the following functions: 1. The use of environmental temperature detection, human detection, environmental combustible gas concentration data real-time acquisition of all data, and real-time judgment of whether the data in the normal area; 2. The data is processed by MCU and displayed by LCD screen; 3. When the three measured data are not within the set range, the linkage buzzer alarm buzzer alarm; When the measured temperature sensor data and CO gas sensor data are not within the set range, the relay will be started to extinguish the fire and start the buzzer alarm; When the human body signal is measured, the buzzer alarm will be activated, and the owner's mobile phone will be sent short messages and de-call prompt after any of the situations occur.

2.2. Hardware circuit of each function

2.2.1. Single chip microcomputer module

Microcontroller structure small volume, low manufacturing cost, widely used in the field of automation control. The single chip microcomputer is used as the control core in the security system, cost-effective, can achieve a variety of functions, and user control is simple and convenient. After taking into account the availability, performance and cost and other factors, this design model for STC89C52 single chip microcomputer, which can store the program written 8K flash memory system, fully enough to support the security system function of this paper. At the same time, STC89C52 single chip microcomputer code burning is simple, and the later modification is convenient, can constantly update and adjust to add new functions, and has great applicability [1]. STC89C52 MCU physical and pin figure is as follows figure 2.

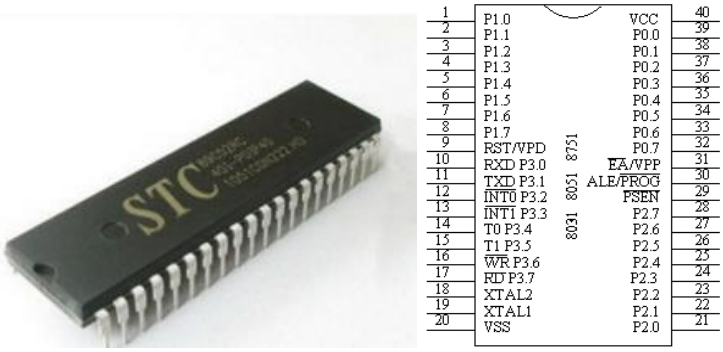

Figure 2. STC89C52 MCU physical object and pin diagram.

The minimum system of STC89C52 single chip microcomputer includes three parts: single chip microcomputer, crystal oscillator circuit and reset circuit. Among them, the main function of the crystal circuit is to provide a stable standard signal, in order to make its control equipment methodically executed without chaos. The design of this paper uses 11.0592MHz crystal galvanizer

as the vibration source, because in the factory, STC89C52 microcontroller internal oscillator circuit has been included, in the external connection capacity of 22pF capacitor can achieve stable crystal signal. The function of the reset circuit is to restore the circuit to the starting state. Due to the non-automatic amnesia of the internal flash memory of the MCU, the MCU and its connected external devices need to be reset at the starting state every time the circuit is started. The reset signal is input by the RST pin into the Schmidt trigger inside the MCU chip. When the system is in normal working state, the MCU keeps the high level on the RST pin for 24 oscillation cycles to start the reset signal.

2.2.2. Sensor module circuit

(1) Infrared sensor:

Considering the reliability, stability and economy of the sensor, this paper uses the human body infrared module, the specific model is BTE16-19, there are three pins in the object, respectively VCC, GND, OUT, VCC is mainly connected to the positive pole of the power supply, GND is mainly connected to the negative pole of the power supply (power supply), OUT is mainly connected to the SCM pin (control), [2] The physical object and pin diagram of BTE16-19 are shown as figure 3 follows.

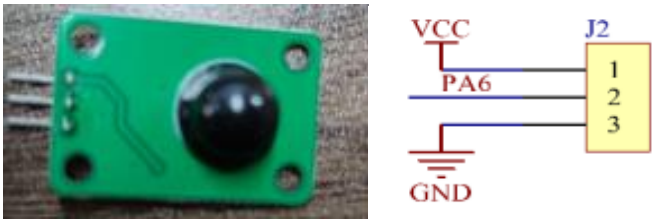

Figure 3. BTE16-19 physical object and pin diagram.

