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Smart Home Monitoring System Based on Wifi Technology

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Abstract

In recent years, with the development of WiFi technology, MCU technology and sensor technology, modern home life has also changed. Therefore, the research of smart home has very important guiding significance for the development of home environment system. In this paper, the design of smart home monitoring system is realized by using single chip microcomputer technology and WiFi technology, combined with temperature and humidity sensor, light sensor, smoke sensor and human infrared sensor. It can collect the information of temperature and humidity, light and smoke concentration in the home environment, and carry out relevant operations on the mobile phone app, Make the home environment meet the most comfortable state perceived by the human body.

Keywords

Intelligent Home Furnishing System ; WiFi Technology.

1. Overall Design of the System

The smart home monitoring system shall meet the requirements of monitoring light intensity, indoor temperature and humidity, smoke concentration, personnel access and other information. Users can obtain corresponding data information through mobile app.

The smart home monitoring system is divided into hardware and software. The hardware includes detection unit, control unit, execution unit, transmission unit and auxiliary unit, which jointly complete the normal operation of the hardware end. The detection unit is composed of various sensors to collect information such as temperature, humidity, light, personnel visit, smoke concentration and so on. The control unit is the core of the hardware, which is composed of STM32 single chip microcomputer to control the hardware. The execution unit is to receive the instructions of the single chip microcomputer for relevant operations. It is mainly composed of LED lights, fans, etc. The transmission unit is composed of WiFi to complete the transmission of data and instructions between software and hardware. The auxiliary unit completes the functions of display and alarm prompt, including display screen, buzzer, etc.

On the software side, it mainly displays the data collected by the detection unit in the hardware part; it can control the opening or closing of LED lights, fans and buzzers to ensure that the home environment is in the most comfortable state.

2. Hardware Design

2.1. Hardware Function Design

The hardware end of the smart home monitoring system can realize the following functions: DHT11 temperature and humidity sensor, light sensor, human infrared sensor and mq-2 smoke sensor, which can collect information such as temperature, humidity, light, personnel visit and smoke concentration respectively, and display data information in real time; When it is detected that the indoor smoke concentration exceeds the threshold, the buzzer will give an alarm and turn on the fan until it recovers below the threshold, the alarm will be eliminated

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and the fan will be turned off; When weak light is detected, turn on the LED light to make up light until the light intensity is above the recovery threshold.

2.2. Hardware Function Realization

The system is programmed in the integrated development environment produced by Keilμ software company, and its version is Keilμ vision5.

2.2.1. Detailed Design of MCU Module

Turn on the power supply, press the reset key on STM32, the MCU starts hardware initialization. After initialization, set the working mode of WiFi module through at command, and then read the threshold value stored in the program chip. If the threshold value is empty, set the initial threshold value, and then enter the main cycle program to start the data of smoke concentration, temperature and humidity, light intensity and human body information Collection: if the detected light value is less than the threshold value, it will automatically turn on the fill light, and set the alarm mark as "1" to turn on the alarm. If the collected smoke concentration value is greater than the threshold value, the relay will be automatically opened to turn on the smoke concentration in the exhaust fan control room, and the alarm mark will be set to "1". Finally, the collected data will be displayed on the OLED display screen and sent to the Mobile terminal.

2.2.2. Detailed Design of Human Detection Module

In this system, the infrared sensor is used to detect whether there is human body information in the room and display it on the OLED display screen. Since the human body detection module used in the design needs 20 seconds of internal initialization operation after initial power on, the human body information detection is not carried out in the first 20 data acquisition cycles of the main program. After 20 seconds, if the human body information is detected, the human body detection mark is set to "1", and the human body detection display is "Y". If the human body information is not detected, the human body detection mark will be set to "1" If it is set to "0", the human detection is displayed as "N".

2.2.3. Detailed Design of Smoke Detection Module

In this system, the MQ-2 smoke sensor is used to detect the concentration value of smoke, so the output of the module is analog signal, and the analog voltage value is collected by ADC2 converter of MCU. First is the initialization operation of ADC2 converter. Then, the smoke concentration is measured in the main program, and the actual voltage value is calculated according to the formula, and whether the collected smoke concentration exceeds the threshold value is judged. If the smoke concentration is less than the threshold value, the buzzer will not alarm; if the smoke concentration exceeds the threshold value, the buzzer will start to sound an alarm.

2.2.4. Detailed Design of Temperature and Humidity Detection Module

In this design, the temperature and humidity measurement element DHT11 is connected with the power supply directly, and the addressing and reading ROM instructions are not considered in the software programming. After the initialization of the temperature and humidity module is completed, the temperature and humidity information in the home environment is collected, and the collected data is converted to a / D, and sent to STM32 MCU, which is processed and displayed on the OLED display screen.

