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Design of intelligent agricultural detection system

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Abstract

Agricultural Internet of things technology has promoted the rapid development of modern agriculture in China. Intelligent agriculture based on Internet of things is a new trend of future agricultural development, and is in line with the development requirement of "Internet plus" agriculture. The system uses raspberry pie as the main control to detect the impact of light intensity, air humidity, air temperature, air quality, CO2 concentration, soil humidity and other factors on plants through light sensor, air temperature and humidity sensor and soil humidity sensor. With the help of the device cloud app launched by onenet, remote monitoring can be realized anytime and anywhere. This system has a very broad application prospect in the future.

Keywords

Raspberry pi,Smart agriculture, Environmental detection.

1. Introduction

With the rapid development of planting industry, the traditional planting technology can not meet the needs of planting industry. The application of digital technology in the field of agriculture has become the general trend of modern agricultural development in the world. In recent years, the rapid development of IC industry provides the basis for intelligent development, and the planting industry is also developing towards intelligence. Indoor potted plants, greenhouse vegetables, seedling culture base and other fields have begun to study intelligent monitoring and control. At present, environmental factors such as air temperature and humidity, soil humidity and light intensity can be accurately detected by electronic sensors. Data conversion and analysis can be completed by single chip microcomputer, and data can be displayed by display devices. A variety of sensor detection systems are used in various places, but there is no perfect intelligent plant system covering all aspects. This design uses raspberry pie based on Linux operating system to monitor the impact of the environment on plants, improve the plant growth environment through the monitored environmental data, and display and alarm the plant environment.

2. System scheme design

A smart agriculture remote monitoring and management system based on onenet platform and Python is designed to provide services for plants. A cloud based monitoring, management and control system uses raspberry pie as the main control. Through the light sensor, air temperature and humidity sensor and soil humidity sensor, the influence of light intensity, air humidity, air temperature, air quality, CO2 concentration, soil humidity and other factors on plants is detected, and the detected data is transmitted to onenet cloud platform for analysis and calculation. The data is displayed through the console and the alarm is processed when the set value is reached.

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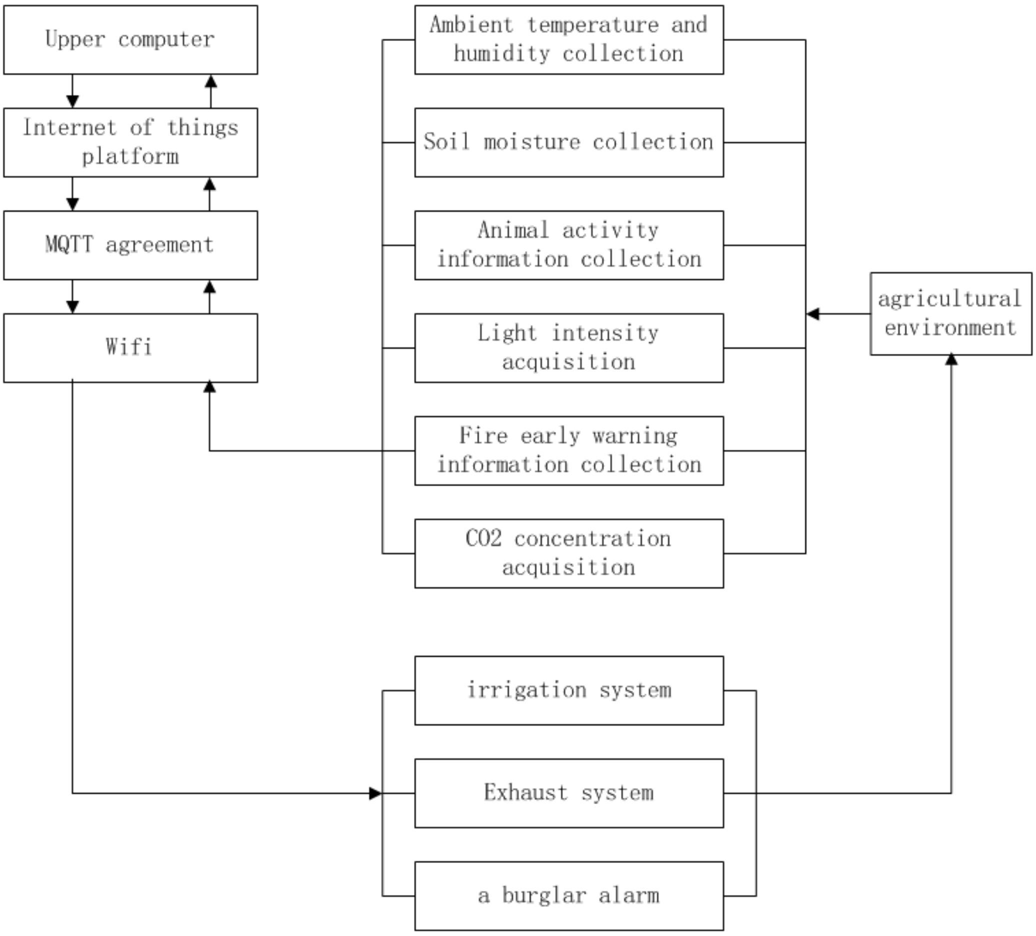