Human body infrared module mainly uses the principle of collecting infrared trigger pin output to detect whether there are people nearby. When a person is detected, the OUT pin will output a low level. When the microcontroller detects the low level of the OUT port, it will consider that someone appears at this time and make a series of alarm measures.

(2) Temperature sensor:

In this paper, the specific model of temperature sensor DS18B20 is used [3] as the temperature sensor. There are three pins in the real object, which are VCC, GND, DQ.VCC is mainly connected to the input end of the external power supply, GND is mainly connected to the negative pole of the power supply (power supply), [4] DQ is the input/output end of the digital signal, the physical object and pin of DS18B20 are shown as figure 4 follows.

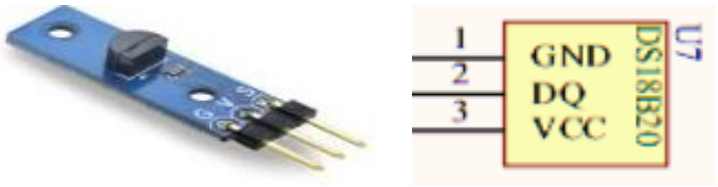

Figure 4. Physical object and pin diagram of DS18B20.

DS18B20 works on the principle that the oscillation rate of its oscillator will change with the change of temperature, and the change value will be stored in a register, and finally converted into a digital signal output.

(3) CO gas sensor:

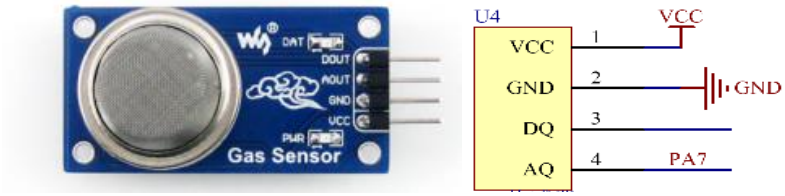

Figure 5. MQ-7 physical object and pin diagram

The specific model of CO sensor module used in this paper is MQ-7, shown in figure 5. There are four pins in the object, respectively VCC, GND, DO and AO. VCC is mainly connected to the positive pole of the power supply, GND is mainly connected to the negative pole of the power supply, DO is mainly connected to the microcontroller pin, output digital switching quantity, AO is mainly connected to the microcontroller pin, output analogy voltage quantity [5].

Because tin oxide sensors made of conductivity is directly proportional to the CO gas density in the air, so especially suitable for using it to detect the concentration of CO, when detected with CO, the DO pin output a low level, the DO output low level MCU detection, argues that there are CO, and then make a series of ventilation measures, While the AO port will output an analogy voltage quantity, usually need to use ADC to convert the analogy quantity into digital quantity (analogy-to-digital conversion), transmitted to the microcontroller [6].

2.2.3. Display module circuit

For the display module, its main function is to visually display the current temperature and humidity information and control information. Considering that the function has low resolution requirements and from the perspective of cost, this constant temperature and humidity incubation system adopts LCD1602 as the system display module [7]. The LCD of this model is relatively small in size, extremely low in power consumption, and low in operating voltage. It can be directly driven by single chip microcomputer, and has strong practicability for highly integrated incubation system. The LCD1602 [8] physical object and pin diagram are as figure 6 follows.

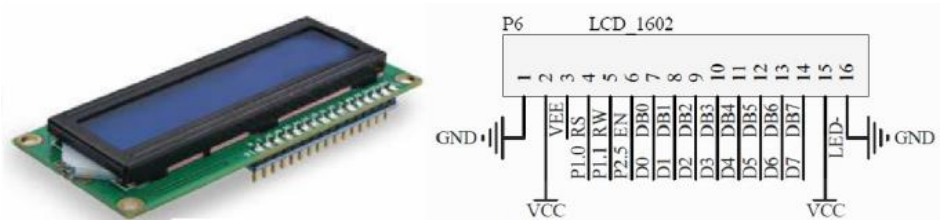

Figure 6. LCD1602 physical object and pin drawing.

The display of 5*7 dot matrix characters can be realized through the ASCII code of the character generator inside the LCD display module. Through the code, program the letters and numbers that need to be displayed, input them into LCD1602, the display will automatically identify the code, and display through ASCII code decoding.

