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Design of Fire Detection and Alarm System for Smart Home

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Abstract

Arduino is used as the main controller to obtain environmental parameters through two sets of temperature/smoke/flame sensors, conduct real-time monitoring on the cloud platform through the WiFi module, and send it to the mobile phone APP to display the alarm status, which can achieve remote fire fighting, escape and request firefighters.

Keywords

Arduino; Cloud Platform; Wifi; Sensors.

1. Introduction

An intelligent home fire monitoring and alarm system is designed to solve the problems of fire accident easily caused by modern home environment and single function of existing alarm system. The system can detect the temperature, combustible gas leakage, smoke and other environmental parameters of the family, use the buzzer and led light for audible and visual alarm reminder, and upload the collected data to the "GizWits" cloud platform through the WiFi module to achieve remote monitoring of house fire. The system can timely alarm and notify users to avoid the occurrence of family fire, and is also suitable for warehouses, coal mines and other environments, with high application value and market prospects.

2. Design of System Framework

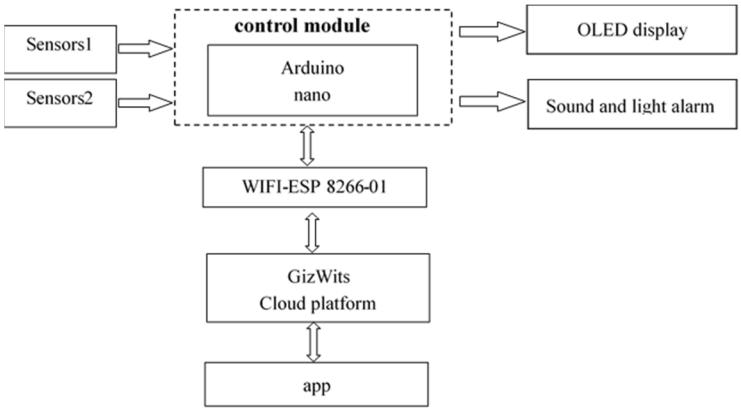

Fig 1. System design

Using Arduino nano development board as the control core, two sets of temperature/ smoke/ flame sensors are used to collect environmental parameters in the kitchen and living room respectively in real time and upload the collected data to "GizWits" cloud platform through WiFi module. Users can use cell phone APP or "GizWits" cloud platform to view and understand the historical or real-time temperature/smoke/flame situation. In case of fire, an audible and visual alarm is issued and can be sent to the mobile app to extinguish the fire and escape effectively.

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living room in real time respectively, and the collected data is uploaded to the "GizWits" cloud platform through the WiFi module. Users can use mobile app or "GizWits" cloud platform to view and learn about historical or real-time temperature/smoke/flame. In case of fire, sound and light alarm will be sent to mobile phone APP, and then fire fighting and effective escape will be carried out. The system design sees below Fig. 1.

3. Design of Hardware Circuit

3.1. Design of the Main Control System

Arduino Nano is a miniature version of Arduino Uno, which uses the Mini-B standard USB socket. Except for the appearance changes, other interfaces and functions of the Arduino Nano remain basically unchanged, but the price is much cheaper. In this design, Arduino nano is used as the main controller to achieve temperature and humidity collection, data upload and other functions, and the requirements for the number of pins and memory are not high.

3.2. Design of Sensors Circuit

Two sets of temperature/smoke/flame sensors of the same model are used in this design, and the selected models are DS18B20, MQ-2 and YL-38 respectively. The physical picture of the sensors is shown in Figure 2.

(a)DS18B20 (b)MQ-2 (c)YL-38

Fig 2. Physical picture of the sensors

DS18B20 temperature sensor is a "single bus" interface digital temperature sensor introduced by DALLAS Semiconductor Company. Its function is to detect whether the indoor temperature exceeds the set upper and lower limits, and read the indoor temperature and display it on the OLED screen. If it is detected that the upper and lower limits are exceeded, an audible and visual alarm will be given and the alarm information will be displayed on the OLED screen. The circuit connection is shown in Figure 3.

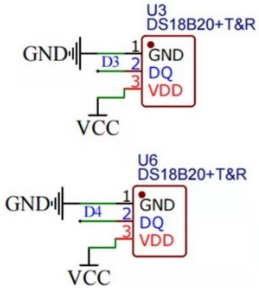

Fig 3. DS18B20 Circuits

MQ-2 smoke sensor is generally used to detect gas leakage devices in homes and factories, such as smoke, alcohol, hydrogen, alkane, etc. It is a low-cost sensor. Its function is to detect the indoor smoke concentration and display it on the OLED screen. If it exceeds the set target value, it will give an audible and visual alarm and the OLED screen will display the alarm information. The circuit connection is shown in figure 4.