Figure 1 System composition block diagram

The change of agricultural environment is detected by sensors, and the detected data is transmitted to the Internet of things platform for analysis and calculation. The data is displayed through the upper computer, and the alarm processing and data distribution are carried out when the set value is reached. The system block diagram is shown in Figure 1. The system design mainly realizes the following functions: (1)air temperature detection: detect the air temperature through DH11(2) Air humidity detection: detect air humidity through DH11(3)Soil humidity detection: detect soil humidity through soil humidity sensor(4)Light intensity detection: detect the light intensity through bh1750 light sensor(5)CO2 concentration detection: detect CO2 concentration through GB30 sensor(6)Fire early warning information collection: collect air smoke through mq-2 sensor(7)alarm prompt: when the preset value is reached, an alarm prompt will be issued(8)Data upload: upload data through WiFi RF chip connected to the Internet through antenna.

3. Hardware design of the system

3.1. Air temperature and humidity detection circuit

The temperature and humidity detection circuit is shown in Figure 2. Since DHT11 device is a digital device, there is almost no need for peripheral circuits. Resistance R20 is the pull-down resistance of the data output IO port of DHT11, which is used to clamp the IO port level. The pull-down resistance is not an arbitrary resistance. The size of the pull-down resistance has a certain impact on the timing of the output signal, so the value is generally 4.7K Ω - 10K Ω. The power supply range of DHT11 is wide, ranging from 3.3V to 5.5V. Single bus signal transmission mode is adopted, and one IO port can read temperature and humidity information. The humidity measurement range is 5% - 95% RH, and the accuracy can reach ± 5% RH. The temperature measurement range is - 20 ℃ - 60 ℃, and the accuracy can reach ± 2 ℃. Meet the design requirements in the intelligent agricultural system.

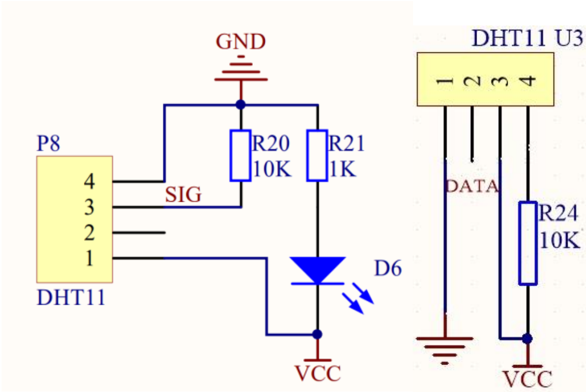

Figure 2 Air temperature and humidity circuit

3.2. Soil temperature detection circuit

The temperature detection circuit is shown in Figure 3. Since the DS18B20 device is a digital device, there is almost no need for peripheral circuits. Resistor R19 is the pull-up resistor of the data output IO port of DS18B20. It has a unique single line interface mode. When DS18B20 is connected with the microprocessor, only one port line is required to realize the two-way communication between the microprocessor and DS18B20. Moreover, DS18B20 supports multi-point networking function. Multiple sensors can be connected in parallel on the only three lines, and at most 8 sensors can be connected in parallel to realize multi-point temperature measurement. The measurement results are transmitted serially in the form of 9 ~ 12 digit words. The temperature measurement range is - 55 ℃ ~ + 125 ℃, and the inherent temperature measurement error is 1 ℃. Meet the design requirements in the intelligent agricultural system.