2.2.4. Process the prompt circuit

The control and adjustment circuit includes alarm circuit, fire extinguishing window opening, GSM short message prompt module.

The alarm circuit through the LED bulb and buzzer, the flame sensor, CO gas sensor, human body infrared sensor when the limit alarm. The buzzer is driven by transistor to realize sound alarm to remind the user.

The fire extinguishing and window opening loop analyses the data returned by the flame sensor and CO gas sensor. If the flame sensor data exceeds the limited range, the relay will be started to extinguish the fire and the stepper motor will open the window. If the CO gas sensor data exceeds the limited range, the stepper motor will be started to open the window.

The GSM short message prompt module will automatically send corresponding short messages to the user's mobile phone when any one or more of the three sensors' data is abnormal.

3. System software design

3.1. System main program design

For the control of single chip microcomputer and related equipment, Keil software is used to write and convert the code. The use of C language programming way, [9] the microcontroller needs to achieve the function of writing, so as to achieve. The whole software program, through the main

program to synthesize, each function separately written subroutine, including display subroutine, temperature detection alarm subroutine, call and SMS [10] prompt subroutine. Such a clear structure of the program design, easy to post error correction and modification.

This system mainly needs to complete the environment temperature value of the security system through the MCU main program to collect whether the value exceeds the safe range, LCD1602 display, alarm module alarm response, and send corresponding prompt information to the user equipment. The flow chart of the main program is shown in figure 7 below.

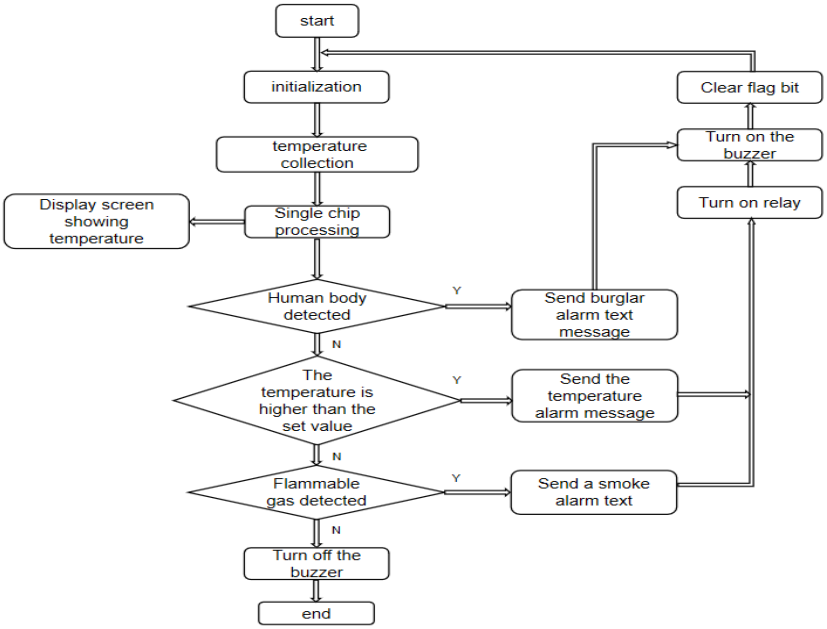

Figure 7. Main program flow chart.

3.2. Each functional subroutine

3.2.1. Temperature collection subroutine

The temperature acquisition subroutine is required to realize the control of the DS18B20 digital temperature sensor. Temperature acquisition program includes DS18B20 initialization, temperature data scanning, analogy-to-digital conversion, signal processing and other steps, the program and flow chart are as follows figure 8.