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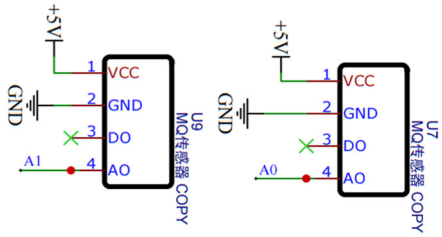

Fig 4. MQ-2 Circuits

YL-38 flame sensor uses infrared receiver tube as basic element. When flame is detected, OLED screen will display alarm information. The circuit connection is shown in figure 5.

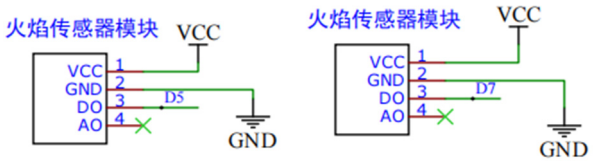

Fig 5. Flame Circuits

3.3. Design of WIFI Circuit

ESP8266-01 is used as the communication module. Configure networking commands to automatically enter transparent mode to connect to the cloud platform. The connection mode adopts soft serial port. The D2 interface and D3 interface of the ARDUINO nano are respectively connected with the TXD and RXD of the ESP8266 module to upload sensor data and receive control signals sent from the platform. The circuit connection is shown in the figure 6.

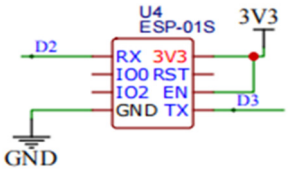

Fig 6. Wifi Circuits

4. Design of Software

4.1. GizWits Cloud Platform Settings

Fig 7. GizWits cloud platform settings

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Enter the developer center on the official website of "GizWits"(“ https://dev.gizwits.com/zh-cn/developer/ ”)Register an account. After registration, log in to the account, and you can create products, add data points, download apps and other operations in the developer center. When creating a product, security, monitoring/home security systems are selected for product classification. The product name is Smart Home Fire Monitoring and Alarm System, and the communication mode is Wi Fi. The "Product Information" interface is automatically generated, which contains basic information, data points, virtual devices, device logs, development guidance and other product information. The basic information includes the product key and product secret specific to the product. Before writing the MCU program, you need to record the Product Key and Product Secret. GizWits cloud platform settings is shown in figure 7.

4.2. MCU Main Program Design

Docking GizWits through WiFi module, first burn ESP8266 into the communication module of GizWits firmware GAgent, serial port debugging and configure with the downloaded cell phone APP, if successful, it will display the data points of GizWits cloud platform. In GizWits product information MCU automatically generates code, which contains the account to generate unique Product Secret, virtual devices and other information for Arduino code writing. Keep the network online, 2 groups of flame, smoke and temperature sensors start to collect information, OLED screen and mobile APP display data, if the value is exceeded, OLED will display alarm information, and cell phone can also receive alarm alerts. The program flow is shown in figure 8.

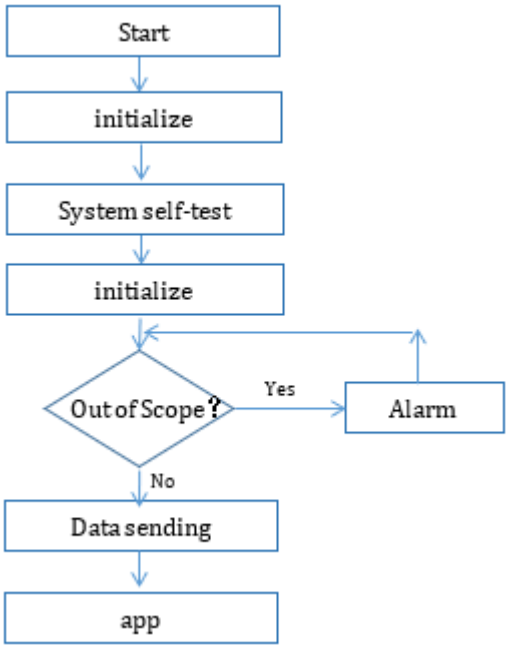

Fig 8. Main program flow diagram

5. System Tests

When the device is started and the mobile phone APP is connected to the WiFi module, the GizWits platform will display online, and you can view real-time data and historical data in the device log. The data on cloud platform is shown in figure 9.

