International Core Journal of Engineering Volume 6 Issue 6, 2020
ISSN: 2414-1895 DOI: 10.6919/ICJE.202006_6(6).0040

Design of Laboratory Fire Alarm System Based on MCU

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Abstract

Laboratory safety is an important prerequisite for normal laboratory teaching and the safety of teachers and students at school. In order to effectively prevent and reduce the losses caused by laboratory safety accidents in colleges and universities, this article has designed a laboratory intelligent fire alarm system with STC89C52 MCU as the core for temperature and smoke detection. This system uses multi-sensor technology to properly manage laboratory safety, which can improve laboratory safety performance, high alarm accuracy and strong applicability, and can effectively prevent university laboratory safety accidents in a timely and effective manner.

Keywords

Laboratory safety, MCU, Sensor, Fire alarm.

1. Introduction

A large number of valuable instruments and equipment are stored in the laboratory of the university, and the concentration of staff is highly mobile. Laboratory safety management is related to whether the experimental teaching and scientific research can be carried out smoothly, whether the national property is protected from loss, and whether the personal safety of teachers and students Security is essential to the safety and stability of colleges and universities [1]. Therefore, the factors that affect the safety of college laboratories are complex, and it is necessary to strengthen their safety management. The use of an intelligent monitoring and alarm system can effectively improve the efficiency of laboratory safety precautions. Through the security monitoring and alarm system, you can grasp the laboratory safety situation in real time, prevent potential safety hazards, and optimize the monitoring and alarm system [2]. Using the intelligent fire alarm detection system based on the single chip microcomputer, the fire is detected in the early stage of the fire, the fire is controlled, and the losses caused by the fire are minimized [3].

2. Overall system design

This system is mainly composed of main controller, temperature sensor, smoke density sensor, LCD liquid crystal display, and sound and light alarm [4]. The system monitors the on-site real-time temperature and smoke concentration sensor through the temperature sensor to detect the smoke concentration. The detection value of the temperature sensor can be directly sent to the single-chip microcomputer, and the smoke concentration sensor needs to pass through the A / D chip for digital-to-analog converter. The digital signal of the MCU is judged according to the received signal. If the real-time temperature is detected or the smoke concentration exceeds the preset value, the alarm subroutine is called to send out an audible and visual alarm signal and display the detected temperature and smoke concentration. The system re-enters the detection Links are circulated in sequence, thereby realizing timely alarm to the fire.

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3. System hardware design

The alarm system is divided into five modules: detection module, data processing module; sound and light alarm module and display module. The system control chip uses STC89C52 single chip microcomputer, because the single chip microcomputer can meet the various functions required by the system and has the advantages of low power consumption and high performance.

3.1 Detection module

The detection module contains a temperature sensor and a smoke sensor. In the event of a fire, the first thing that manifests is smoke. The smoke sensor uses MQ-2. MQ-2 and the analog-to-digital converter ADC0809 are used together to detect the smoke concentration value in the environment. The smoke sensor converts the detected smoke value into an electrical signal and inputs it to an analog-to-digital conversion circuit. The analog-to-digital conversion circuit converts the analog electrical signal into a digital signal and inputs it to the single-chip computer. The single-chip computer processes the signal and responds accordingly according to the program. The temperature sensor selected is DS18B20, which has high sensitivity, small measurement error range and temperature measurement distance of up to 200 meters, and its detection data can be directly output to the single-chip microcomputer for direct use.

3.2 Button module

The button module is used to set the alarm value of the temperature and smoke sensor. The button circuit includes three buttons S1, S2, and S3.

3.3 Display module

The display module uses the liquid crystal display LCD1602. During this period, it has a small size, light weight, low power consumption, high cost performance, and no flicker.

3.4 Sound and light alarm module

The sound and light alarm module consists of a single LED light and a buzzer. When the system detects that the temperature or smoke concentration exceeds the set value, it will call the alarm program to trigger the alarm. At this time, the LED light is on and the buzzer sounds Sounds to warn the outside world. You can also pass this signal to the school monitoring room to prevent the fire from being untimely when the laboratory is empty.