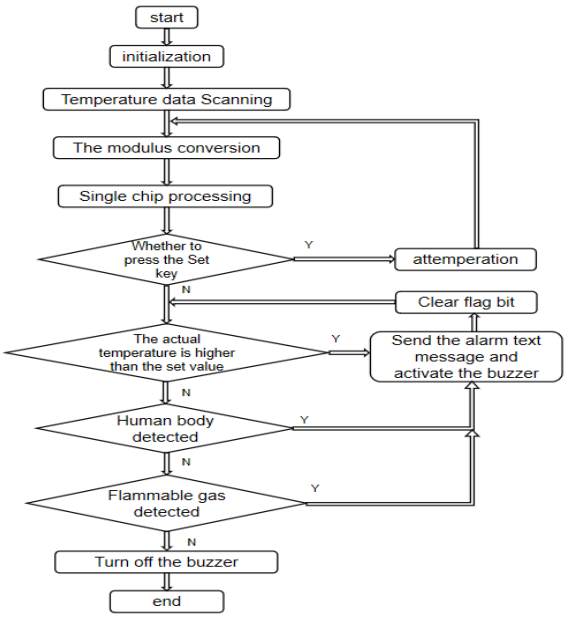

Figure 8. Temperature acquisition flow chart.

3.2.2. LCD subroutine

First, the LCD1602 module should be initialized. After initialization, the temperature data processed by the microcontroller should be called in real time and displayed. If there is no need to regulate the content, that is, the temperature value is within the set range, it is directly finished; if it needs to be regulated, repeat the cycle after the regulation is completed. According to the program idea, the liquid crystal display subroutine flow chart is as follows figure 9.

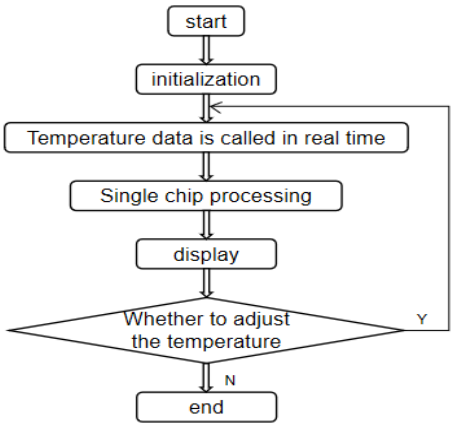

Figure 9. Liquid crystal display subroutine flow chart.

3.2.3. SMS prompt subroutine

Firstly, the TC35 module should be initialized. After initialization, the alarm content should be extracted and recognized in real time. If there is no need for alarm content, it will end directly. If the need for regulation, then send the corresponding alarm signal

To the user. According to the program idea, the subroutine flow chart is as follows figure 10.

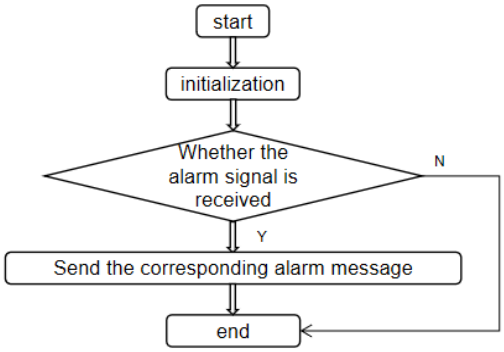

Figure 10. SMS prompt subroutine flow chart.

4. System test

4.1. Programming software testing

Part of the software program is written by Keil C51, using C language to realize the input of the code, and finally converted into MCU code by software.

According to the design of the main process, the code is decomposed into main, LCD1602, DS18B20, TC35 four parts for code compilation. The Main function realizes the synthesis of the overall function, TC35 realizes the sending of short message warning signal to the user, LCD1602 realizes the data display, and DS18B20 realizes the temperature and humidity reading. Input the code program of each part completely and compile it. During the process, some problems such as variable definition, code syntax and format are encountered, and the internal check is used to correct them, and the executable object code is finally generated.

4.2. Hardware Testing

In terms of hardware testing, in order to have a clearer understanding of the circuit structure, the hardware circuit circuit simulation debugging is carried out first to ensure the correctness of the relevant hardware connection and code.

