

## Design of flower monitor based on AppInventor 2

Xueziyu Shen<sup>1,a</sup>, Zhengze Tang<sup>1,b</sup>, ZhengZhang<sup>1,c</sup>, Minhua Ju<sup>1,d</sup> and Hao Liu<sup>1,e</sup>

Suzhou Institute of Industrial Technology, Suzhou 215104, China.

<sup>a</sup>286493528@qq.com, <sup>b</sup>2424498393@qq.com, <sup>c</sup>570071444@qq.com, <sup>d</sup>jmhsj@163.com, <sup>e</sup>profliuh@126.com

### Abstract

A smart flower monitor system is developed based on APP Inventor 2. When the mobile phone is connected to Bluetooth on Arduino MCU, it can obtain information of plant illumination, temperature, humidity and soil moisture through the mobile phone, and control the operation of ventilation, heating, drip irrigation and lighting equipment. In addition, the App can also record and view plant growth, and query popular plant websites by calling the web browser. The system meets the needs of general family plant maintenance and has considerable application value and market prospects.

### Keywords

Arduino, bluetooth, AppInventor 2.

### 1. Introduction

Many families plant a variety of plants as their level of living increases. However, due to the enclosed environment of the family, plants are difficult to feel the sunlight and rain in the natural world and need manual care. The judgment of whether plants need sunshine, temperature and moisture depends more on subjective feeling and planting experience. Therefore, it is necessary to design a device that can monitor information such as soil moisture, temperature and illuminance, and automatically control these parameters.

### 2. Design of system framework

The flower monitor consists of the Arduino UNO development board, soil moisture sensor, temperature and humidity sensor, illuminance sensor, OLED display, bluetooth module, relay and execution equipment and an Android phone. Sensors are used to detect soil moisture, environmental temperature, humidity and illumination, which are transmitted to Arduino microcontroller. The parameters of plant growth environment are displayed on OLED screen. After connecting bluetooth on mobile phone with bluetooth on Arduino MCU, it can monitor environmental parameters and control the work of executing devices on relays through APP on mobile phone. The system design sees below Fig. 1.

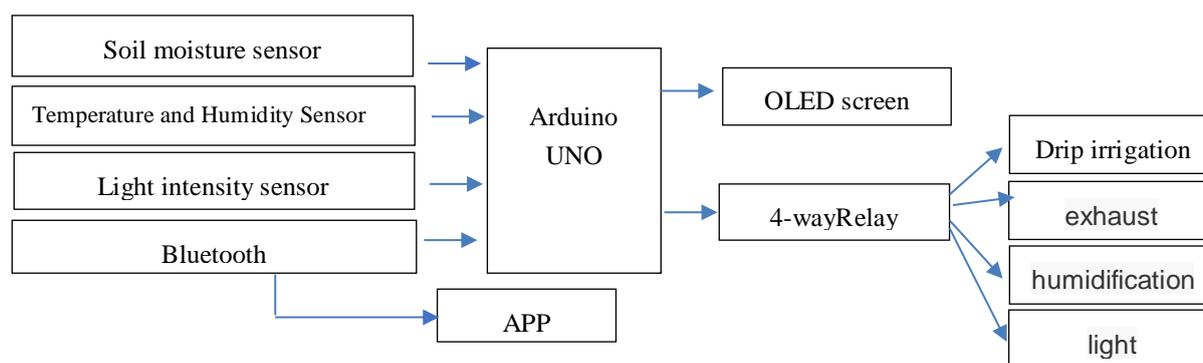


Fig. 1 System design

### 3. Design of hardware circuit

#### 3.1 Design of the main control system

Arduino is a flexible and simple open source electronic platform, which is now almost synonymous with the founder. It contains a wealth of Library functions, so that beginners can develop without too much programming foundation. Considering that the number of IO ports needed in this design and the memory occupied by the code are not much, Arduino UNO R3 is adopted as the main control module.

#### 3.2 Design of data acquisition circuit

In the information collection part, a temperature and humidity sensor, a soil moisture sensor and an ambient light sensor are used to realize automatic collection of various planting data.

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 UNO 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 2.

The BH1750 module was used as the illuminance monitoring. The BH1750FV1 is a digital light intensity sensor integrated circuit for a two-wire serial bus interface. The range is from 1 to 65535 lx. Since the module itself already has a 3.3V regulator chip and an I2C level shifting circuit, the module can be directly connected to the I2C interface of the UNO board. For the UNO board, the SDA signal line of the I2C bus corresponds to the A4 pin, and the SCL clock line corresponds to the A5 pin.

Risym soil moisture module was used to monitor soil moisture. There are two ways to get humidity information in this module. One is to get the humidity information from the D0 pin of the sensor, which is mostly used for the humidity threshold control switch. If the soil humidity is greater than a certain threshold, the D0 output will be 0, otherwise the output will be 1. The other is from the A0 pin of the sensor, which is used to display the humidity value in real time to make the simulation more accurate. The greater the soil moisture, the greater the simulated value. This design needs real-time display of soil moisture, so the second method is used to connect the A0 pin of the module to the analog I/O foot A0 of Arduino.

