Design of Greenhouse Automatic Control System based on Arduino

Minhua Ju

Suzhou Institute of Industrial Technology, Suzhou 215104, China.

jmhslj@163.com

Abstract

Arduino Mega 2560 is used as the main controller, and the temperature and humidity of the environment are obtained in real time through the temperature and humidity sensor DHT11. The temperature and humidity data are uploaded to ONENETcloud platform by WiFi module. Using ONENETplatform to view the temperature and humidity data in the greenhouse in real time, and can realize the function of reverse control on the Arduino terminal relay to execute the equipment opening and closing according to the set temperature and humidity threshold conditions, and realize the function of intelligent control through the greenhouse.

Keywords

Arduino; ONENET; WiFi; DHT11.

1. Introduction

The traditional temperature control relies on the placement of temperature and humidity meter in the greenhouse, which controls the temperature and humidity of the greenhouse according to the manual reading. This method is not only time-consuming and laborious, but also easy to produce errors.

With the rapid development of agricultural informatization and greenhouse intelligent control, greenhouse automatic control has increasingly become an urgent demand of agricultural practitioners, and the research of greenhouse automatic control system has gradually become the focus and hot spot of agricultural science and technology development. Therefore, it is of great significance to design an intelligent, accurate and real-time temperature and humidity control system that can be monitored and controlled on PC or mobile client.

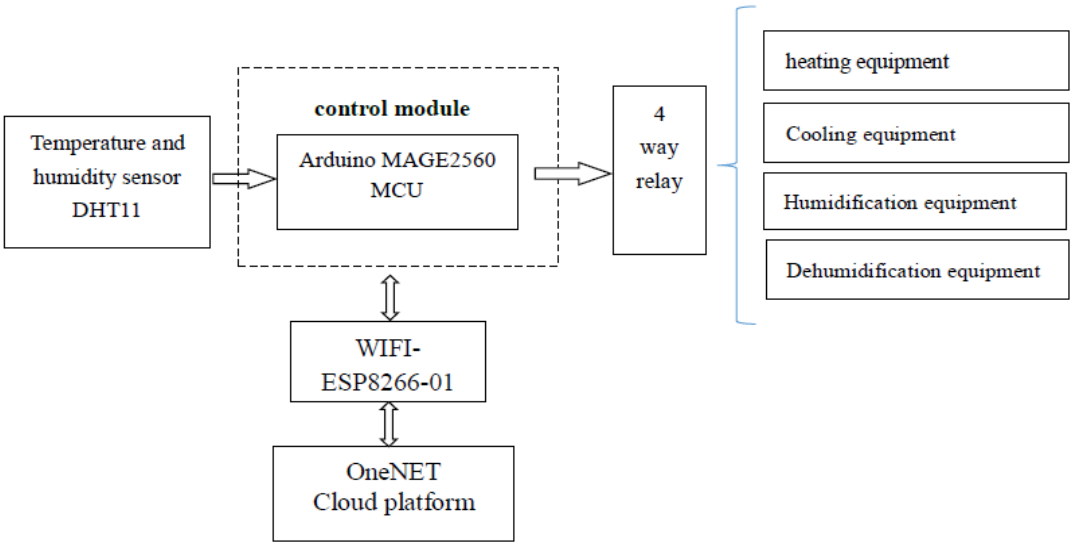

Fig. 1 System design

2. Design of system framework

Taking Arduino development board as the control core, the temperature and humidity sensor DHT11 is used to collect the temperature and humidity information in the greenhouse in real time. The

environment temperature and humidity are obtained in real time through the temperature and humidity sensor DHT11, and the temperature and humidity data are uploaded to ONENETcloud platform by WiFi module. Using ONENETplatform to view the temperature and humidity data in the greenhouse in real time, and can realize the function of reverse control on the Arduino terminal relay to execute the equipment opening and closing according to the set temperature and humidity threshold conditions, and realize the function of intelligent control through the greenhouse.The system design sees below Fig. 1.

