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Wireless wifi smoke temperature and humidity alarm system based on stm32 microcontroller

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Abstract

This article designs a wireless WiFi smoke temperature and humidity alarm system based on the STM32 microcontroller. The system can detect the temperature and humidity situation and smoke concentration in the current environment in real time. When the smoke concentration or temperature and humidity exceed the threshold, an alarm will be triggered, and the relay simulates the shutdown of the home power supply. This system can be applied in home decoration to provide security for families.

Keywords

Single chip microcomputer, Temperature and humidity sensors, Smoke sensor.

1. Introduction

The progress of technology has brought unprecedented changes to people's lives compared to the past, and people's clothing, food, housing, and transportation have been greatly satisfied. The development of power technology has gradually increased the number of household appliances in residents' homes. While various household appliances and electronic products bring convenience, they also bury the risk of fire. In addition, people nowadays live in urban communities, and although daily travel is very convenient, they are more susceptible to the threat of fire due to their densely populated areas. Every fire not only brings property losses, but also threatens people's life safety. It is very important to avoid the occurrence of a fire. Relying solely on human resources for fire warning is not only time-consuming and inefficient, but also requires the design of an automatic fire warning system. The household warning system designed in this project uses temperature and humidity sensors to detect air temperature, and smoke concentration sensors to detect smoke concentration in the air. When the temperature rises and smoke concentration increases, the system will automatically alarm, The buzzer starts to sound to remind people to evacuate. In order to facilitate users to view home environmental data, the ESP8266 module has also been designed to display the collected environmental data on the mobile phone.

2. System hardware design

2.1. Design ideas

The wireless WiFi smoke temperature and humidity alarm system designed this time mainly consists of three parts, namely the temperature and humidity and smoke detection part, the environmental data display part, and the alarm part. The system uses the STM32F103 microcontroller as the main control core of the system. The temperature and humidity data detection part of the system uses DHT11 sensor to achieve, and the smoke concentration data detection part uses MQ-2 smoke sensor to achieve. The analog signal is transmitted to the STM32 microcontroller through a data line and converted into a digital signal through an internal AD module. After receiving the temperature, humidity, and smoke data, the microcontroller will display it on the LCD1602 LCD display module, Users can design the threshold of temperature, humidity, and smoke through the system buttons. When the system detects that the current temperature, humidity, or smoke concentration has reached the threshold, it will control the buzzer to activate an alarm prompt. The ESP8266 infinite module can achieve communication between the STM32 microcontroller and the phone. The STM32 microcontroller will send the collected temperature, humidity, and smoke data to the phone through a wireless serial port for display.

2.2. System composition

When designing a wireless WiFi smoke temperature and humidity alarm system based on STM32 microcontroller, it is divided into two parts: the hardware part and the software part. The hardware part includes the selection of the system's main control core, smoke sensors and temperature and humidity sensors, WiFi modules, and some electronic components. After determining the components of the wireless WiFi smoke temperature and humidity alarm system, the electronic circuit design of the system can be carried out, and the design should ensure that the circuit runs smoothly and correctly. After completing the circuit diagram design, the welding work of the wireless WiFi smoke temperature and humidity alarm system can be carried out based on the STM32 microcontroller, and the components can be assembled into a complete system. After the hardware design of the system is completed, the next step is to start designing the system software to ensure that all components of the system run uniformly. The writing of system programs requires the use of KEIL software, which integrates various debugging and compilation tools internally, and can also facilitate program simulation debugging. The program is written in C language, and after the testing is completed, the hex file can be burned into the STM32 microcontroller.