#### 3.3 Design of bluetooth circuit

Bluetooth module is used for wireless transmission. Bluetooth module is low power consumption, as long as the mobile phone opens Bluetooth, it can be connected without other intermediaries. The connection mode between HC-05 Bluetooth module and Arduino UNO is: VCC connects 5V of Arduino; GND connects GND of Arduino; TXD transmitter connects RX of Arduino; RXD receiver connects TX of Arduino.

#### 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.

#### 3.5 Design of display circuit design

The display uses an OLED12864 driven by the ssd1306. The screen module measures approximately 0.96 inches and has the advantages of high brightness and low power consumption. The module uses the resistor to cure the corresponding IO port using the I2C interface mode. The VCC pin of the

OLED12864 display is connected to the Arduino 3.3V pin, GND to GND, SCL to SCL, and SDA to SDA.

#### 4. Design of software

Software programming mainly includes the following two aspects: firstly, in ArduinoIDE software, the sensor collects all kinds of environmental information, OLED display environment parameters and Bluetooth transmission codes are compiled; secondly, in Appinventor 2 software, Bluetooth connection, environmental parameters acquisition, writing and reading of plant growth records and website query pages are compiled.

##### 4.1 Software Design of Lower Computer

Mainly composed of initialization, acquisition data, data processing, data display and relay control. The first is to use sensors to collect various environmental information, and then send the the environmental parameters to OLED. When the MCU receives the inquiry code "D" sent by the mobile phone Bluetooth, it uses the serial port to output the sensor information. Taking the control of the first relay as an example, when the MCU receives the control code "1" sent by Bluetooth of mobile phone, it writes the low level to the pin 10 of MCU, and the first relay sucks in. When the MCU receives the control code "2" sent by Bluetooth of mobile phone, it writes the high level to the pin 10 of MCU, and the first relay disconnects. The working process of the lower computer software of this system is shown in Fig. 2.

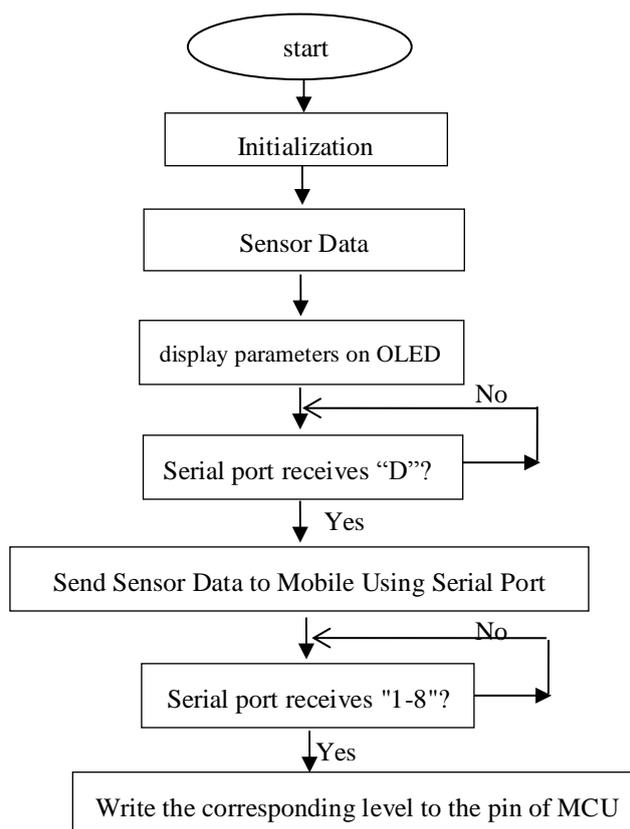


Fig. 2 Software Workflow of Lower Computer

##### 4. Software Design of Upper Compute

The upper computer is designed by Appinventor 2 and programmed by graphical block language. It is easy to learn and can complete Android program without complex code. Appinventor2 programming is used to realize Bluetooth connection, acquisition of environmental parameters, writing and reading of plant growth records, website query pages and user profile settings. The main function interfaces include login management, navigation, plant monitoring, growth record and website query. The function diagram of APP software is shown in Fig. 3.

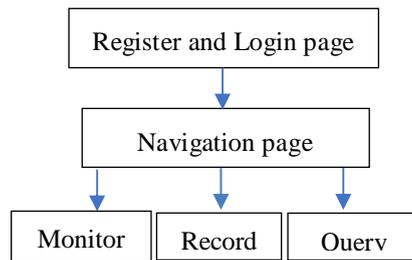


Fig. 3 App Function Design Block Diagram

### 5. System tests

There are many executing equipments involved in this design, but their control principles are similar, so the control of drip irrigation equipment is only illustrated as an example. The OLED display screen, Bluetooth HC05 and sensors are fixed on the breadboard, and connected with the MCU by the wiring, as long as the USB power supply is available. Drip irrigation receives 220V AC power separately, and its intake pipe is put into the outlet pipe of a bucket filled with water and the soil moisture sensor is inserted into the soil beside the pot. The physical connection is shown in Fig. 4.