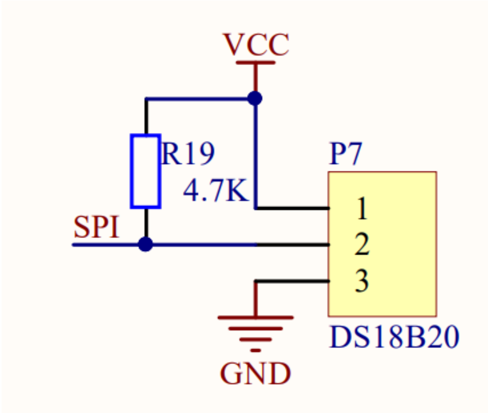

Figure 3 Soil temperature detection circuit

3.3. Sensor detection circuit

The sensor detection circuit is shown in Figure 4. The upper part is the differential circuit of hm-rd raindrop sensor and mq-2. LM393 comparator chip is adopted. Pins 4 and 8 are the power terminals. Pin 2 adjusts the sensitivity through R9 adjustable variable resistance, and pin 3 is connected to the analog output port of hm-rd raindrop sensor. The level signal of pin 1 is input to the single chip microcomputer, and pin 5 adjusts the sensitivity of mq-2 through R12 adjustable variable resistance, The analog input voltage signal of mq-2 smoke sensor is input through pin 6, and the level signal is output to the single chip microcomputer through pin 7. Sgp30 is a CO2 sensor integrated module. Only one pin and two pins need to be connected to VCC and GND respectively, three pins and four pins are IIC serial bus, bh1750 is a digital lighting sensor, R14 is a pull-up resistor to prevent interference, one pin is connected to VCC, two pins and three pins are connected to GND, four pins and six pins are IIC serial bus pins, and five pins are DVI voltage regulation pins to provide IIC output reference voltage. The above sensors transmit the digital form of data to a single chip for processing in the form of level and bus to obtain the data collected by the sensor.

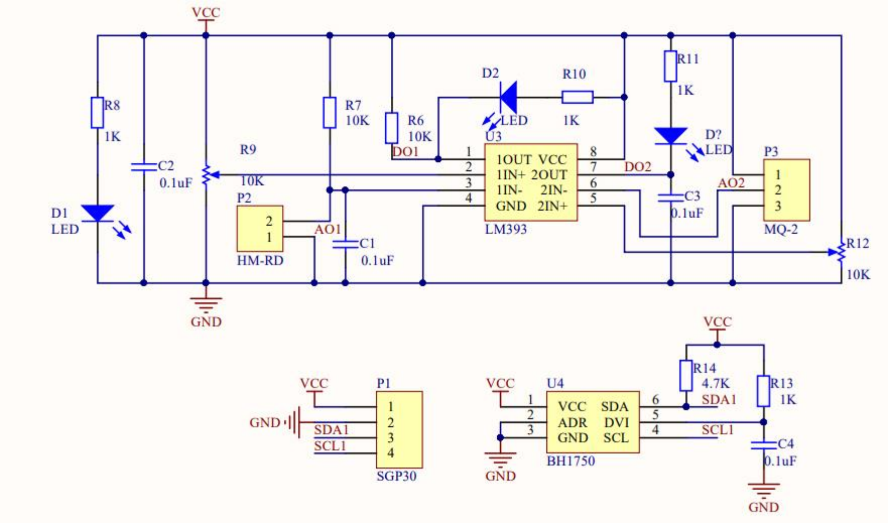

Figure 4 Sensor detection circuit

3.4. Stepping motor circuit

The stepping motor circuit is shown in Figure 5, which is divided into driving part and stepping motor part. The driving part is ULN2003, which is a non gate circuit, including 7 units, and the positive poles of each diode are respectively connected to the collectors of each Darlington tube. When used for inductive load, this pin is connected to the positive pole of load power supply to play the role of freewheeling (in inductive load, a large back emf will be generated after the circuit is disconnected. In order to prevent damage to Darlington tube, it is connected with an inverted diode to form a path and convert it into current). 1 to 7 are input pins, 10 to 16 are output pins, pin 8 is the ground terminal, and pin 9 is the common terminal of clamp diode. R1-R4 are pull-down resistors. When there is no level input, the motor does not rotate. Pins 13-16 are the pins connecting the stepper motor. Stepping motor is an electromechanical component that converts electric pulse signal into angular displacement or linear displacement. The input of stepping motor is pulse sequence, and the output is corresponding incremental displacement or stepping motion. The stepping motor is a four phase stepping motor, which is powered by unipolar DC power supply.