2.2.5. Detailed Design of Illumination Detection Module

The light intensity detection method in the design is consistent with the smoke detection method, but the smoke adopts ADC2 channel 9 for data acquisition, while the light intensity voltage value is collected by ADC1 channel 9. The first step is to initialize the ADC1 converter and start ADC1. When the data detection cycle is reached, the sampling meter of ADC channel 1 is output through ADC sampling The value is converted into the actual analog voltage value

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through the formula, and the analog voltage value is compared with the set threshold value to judge whether the current indoor light is low. If the light intensity is less than the threshold value, the fill light will be automatically turned on, and the buzzer alarm will be given at the same time.

2.2.6. Detailed Design of Wifi Communication Module

First of all, WiFi module is initialized, and serial port 3 is initialized. Set WiFi module through at command to judge whether the module setting is successful. If it is not successful, return to "set WiFi module through at command" to reset. If successful, judge whether serial port 3 has received data. If data is received, judge whether data conforms to the protocol. If it does, conduct data processing If not, return to "serial port 3 initialization" and reinitialize. If serial port 3 does not receive data, judge whether there is data transmission. If data length is sent through at command, then send data through at command. If no data is sent, return to "module setup succeeded?" Re judge whether the WiFi module is set successfully.

2.2.7. Detailed Design of Control Relay Module

In this system, the environmental data is detected once every 1s time cycle. When the smoke concentration value is detected to exceed the set smoke threshold, the fan will be automatically turned on for smoke exhaust operation, until the detected smoke concentration is lower than the threshold value of - 0.2V, the fan will be turned off again, and the fan is controlled by the action of control relay to control the fan switch.

3. Software Design

3.1. Software Function Design

The smart home monitoring system can realize the following functions on the software side through the setting of mobile app: set the login main interface and log in successfully; Real time display of collected data; The control of hardware can realize the opening / closing of fan and LED light in app.

3.2. Software Function Realization

The system software is implemented through Android studio, and its source code is open source. Although Android studio is composed of a framework platform, due to the numerous plug-in support, Android studio has the flexibility that other ide software does not have.

3.2.1. Detailed Design of Login Interface

The main function of the main interface of the mobile phone software designed in this system is the network connection of software and hardware and the entry button to enter the corresponding sub interface. Through this interface, users can input the port number of IP address and click the "connect server" button to connect with the hardware. After the connection is successful, there will be a "connection success" message at the bottom of the interface. Three buttons are also distributed in the interface, which can enter the real-time data interface, hardware control interface and threshold setting interface. If the network connection is not successful, clicking the three buttons will not directly enter the corresponding sub interface, but pop-up window will prompt the user that the network is not connected.

3.2.2. Detailed Design of Real Time Data Interface

Click the real-time data button in the main interface, and on the premise of successful network connection, the software enters the real-time data sub interface. The interface is composed of 8 icons and 8 data display boxes. After the hardware and software are connected successfully, the hardware side will send real-time data to the software side every 1s to display on the sub interface.

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3.2.3. Detailed Design of Hardware Control Interface

Six icons are distributed in the control hardware sub interface, which are fan on, fan off, fill light on, fill light off, alarm on and alarm off. Click the corresponding icon position to control the corresponding action of hardware.

3.2.4. Detailed Design of Threshold Setting Interface

The threshold setting interface is mainly used to set the threshold of smoke concentration and light intensity. The interface is composed of three kinds of controls: text input control, text display control, and button control. Users can input the threshold to be set and click the "set" button to send the corresponding threshold to the hardware.

4. System testing

4.1. Connection Testing

Before the hardware test, the pin connection of each component must be checked to avoid unnecessary damage after power on. After power on, test whether the system works normally. After many tests, it is found that there is no big gap between the function of the system and the expected goal.

4.2. Functional Testing

Through the test and analysis of various functions of the system, it can be concluded that the system has realized the expected basic functions, can collect and display relevant data in real time and accurately at the software and hardware end, and can also realize relevant control through the hardware end / software end, and the system functions are basically realized.

5. Summary

The system uses sensor technology, MCU technology and WiFi technology to collect and display data in the environment, and send the data to the mobile app. Through the collection and display of temperature, humidity, light, smoke and other information, the home environment is always in a comfortable state; Through the collection, display and corresponding alarm processing of smoke and human infrared information, the possibility of danger is predicted and users are reminded to take relevant precautions.

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