3. Design of hardware circuit

3.1 Design of the main control system

The core of Arduino mega 2560 processor is ATmega2560, which has 54 channels of digital I /O (16 of which can be used as PWM output), 16 channels of analog input and 4 channels of UART interface. It is especially suitable for the design that needs a large number of IO interfaces. The memory of mega 2560 is 8K. In this design, the functions of temperature and humidity collection, data upload and reverse control are implemented on Arduino platform, so Arduino mega2560 is used as the main controller.

3.2 Design of Temperature and humidity sensor circuit

DHT11 was used as temperature and humidity monitoring. The module includes a resistive wetted component and an NTC temperature measuring component. The standard single bus interface has simple wiring and the measuring range is: humidity 20-90% RH, temperature 0-50 °C. The DHT11 temperature and humidity sensor and Arduino Mega 2560 are wired as follows: VCC is connected to Arduino's 5V; GND is connected to Arduino's GND; NC is not connected to the empty pin; DATA is connected to Arduino's digital I/O pin 3.

3.3 Design of WIFI circuit

Esp8266-01 is used as the communication module, its role is to receive the real-time data collected by DHT11 and upload it to ONENET platform; receive the command sent by ONENET to control the relay and thus control the switch of heating board, humidifier, dehumidifier and other devices. CH-PD, GPIO0 and VCC of esp8266-01 are connected to 3.3V of Arduino mega 2560; The GND pin is connected to the GND of Arduino mega 2560; UTXD and URXD are respectively connected to RX3 and TX3 of Arduino mega2560 (i.e. digital ports 15 and 14).

3.4 Design of relay circuit

Since the power supply of ventilation, heating, drip irrigation and lighting, etc. is usually 220V AC, and cannot be directly driven by the MCU, a 4-way Risym relay module is used to control each device. The relay is a low level trigger. When the relay coil receives a low level signal, the common terminal and the normally open terminal are turned on. The input terminals IN1~IN4 are respectively connected to the pins 10, 11, 12 and 13 of the single chip microcomputer, and the four sets of execution devices of the water pump, the electric fan, the humidifier and the fill light are respectively connected to the common end and the normally open end of the output end of the four-way relay.

4. Design of software

4.1 ONENETcloud platform settings

To register an account on the official website of OneNET ("https://open.iot.10086.cn/"). After registration, click "Developer Center" in the upper right corner of the home page to enter the product development interface, create a product (multi-protocol access-HTTP protocol), create a device, create a new data stream (The name of the data stream should be the same as the one in the program), and add the application.

OneNET supports data upload in JSON format and data download in JSON format. OneNET platform has certain format requirements for JSON data, including not only the data to be transmitted, but also the device ID and key, so that the data can be sent to the correct device.

You need to record the device ID and the secret key. The device ID can be seen in front of the device by clicking on "Device List", and the secret key can be found in the APIKey column by clicking on "Rights Management". Device ID sees below Fig. 2 and apikey sees below Fig. 3.