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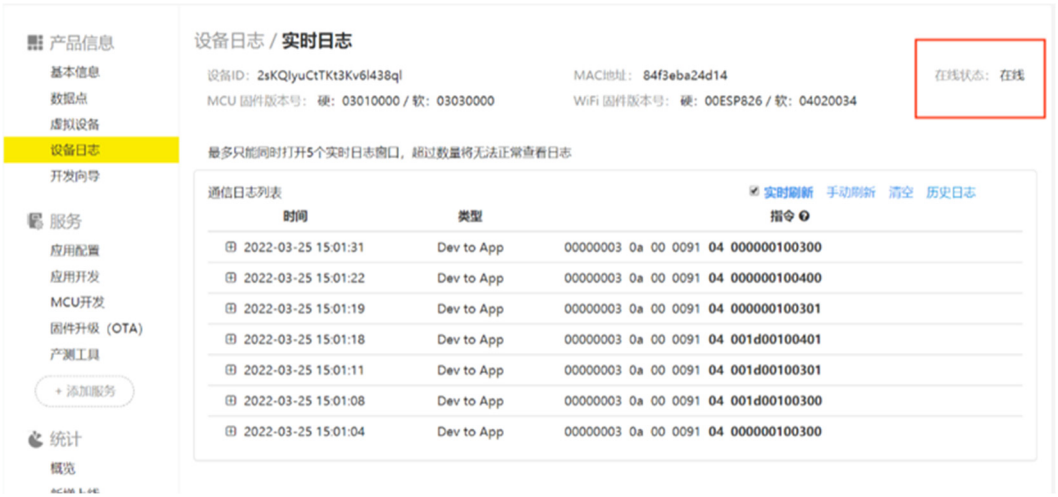

Fig 9. Data on Cloud Platform

Taking temperature detection as an example, the upper limit of mobile phone APP is 30 and the lower limit is 0. When a fire source is close to the DS18B20 sensor, the temperature on the OLED screen will rise. When the set upper limit is exceeded by 30 ℃, an audible and visual alarm will be given, and the alarm information will be displayed in the alarm column of OLED screen. The sensor data information and alarm prompt can also be seen in the mobile phone APP. As shown in the figure.10.

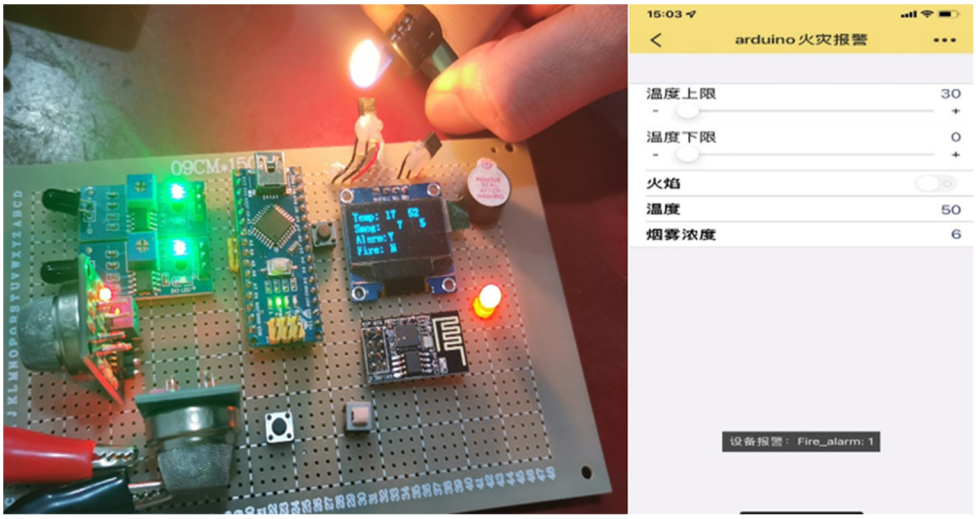

Fig 10. Temperature Alarm

6. Conclusion

In this paper, Arduino and GizWits Internet of Things cloud platforms are used to design the fire monitoring and alarm system, and realize the remote detection and alarm of home environment fires.

The test results show that the smart home fire monitoring and alarm system based on Arduino and GizWits Internet of Things cloud platform is simple in development process, friendly in cloud control platform and app user interface, and basically achieves the expected design goals.

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