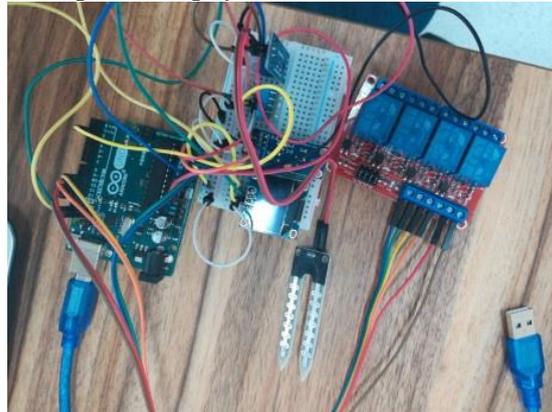


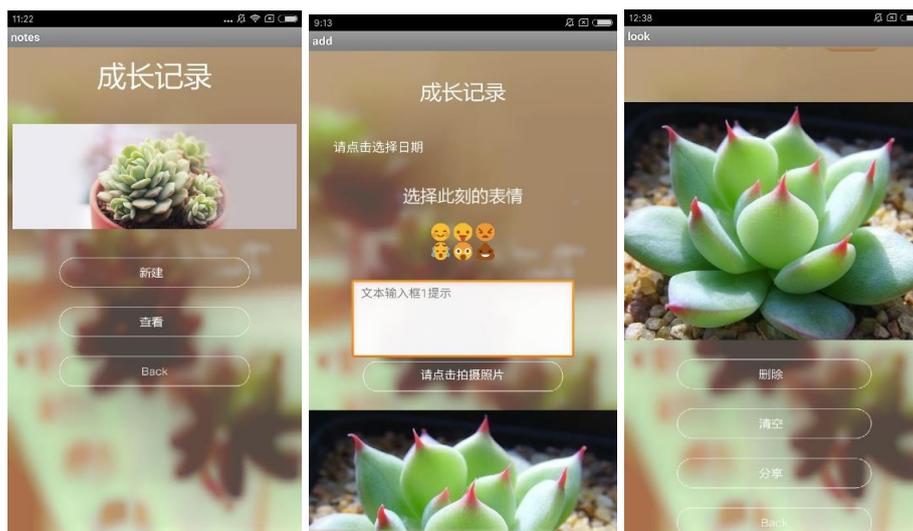
Fig. 4 Physical Connection

When the mobile phone is connected to the Bluetooth of the MCU, the mobile App displays four sets of sensor data, as shown in Fig. 5. Click the "on" button of drip irrigation in App to open the pump; click the "off" button of drip irrigation to close the pump.



Fig. 5 Demonstration of Monitor Function

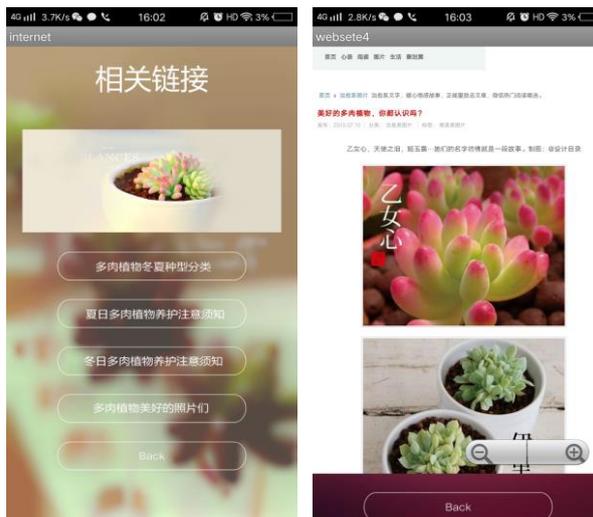
You can create or view new records on the “Records”page, as shown in Fig. 6 (a). On the "New" page, there are functions such as taking plant photos and writing records, as shown in Fig.6 (b). After completing the record, when you click the "View" button, you will jump to the "View" page. You can click the "Share" button to your friends through QQ, Wechat and other software. As shown in Fig. 6 (c).



(a) "Record"page (b) "New"page (c) "View"page

Fig. 6 Demonstration of Record Function

From the "navigation"page to the "Query" page, click on the Common Flower Websites to select any column, as shown in Fig. 7 (a). Click on different buttons to jump to the corresponding page, and then jump to the corresponding web address by calling the web browsing box on the page. For example, by clicking on the "Meat Plants Beautiful Photos" button, you can open the corresponding website, as shown in Fig. 7 (b).



(a) "Query"page (b) Website Link Page

Fig. 7 Demonstration of Query Function

## 6. Conclusion

In this paper, an open source Arduino MCU and AppInventor 2 are used to develop a flower monitor system. Using bluetooth serial communication, the intelligent control of plant temperature, soil moisture and illumination parameters by mobile APP is realized. In addition, APP also has the ability to record and view plant growth, and call the web browser box to query popular plant websites. The development scheme is simple, and the idea of modularization of MCU programming is easy to modify and maintain. Mobile APP is implemented by building block programming, which is easy to learn and has a short development cycle. The design can meet the needs of general family plant maintenance, and has certain application value and market prospects.

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