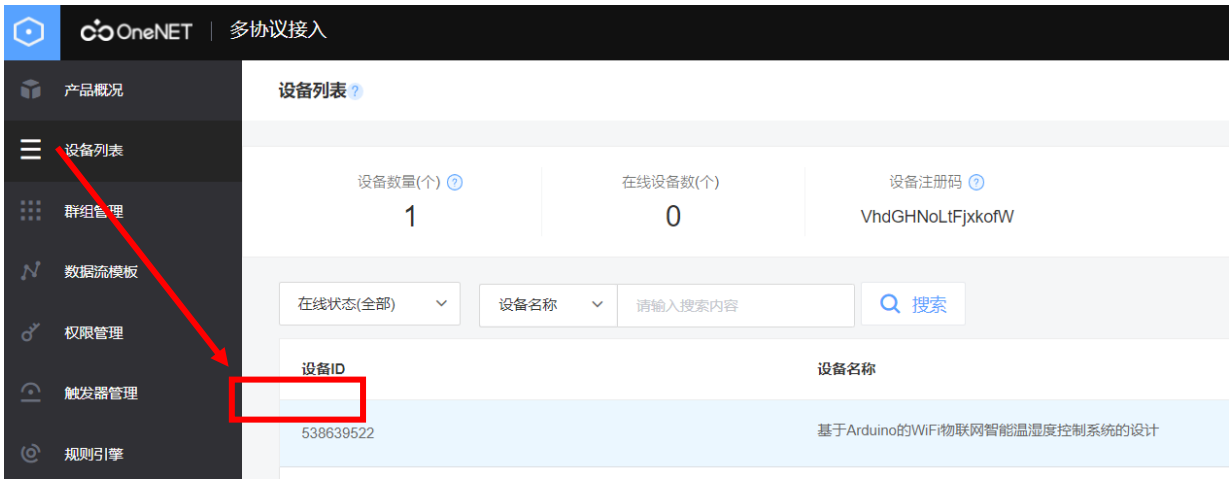

Fig. 2 Device ID

Fig. 3 Apikey

4.2 MCU main program design

Connect to OneNETvia esp8266 WiFi module and use OneNET's HTTP protocol to POST data stream to OneNETcloud platform and GET data stream from One NET cloud platform. The data sent from Arduino to OneNETvia ESP8266-01 is in Json format, so we need TimerOne.h, HttpPacket. h, ArduinoJson.h libraries are needed.

The programming idea is: use the library <dht11.h> of DHT11 sensor to read the temperature and humidity value; use the library <TimerOne.h> to monitor the time of AT command sending and getting the returned data; use the library <HttpPacket.h> provided by OneNETto synthesize the HTTP header of POST request; use the library < ArduinoJson.h> library to synthesize the required JSON data stream; use the ESP8266 to connect to the router to send the data to the OneNETserver.

5. System tests

The application management in OneNETcloud platform can display the real-time temperature and humidity, and can also send data to control the switch. As shown in Figure 4.

