Design and Application of Home Fire Alarm System

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Abstract: With the application and development of Internet of things technology, the demand for home intelligent devices is higher and higher. Home fire safety is particularly important. In view of the current home fire safety problems, this paper proposes a home fire alarm system based on the combination of microcontroller and sensor. The system takes microcontroller and sensor as the main components, and uses the combination of combustible gas detection module, temperature detection module and flame detection module to form a fire alarm system. The functions of gas leakage early warning exhaust, fire sound and light alarm exhaust and high temperature detection alarm are realized. Combustible gas detection, temperature detection and flame detection all collect data through sensors, and then compare with the preset alarm value to judge whether the fire occurs. The design has the advantages of accurate detection, high degree of intelligence, convenient installation, strong scalability and so on. It gives a new solution to the fire safety of the home.

1. Establishment of home fire fighting system
With the progress of society and the development of science and technology, the number of household electrical equipment and gas facilities increases, and the potential safety hazards such as household electrical fire and gas fire increase correspondingly, which seriously endanger people's housing safety. Home fire alarm system is aimed at home fire problems, real-time detection of changes in the environment, when there is a fire risk, timely pretreatment and alarm.

The fire alarm system takes microcontroller as the core, and designs gas detection module, fire protection module, ventilation module and alarm device. In the gas detection module, combustible gas sensors are used to detect methane, propane, liquefied gas and other combustible gases effectively, and fans are used to ventilate in time to reduce the concentration of combustible gas and reduce the risk of poisoning or ignition. In the fire protection module, the temperature sensor and flame sensor are used to judge whether there is a fire, and the buzzer is used to alarm and the fan is used to exhaust smoke.

The design of fire alarm system includes hardware design and software design. The hardware design is a combination of various modules and parameter design. The overall structure is composed of microcontroller, sensor data acquisition, buzzer alarm module and exhaust module. The software design is the key to the successful operation of the system. After the specified functions are designed, the program is written in C++ language. The overall structure of the system is shown in Figure 1.
The overall design and operation process of the system is as follows: after the system is powered on, the user can set the alarm threshold of each module by setting the key. After the setting, the sensors of each module enter the data acquisition stage and send the collected data information to the microcontroller through the acquisition circuit, and then the old display will display the data in real time. If the data is greater than the preset threshold, the buzzer will alarm and turn the fan.

The following is the overall structure design flow chart of the system:

2. System hardware design
The hardware system is based on microcontroller and integrates a variety of sensors and OLED display modules. Rich hardware resources and Internet of things related applications.
The hardware design has an open Colink emulator, which provides a simple, convenient and fast development environment for developers, saves time and improves efficiency for application development.

Through the external interface module, the communication between the microcontroller and the external module can be realized, the usability of the system is enhanced and expanded, and a favorable solution is provided for adding new functional modules in the future.

Temperature and humidity sensor DHT11
DHT11 digital temperature and humidity sensor is a temperature and humidity composite sensor with calibrated digital signal output. It uses special digital module acquisition technology and temperature and humidity sensing technology to ensure that the product has high reliability and excellent long-term stability. DHT11 device adopts simplified single bus communication. Single bus means that there is only one data line, and the data exchange and control in the system are completed by single bus.

Buzzer
After receiving the control signal from the microcontroller, the buzzer gives an alarm.

Combustible gas sensor
The combustible gas sensor can convert the collected gas signal into electrical signal and transmit it to the microcontroller.

Flame sensor
The flame sensor can convert the collected flame signal into electrical signal and transmit it to the microcontroller.

3. System software design
For this system, the function of the software is simple, mainly using C language programming, debugging is more cumbersome, according to the requirements of the control system to write the software, through the download line to download the program to the hardware system for debugging.

The main functions of the program are to detect the temperature and humidity, judge whether there is gas leakage and flame, and automatically run the alarm system and exhaust system when the danger occurs.

The flow of software design is as follows: the first step is to write the relevant C code, the second step is to burn the compiled program into the hardware system for debugging, the third step is to collect the gas leakage data, high temperature data and flame data through the real test, the fifth step is to set the pre collected threshold value and carry out the test again. If the buzzer and fan are
successfully started, the development will be completed, if not, it needs to be completed. Reinitialize the program and go back to the third step to re collect data and set a new threshold until the buzzer and fan are successfully started.

4. system operation test

The system running test mainly tests the following four functions

A combustible gas monitoring alarm function

Place the lighter near the combustible gas sensor to observe whether it changes. When the lighter is close to the combustible gas sensor, the number on the OLED display gradually increases, but there is no alarm. After a while, you can hear the buzzer alarm, and see the indicator light flashing and the fan rotating. The digital value of the OLED display is greater than 2700mv (the preset alarm threshold is 500mv).

B temperature monitoring alarm function: light the lighter close to the DHT11 temperature sensor, and the number on the OLED display gradually increases. When the temperature reaches 40 ℃, you can see the fan turning, the LED light flashing, and you can hear the buzzer alarm.

C flame monitoring alarm function: when the flame is not ignited, there is no change in the display and buzzer; when the ignited lighter is close to the flame detection module, the value of the flame detection module changes from 0 to 1, at the same time, the buzzer alarms, and the fan rotates to exhaust smoke.

D emergency response function: after power on, press the emergency alarm button directly, you can hear the buzzer alarm, at the same time, you can see the indicator flashing and the fan rotating.

The test results show that each module of the system can operate stably and easily, and can successfully detect temperature and humidity, gas leakage and flame, with good operability and accuracy.

5. Conclusion

The home fire protection system has realized the required home fire alarm function. In the aspect of application expansion, the human body detection system and wireless communication alarm system can be added. The human body detection system can use the human infrared sensor to judge whether someone is firing to cook, and automatically raise the threshold to change it to the cooking mode, so as to realize intelligent mode switching and reduce misjudgment. The system uses microcontroller as the core controller, and uses temperature and humidity sensor and flame sensor to effectively detect the fire in a home area. When the sensing signal exceeds the warning range, it uses buzzer and fan to alarm and exhaust smoke. At the same time, it also uses combustible gas sensor to detect gas leakage, so as to prevent the possible fire and poisoning events. Before intervention, timely ventilation alarm, that is to achieve the diversification of intelligent detection. Moreover, it has strong customization and rich expansion modules, which is of great practical significance to improve people's fire prevention ability in the home area. Moreover, the system has the advantages of low cost and easy installation, which has the practical value of wide promotion.

Reference

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