4. System software design

The main program flow chart is shown in Figure 1. The software part of the fire alarm system calls various subprogram modules through the main program to complete various functions. Subprograms include key subprograms and sound and light alarm subprograms. Since the smoke sensor cannot be reflected in the simulation, a sliding rheostat is used instead. After the main program starts, firstly the LCD display, threshold and temperature sensor are initialized, then start AD conversion, read the temperature value and smoke concentration value, pass it to the display, then access the key subroutine, access the alarm program, and enter the next cycle after completing the function . The concentration signal is transferred to the single-chip microcomputer after A / D conversion. The single-chip microcomputer compares the received signal with the preset alarm value. If the value is higher than the preset value, the alarm subroutine is called, and then the program re-enters the initialization phase. A complete fire alarm system is formed.

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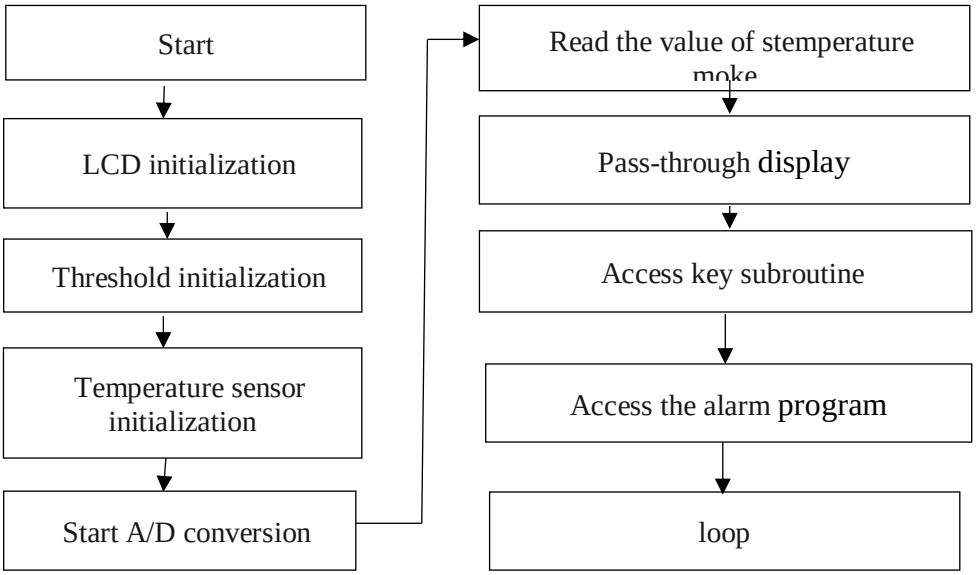

Figure 1. System main program flow chart

The set temperature alarm value is 50 ℃, and the smoke concentration alarm value is 100ppm. When any of the measured values exceeds the set value, the corresponding light-emitting diode lights up and the buzzer alarms. At the same time, the real-time temperature and smoke on site concentration. as shown in picture 2. Because the smoke density sensor cannot be realized in the simulation diagram, a sliding rheostat is used instead, and its resistance value is changed to simulate the output value of the sensor.