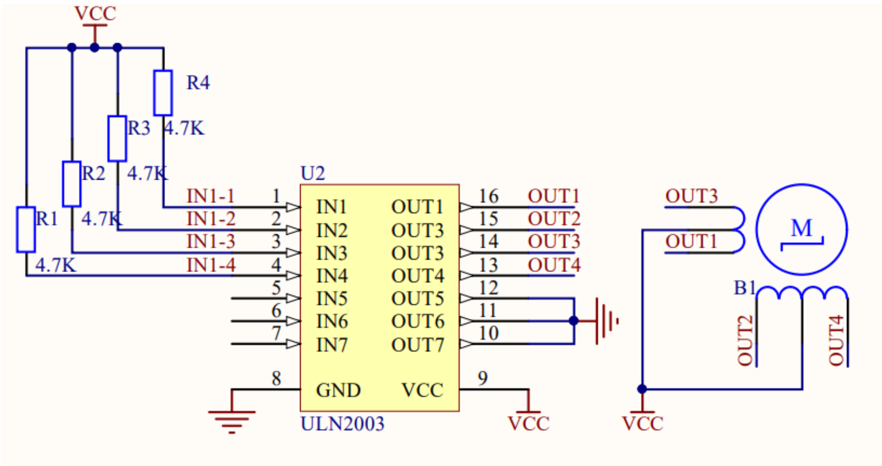

Figure 5 Stepping motor circuit

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4. System debugging

Soil humidity sensor, smoke sensor and raindrop sensor are converted into IIC digital bus signal through ad chip, and connected to ad chip through correct connection. Print the ad detection resistance partial voltage value of the test code as shown in Figure 6, run the test program in raspberry pie, and connect IIC pin. Receive the data through the serial port and view the results on the PC side, such as error! Reference source not found. As shown in, the soil humidity calculated by the ad partial pressure value after power on is 18% RH, the smoke is 255 (255 ~ 0), and the raindrop sensor detects 139 (0 ~ 255). After testing, the analog sensor is debugged normally.

```
PCF8591.py - /home/pi/Desktop/项目/PCF8591.py (3.5.3)
File Edit Format Run Options Window Help

#check your PCF8591 address by type in 'sudo i2cdetect -y -1' in terminal.
def setup(Addr):
        global address
        address = Addr

def read(chn): #channel
        if chn == 0:
                bus.write_byte(address,0x40)
        if chn == 1:
                bus.write_byte(address,0x41)
        if chn == 2:
                bus.write_byte(address,0x42)
        if chn == 3:
                bus.write_byte(address,0x43)
        bus.read_byte(address) # dummy read to start conversion
        return bus.read_byte(address)

def write(val):
        temp = val # move string value to temp
        temp = int(temp) # change string to integer
        # print temp to see on terminal else comment out
        bus.write_byte_data(address, 0x40, temp)

if __name__ == "__main__":
        setup(0x48)
        while True:
                print ('AIN0 = ', read(0))
                print ('AIN1 = ', read(1))
                print ('AIN2 = ', read(2))
                tmp = read(0)
                tmp = tmp*(255-125)/255+125 # LED won't light up below 125, so c
                write(tmp)
                time.sleep(0.3)
                                                                    Ln: 1 Col: 0
```

Figure 6 Sensor detection and debugging code

```
*Python 3.5.3 Shell*
File Edit Shell Debug Options Window Help
Python 3.5.3 (default, Sep 27 2018, 17:25:39)
[GCC 6.3.0 20170516] on linux
Type "copyright", "credits" or "license()" for more information.
>>>
================== RESTART: /home/pi/Desktop/项目/PCF8591.py ==================
AIN0 =  139
AIN1 =  254
AIN2 =  17
AIN0 =  140
AIN1 =  255
AIN2 =  17
AIN0 =  141
AIN1 =  254
AIN2 =  18
```

Figure 7 Sensor detection and commissioning

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5. Conclusion

This design aims to realize intelligent and intelligent agriculture. Through the module circuit design, the hardware and software parts are designed, the real object is made, and the corresponding design is adjusted and optimized according to the test results.

This design is a remote monitoring and management system for intelligent agriculture, so how to provide corresponding services for agriculture is the key. Environmental factors such as air temperature and humidity, soil humidity, light intensity and CO2 concentration can now be detected by corresponding sensors. Relevant data can be displayed through cloud data docking through relevant Internet of things protocols, and an alarm will be sent when the preset value is reached.

Acknowledgements

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