Design of Intelligent Illumination Controller for Agricultural Greenhouse Based on Arduino Board

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Keywords: Arduino; intelligence; environmental monitoring; illumination control; illumination monitoring

Abstract: Aiming at real-time environmental condition monitoring, a lighting control system based on Aduino for environmental condition monitoring greenhouse was designed. The system takes Arduino UNO and all kinds of sensors as the core, designs and compiles Arduino UNO program, realizes real-time and convenient monitoring of the surrounding environment temperature, humidity, light and noise changes, and collects sensor data to upload to the monitoring platform. Practice shows that the design can achieve data acquisition economically and efficiently, and can be used for rapid monitoring of real-time environmental conditions.

1. Introduction

In the past two years, with the development of industrialization, environmental pollution has become increasingly prominent. With the deterioration of environmental conditions, haze weather has become more and more serious everywhere, which has affected people's normal travel, life and health. Therefore, it is more and more urgent for people to have information about their surrounding environmental conditions. . With the rapid development of mobile Internet technology, the realization and wide application of 3G, WiFi, GPRS and other wireless communication methods provide conditions for real-time environmental monitoring. People can know their environmental status information anytime and anywhere, provide convenient services for travel and life, and seek a healthier environment. Provide basis for environment. This paper mainly studies the real-time acquisition of environmental information by using the existing mature sensing technology and Internet technology. This method is simple, fast, low-cost and highly practical.

Arduino is a kind of controller which is rapidly popular in recent years. It is a hardware platform. The core of Arduino is an AVR chip. The whole control board is similar to the MCU development board, but it has a lot of powerful functions. This paper designs an environmental monitoring system based on Arduino platform, which can detect the changes of temperature, humidity, illumination and noise in a day, and write the data into SD card for analysis. It has high practicability.

2. Arduino UNO main board and sensor

Arduino is an open source prototype platform which is convenient and flexible for developers to use and use. It includes hardware resources of various types of Arduino board and expansion board and software resources of Arduino IDE. Arduino is not only the most popular open source hardware in the world, but also an excellent hardware development platform. It is also the current trend of hardware development.

This design mainly uses Arduino UNO master board, DHT11 temperature and humidity sensor module, light intensity sensor and sound sensor, and SD card for data storage.

2.1 Arduino UNO main board and expansion board

Arduino consists of an open source hardware platform based on ATMEL AVR MCU and a special development environment. Arduino UNO[1] is the most widely used Arduino controller at

present, which has all the basic functions of Arduino. The core of UNO processor is ATmega328, which includes 14 digital input/output interfaces (6 of which can be used as PWM output and 6 analog inputs), a 16 MHz crystal oscillator, a USB interface, a power socket, an ICSP interface and a reset button, its structure and pin circuit [2]. After mastering the development technology of Arduino UNO, you can easily transplant your own code to other types of controllers, which can be used to develop interactive products, such as reading a large number of switch and sensor signals, and controlling a variety of lights, motors and other physical and electronic devices.

2.2 DHT11 temperature and humidity monitoring module

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 sensor module has high reliability and excellent long-term stability. DHT11 uses single bus mode to transmit data with Arduino, and single-wire serial interface makes system integration easy and fast. The sensor has the advantages of small size, low power consumption, over 20 m signal transmission distance, accurate accuracy and sensitive reading, making it the best choice for all kinds of applications and even the most harsh application occasions. DHT11 digital temperature and humidity sensor can measure real-time ambient temperature and relative humidity, the temperature range is 0-50 C, the temperature detection accuracy is 1 C; its relative humidity range is 20% RH-90% RH, the detection accuracy is 1% RH, and the time sampling interval of reading sensor data twice is not less than 1 s [4].

The sensor consists of a resistive humidity sensor and a NTC temperature sensor, which are connected with a high performance 8-bit single chip computer. Therefore, the product has the advantages of excellent quality, fast response, strong anti-interference ability and high cost performance. Each DHT11 sensor is calibrated in an extremely accurate humidity calibration laboratory. The calibration coefficients are stored in OTP memory in the form of a program. These calibration coefficients are invoked in the process of testing the model inside the sensor.

2.3 Photosensitive Intensity Sensor

Thermistor module is used for temperature detection. NTC 10 k? Superfluous thermistor is used to detect the temperature of the environment. The sensitivity is good. When the temperature rises, the resistance value will decrease. The output of analog value is 0-1 023. The analog value can be read by analog port combined with Arduino sensor expansion board.

Photoresistor is a kind of resistor, which is made of the photoconductive effect of semiconductor. Its resistance value changes with the intensity of incident light. It is also called photoconductive detector. When the incident light intensity decreases, the resistance increases when the incident light is weak. Photoresistors can be used to detect the intensity of ambient light. Combining with Arduino controller, light can be measured. It can be combined with Arduino special sensor expansion board through 3P sensor connection line.

2.4 Voice Sensor

The sound module of analog sound sensor is most sensitive to the sound intensity of the environment. It is generally used to detect the sound intensity of the surrounding environment. The sensor outputs high level when the ambient sound intensity does not reach the set threshold, and low level when the ambient sound intensity exceeds the set threshold; the digital output of the small board can be directly connected with the single chip computer, which can detect the ambient sound through the single chip computer; the digital output of the small board can be straight. Connect and drive the relay module, so as to form a voice-controlled switch, which can be used to make voice-controlled switch and so on. The sensor can only recognize the presence or absence of sound according to the principle of vibration. It can not recognize the size of sound or the sound of a specific frequency. Its sensitivity can be adjusted by a digital potentiometer. Arduino can collect the output signal by simulating the input interface.