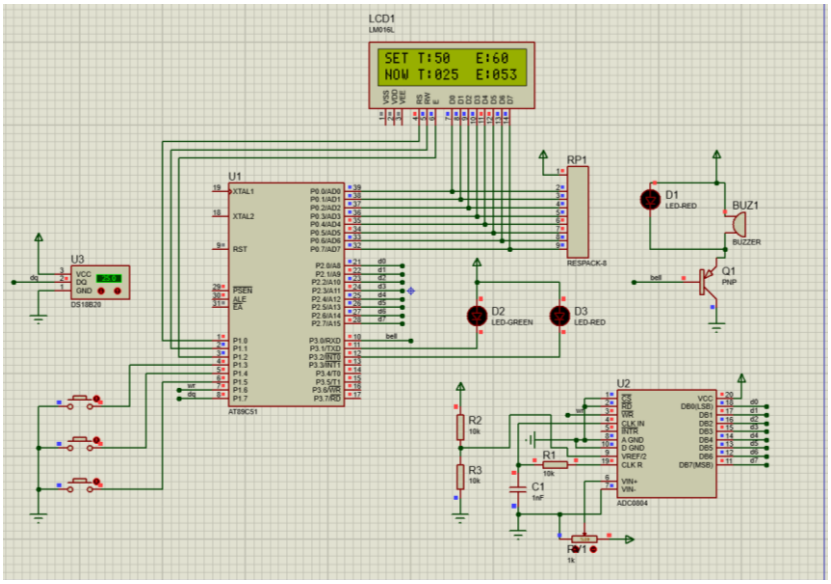

Figure 2. Alarm system circuit diagram

5. Test system

Realize the designed alarm system with hardware, and the final physical object is shown in Figure 3. Use a lighter to simulate the fire scene, and test the smoke alarm and temperature alarm functions separately. As shown in Figure 3, set the upper temperature limit to 50 ° C and the upper smoke limit to 100ppm. When the smoke concentration around the system is 197ppm and exceeds the preset value, the red light is on and the buzzer sounds; It is 33 ℃, and the upper limit of smoke is 97ppm. When the ambient temperature of the system exceeds 34.9 ℃, the yellow light is on and the buzzer sounds. The test results show that the experimental effect is good, and the real-time fire alarm can be realized.

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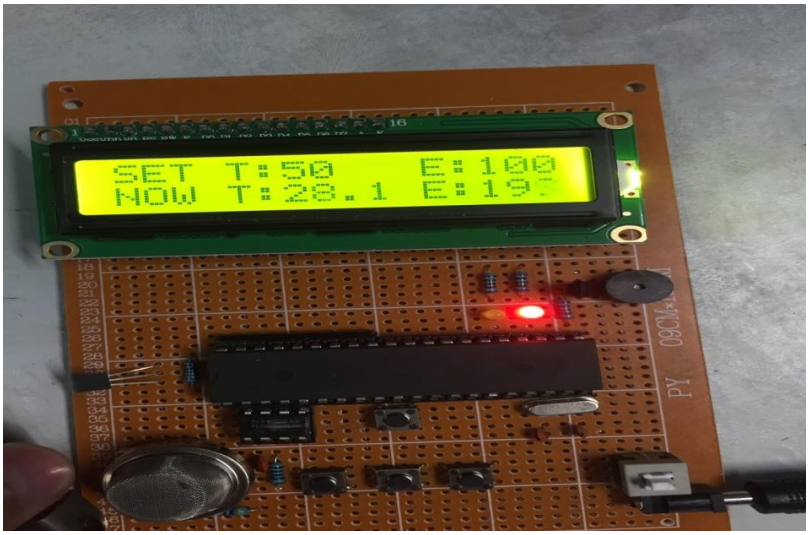

Figure 3. Alarm graph when smoke density exceeds preset value

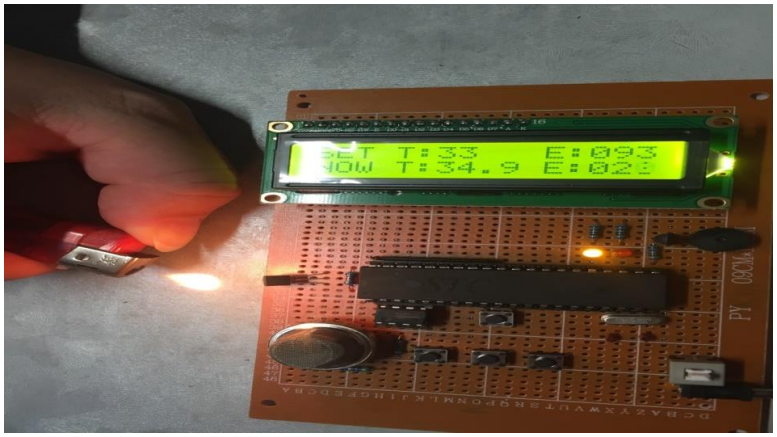

Figure 4. Alarm graph when temperature exceeds preset value

6. Conclusion

This system design uses STC89C52 single-chip microcomputer as the main controller, uses digital-to-analog conversion chip, display screen, smoke sensor and temperature sensor to design the laboratory fire alarm system. It can monitor the temperature value and smoke value of the laboratory in real time in real time, and emit sound and light alarm when the preset value is exceeded, and based on this, a hardware circuit is made. After debugging, the hardware meets the production requirements of fire alarm And, the cost is low, the production operation is simple and the performance is stable, it can effectively realize the function of laboratory fire alarm, and has good practical value.

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