Because of the relatively unfamiliar to SCM Proteus simulation software, in the process of circuit simulation debugging, encountered many difficulties. After connecting the corresponding circuit diagram, the program is written into the MCU program. The problems such as key failure caused by inconsistent code definition port, alarm circuit cannot automatically alarm caused by high and low flat reverse, and finally realize the smooth operation of the simulation program. The complete circuit of system simulation is as follows:

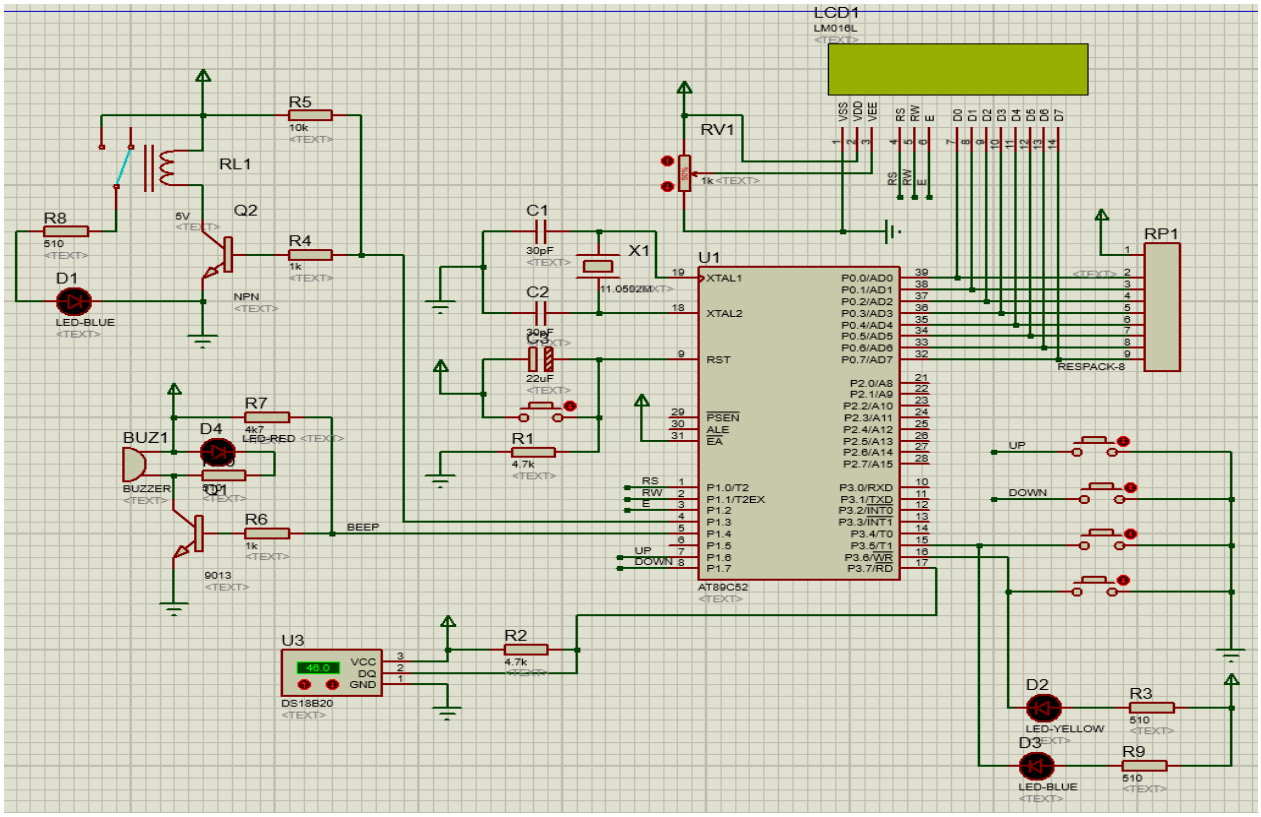

Figure 11. Overall circuit of the system.

4.3. System function test

After successful hardware and software testing, the pre-set functions are tested.

Firstly, the display and key control circuit are tested. The test results show that LCD1602 can normally display the temperature value of the current environment, and the display content is clear. The key control circuit can adjust the pre-set temperature, the setting process is normal. The monitor can show the current temperature and set the temperature, when the limit is exceeded, the buzzer will alarm.

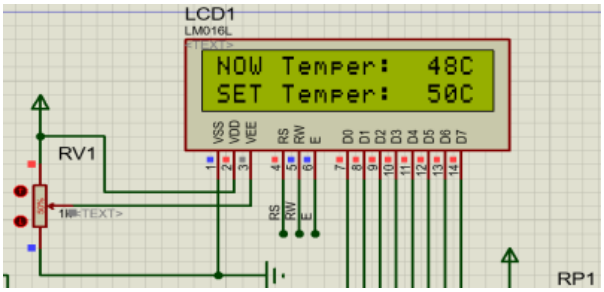

Figure 12. Display and key control circuit test.