3. Hardware Design

Temperature, humidity, light and sound sensors collect analog signals, which need to be converted from analog to digital to achieve digital output. The connection between each sensor and Arduino is very convenient, just connect its output to the corresponding digital pin of Arduino, or use the Arduino sensor expansion board to connect the output of the sensor directly to the expansion board. Schematic diagram of hardware connection.

The VCC, GND and DOUT pins of DHT11 temperature and humidity module are connected to + 5V, GND and digital port 2 of Arduino UNO control board respectively, and a 5 k_pull-up resistance is also needed to be connected in series between VCC and DOUT. The VCC, GND and DOUT pins of the photosensitive sensor are connected to + 5V, GND and analog pin port A0 on the Arduino UNO control board respectively. VCC, GND and DOUT pins are connected to + 5V, GND and analog pin port A1 of Arduino UNO control board respectively. SD card module VCC and GND pins are connected to + 5V and GND of Arduino UNO control board respectively. MISO, MOSI, SCLK and CS pins are connected to 10, 11, 12 and 13 ports of control board respectively.

4. Software Design

4.1 Arduino IDE

Arduino IDE is a software specially used to write Arduino program. After the program is written, the program can be uploaded to the Arduino development board for execution. The program of AVR MCU is written by using Arduino library. The integrated development environment of Arduino is simple and convenient to use, which simplifies the working process of MCU, compiles and encapsulates the AVR library twice, packs the ports well, and basically does not need to care about registers and address pointers, which greatly reduces the difficulty of software development.

After the Arduino IDE software development environment is installed on the computer end, Arduino UNO is connected to the USB port of the computer to supply power for the control board, and the program can be written, downloaded and debugged [5].

4.2 Implementation Procedures

ArduinoThe main program code is as follows：

```
#include&lt;SD.h&gt;
#include&lt;dht11.h&gt;
dht11 DHT11;
#define DHT11_PIN 2//DHT11 Pin
#define LIGHT_PIN A0// Photosensitive pin
Const int chipSelect=4; / / SD card CS select pin
void setup()
{
Serial.begin (9600); / / initialization serial port
pinMode(10，OUTPUT);
/ / set the SS pin to output state, UNO is pin 10.
Serial.println (" Initializing SD card&quot); / / initialize SD card.      if(!SD.begin(chipSelect))
{
Serial.println(&quot;initialization failed!&quot;);
return;
}
Serial.println(&quot;initialization done.&quot;);
}
void loop()
{
Serial.println(&quot;Read data from DHT11&quot;);
DHT11.read (DHT11_PIN); / / read DHT11 data
```

```
Serial.println (" Read data from Light Sensor&quot);

/ / read photosensitive module data
    int light=analogRead(LIGHT_PIN);
    Serial.println(&quot;Open file and write data&quot;);
    File dataFile=SD.open(&quot;datalog.txt&quot;，FILE_WRITE);
  / / open the file and write the data detected by DHT11 to the file.
    if(dataFile)
    {
    dataFile.print(DHT11.humidity);
    dataFile.print(&quot;，&quot;);
    dataFile.print(DHT11.temperature);
    dataFile.print(&quot;，&quot;);
    dataFile.println(light);
    dataFile.close();
    }
    else
    {
    Serial.println(&quot;error opening datalog.txt&quot;);
    }
    Serial.println(&quot;Wait for next loop&quot;);//delay 1 min
    delay(60000);
    }
```

4.3 data export and chart analysis

After the connected SD card records the data of different sensors, when the SD card is opened by the computer, you can see the file named datalog. txt, which is the data environment collected by the data recorder. There are many ways to analyze data and draw charts, which can be accomplished by many professional software. This design only needs to do some simple data analysis, so it can be completed in Excel.

Import the text data recorded in the SD card data recorder into Excel, and import the method as follows: [6]:

(1) First, select the "File" "Open" menu item in EXCEL, and the open file window will pop up. In the open window, the open file type will be selected as "all files (*. *)", and then open the file that needs to be imported and open it.

(2) When you click the "Open" button, a text Import Wizard will pop up, and Excel will process the text in rows and columns.

(3) After the imported text is divided into rows and columns, select one of the columns of data (i.e. the data of a sensor) and generate a corresponding form of data line chart according to the data selection to show the changes of the data.

5. Conclusion

This design uses DHT11 temperature and humidity sensor, photosensitive sensor and sound sensor to constitute the basic factors of environmental monitoring. It realizes the rapid and real-time detection of temperature and humidity, environmental light and noise, and can easily grasp the environmental situation of oneself. This design has the characteristics of low price, simple and portable. It can be used in computer room, library, storage granary, greenhouse greenhouse temperature measurement, air conditioning room temperature control and other places which are more sensitive to the environment and require higher temperature control. In addition, the design has a wide range of applications, including HVAC testing and testing equipment, automobiles, data recorders, consumer goods, automatic control, weather stations, household appliances humidity

regulators, medical dehumidifiers, etc. In the near future, with the maturity of ZigBee module of wireless sensor technology, wireless sensor has been well applied in this design, which makes it easier to transmit and communicate information between nodes in the network, and makes real-time monitoring of environmental status more convenient, timely and effective.

Acknowledgements

Research and innovation project of graduate students of Shaoyang University (CX2016SY032).

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