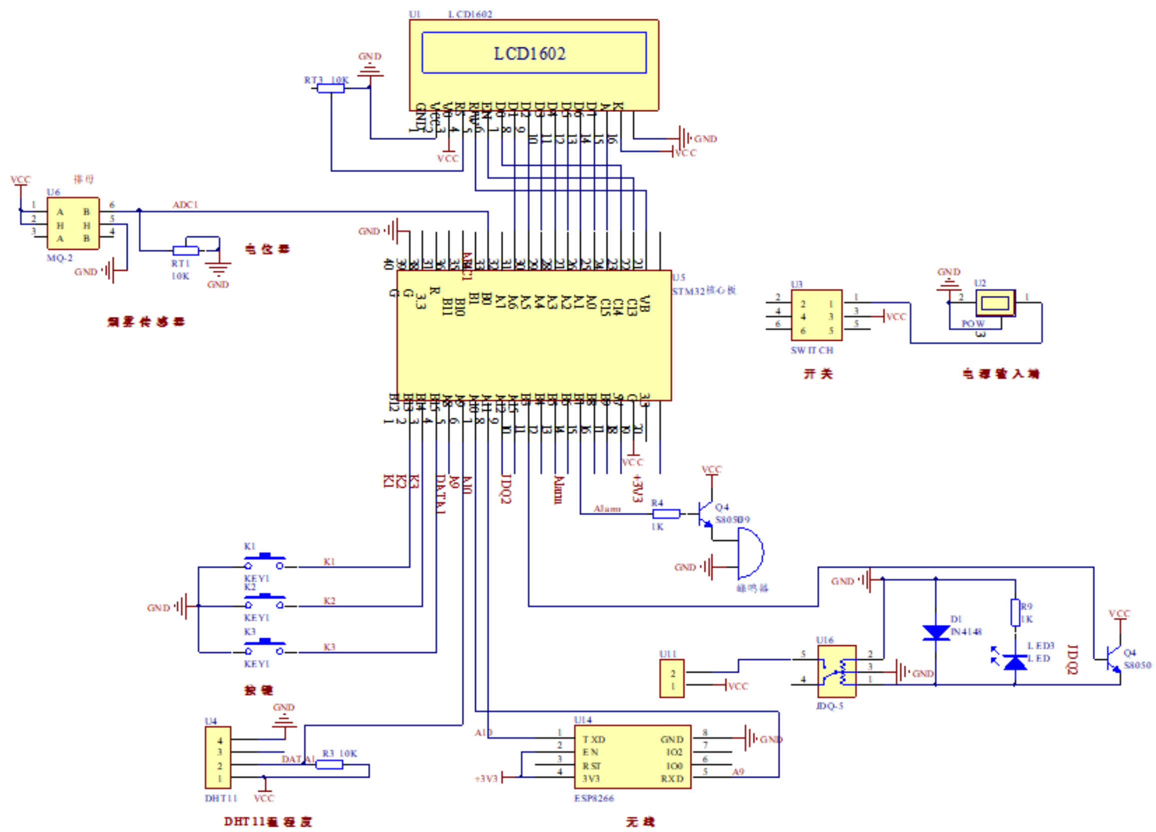

Figure 1: Physical Picture of Single Chip Microcomputer

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3. System hardware circuit design

The wireless WiFi smoke temperature and humidity alarm system designed in this project uses the STM32F103 microcontroller, which is characterized by high performance and low power consumption. It is a microcontroller model mainly used for industrial control developed by STC company. It can output instructions to control the operation of sensors and peripherals, and automatically execute corresponding commands based on the received data, similar to the use of the human brain. A microcontroller is similar to a computer used in daily life, but it cannot process a lot of data and can only perform simple control tasks.

The reason why STM32F103 was selected as the main control in this design is that this model has more functions compared to the 51 microcontroller, faster data processing speed, and has AD conversion, which is convenient for use in smoke design and eliminates the problem of installing an additional ADC. The system schematic diagram is shown in Figure 1.

4. Software System Design

After the hardware design of the wireless WiFi smoke temperature and humidity alarm system is completed, the system software can be designed. Before proceeding with system programming, the overall flowchart should be designed and the programming tasks should be completed in order. After the system is started, initialization will be completed first, and then the modules will start normal operation. The temperature and humidity sensor will transmit the temperature and humidity data to the STM32 microcontroller, and the smoke sensor will also transmit the smoke concentration data to the STM32 microcontroller. The microcontroller will display the data on the LCD1602 liquid crystal display module and judge the data. When the temperature and humidity data or smoke concentration exceeds the threshold, an alarm program will be triggered. In addition, the STM32 microcontroller will transmit the collected temperature, humidity, and smoke concentration data to the mobile phone through a wireless module for indoor environmental data display. Figure 2 shows the main process diagram of the program.

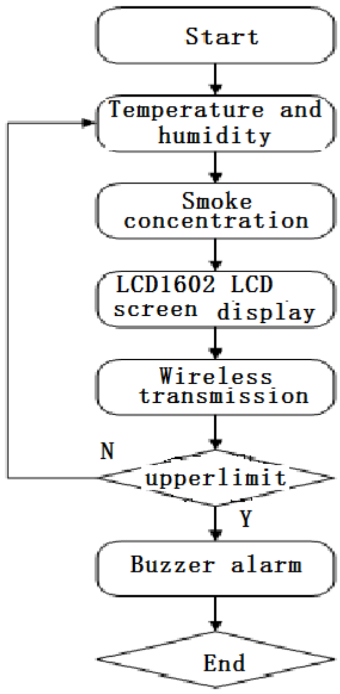

Figure 2: System flowchart

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5. Hardware system debugging

5.1. Welding debugging

After completing the hardware and software design of the wireless WiFi smoke temperature and humidity alarm system, the welding and debugging of the components will begin. Firstly, prepare welding tools and components. And welding the microcontroller circuit according to the schematic diagram. During the welding process of components, it is necessary to pay attention to whether the solder joints are firm to avoid false soldering, and whether the circuit connections are correct and unobstructed. After completing the hardware welding, the program can be burned into the STM32 microcontroller for functional testing. Before the initial power on of the system, attention should be paid to observing the hardware condition to avoid overheating causing component damage. When abnormal phenomena occur, the power should be turned off in a timely manner, and the problem should be investigated before continuing the power on test.

5.2. Functional debugging

Next, we will start the functional debugging of the wireless WiFi smoke temperature and humidity alarm system based on the STM32 microcontroller. After the system is powered on, initialization will be performed first, and then the temperature and humidity sensors and smoke sensors will start collecting environmental data, which will be displayed on the LCD1602 LCD display module by the STM32 microcontroller.

Figure 3: Normal display data when the system is powered on

When the system wirelessly connects to the phone, it is necessary to use the phone to search for the system's wifi name "TEST" and enter the password 12345678 to connect.

6. Conclusion

This article designs a wireless WiFi smoke temperature and humidity alarm system based on the STM32 microcontroller. The system can detect the temperature and humidity situation and smoke concentration in the current environment in real time. When the smoke concentration or temperature and humidity exceed the threshold, an alarm will be triggered, and the relay simulates the shutdown of the home power supply. This system can display data in real-time

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on the mobile phone through the WiFi module, which is very convenient and has a certain degree of intelligence. The hardware part of the wireless WiFi smoke temperature and humidity alarm system is mainly composed of temperature and humidity detection module, smoke concentration detection module, ESP8266 wireless module, button module, and display module. The temperature and humidity and smoke detection module will detect environmental data, and the microcontroller will display the data in the display module and compare the data. When the threshold is exceeded, the alarm program buzzer will be triggered to activate the relay and close. The ESP8266 wireless module can send system detection data to the mobile phone and display the data through the APP.

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