Secondly, the temperature regulation circuit is tested, when the ambient temperature and humidity exceeds the set value, the buzzer in the alarm circuit sounds loud. At the same time, the corresponding alarm short message can be sent to the user's equipment for prompt, and the system runs well. When a fire is detected, a yellow light in the lower right corner will light up to give an alarm.

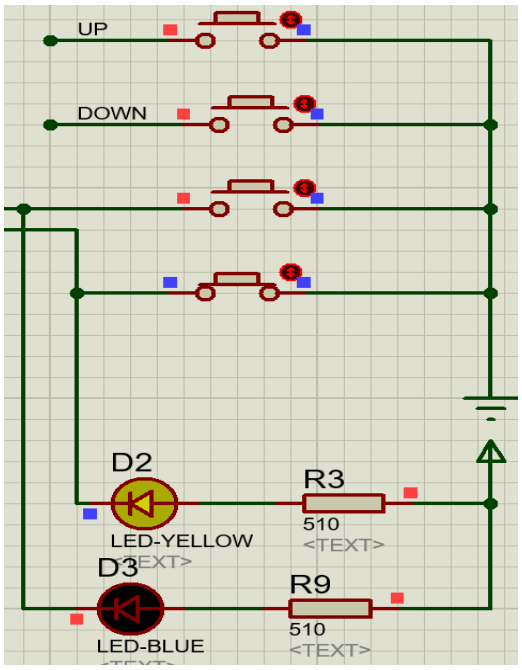

Figure 13. Temperature regulation circuit test.

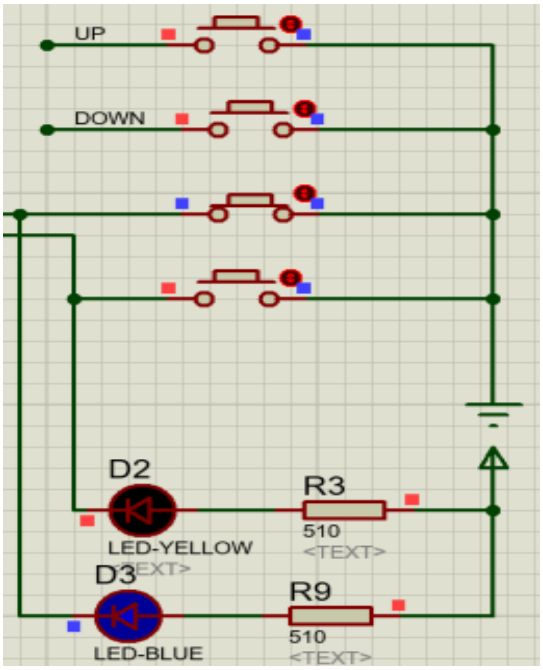

Figure 14. Human body detect test.

Third, when a theft is detected, an alert text message is sent to the user's device and the buzzer is activated. The bottom right corner of the blue light will light up alarm.

Finally, according to the functional test results of the system, all functions of the designed security incubation system can be realized and run well, reaching the design goal.

5. Conclusion

In the aspect of hardware design, in order to achieve pre-set functions, this paper first carries out the overall system design, clearly defines the design purpose and steps, and then reduces the required cost through the selection of hardware without reducing its function and use experience. In the aspect of software design, the overall design steps are first clarified, which is divided into three subprograms for refinement, and the corresponding functions of each program are clarified and built. Finally, relevant tests are carried out. In terms of software testing, this paper inputted the designed software code into Keil in the form of C language, and finally realized the complete operation of the code. In terms of simulation application, the HEX file of software code compiled in Keil is imported into the simulation file designed in Proteus to realize the simulation function of security system. Through test, this paper studies intelligent household security all functions of the implementation, and in the testing, process has good running stability, can carry on the application in most cases, also has high accuracy, reduced the work cost, provides users with more high-quality intelligent household security system experience, providing them with a more safe and comfortable living environment.

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