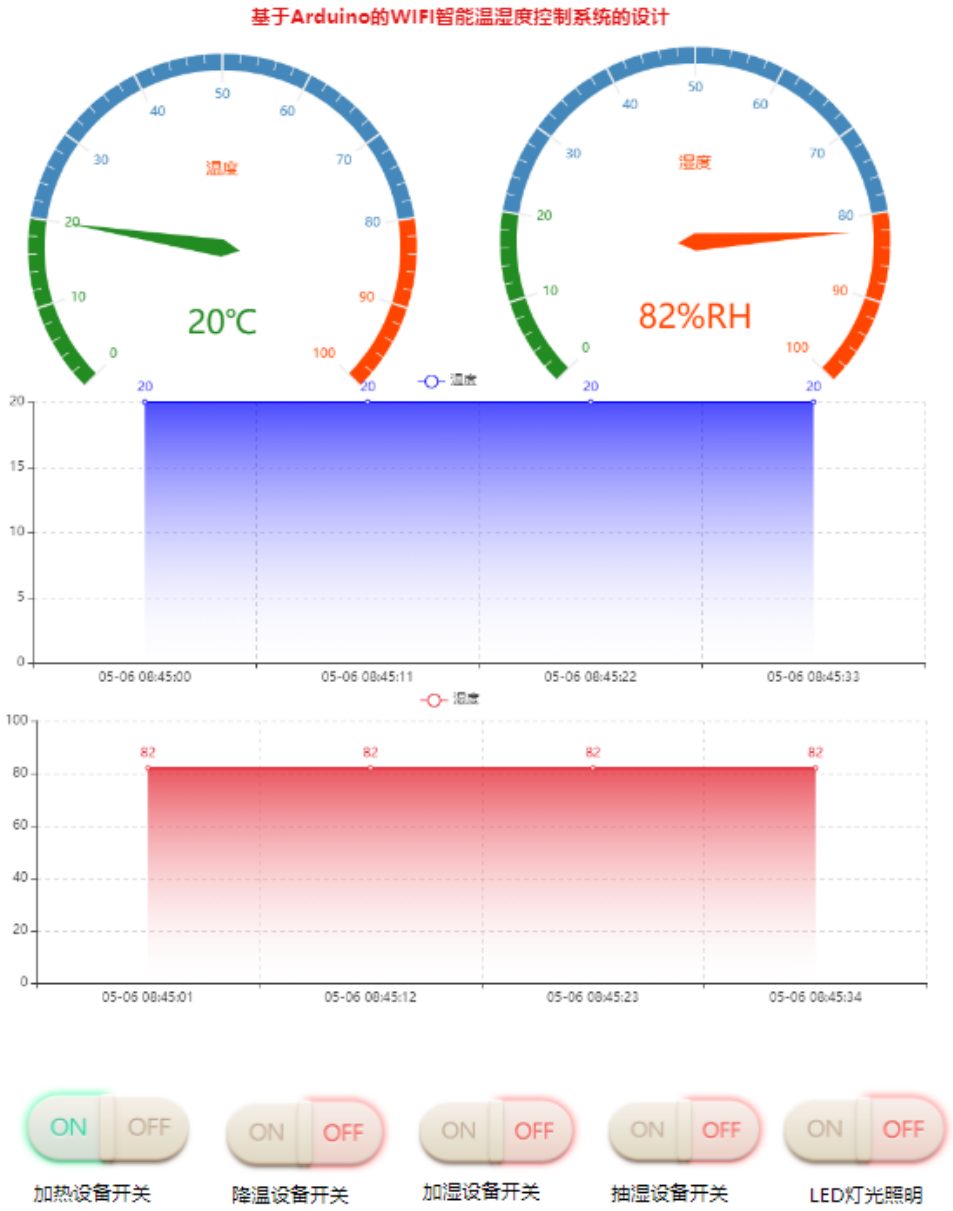

Fig. 4 Terminal display and control interface

6. Conclusion

In this paper, the software and hardware design of the automatic control system of greenhouse greenhouse was completed by using Arduino and OneNETIOT cloud platform, and the remote detection and control of greenhouse environment was realized.

The test results show that the temperature and humidity greenhouse monitoring system built based on Arduino and OneNET cloud platform has a simple development process, stable hardware and software operation, and friendly user interface of the cloud control platform, which basically achieves the expected design goal and provides an important theoretical basis and reference model for greenhouse agricultural production.

References

[1] An Chenwei. Home environment monitoring system based on Internet of things [D]. Inner Mongolia University, 2019.

[2] Lu Xiao. Intelligent bird repeller based on Internet of things and its design [D]. Shandong University, 2019.

[3] Yuan Zhenhua, Wang Benyou, Chang Zhiqiang. Development and design of smart home system based on Arduino [J]. Electronic technology, 2018,47 (11): 95-97.

[4] Yang Jing. Design of air temperature and humidity detection system based on Arduino and app inventor2 [J]. Electronic technology and software engineering, 2018 (21): 52-53.

[5] Chen Kaihui, Yin Ling, Wu Zhenghao, Wang Yongfu, Chen Zhenxu, Lin Yingshi. Personalized intelligent potting system based on Arduino [J]. Guangdong Agricultural Sciences, 2018,45 (09): 134-141.

[6] Chen Lin, Zhao Jiang, Zhong Jing, Li Qi. Design and implementation of distributed network temperature and humidity monitoring system based on Arduino [J]. Electronic design engineering, 2018,26 (04): 66-69 + 75.

[7] Zhu Chen. Implementation of smart home control system based on Arduino Mega 2560 [D]. Wuhan Research Institute of Posts and telecommunications, 2018.