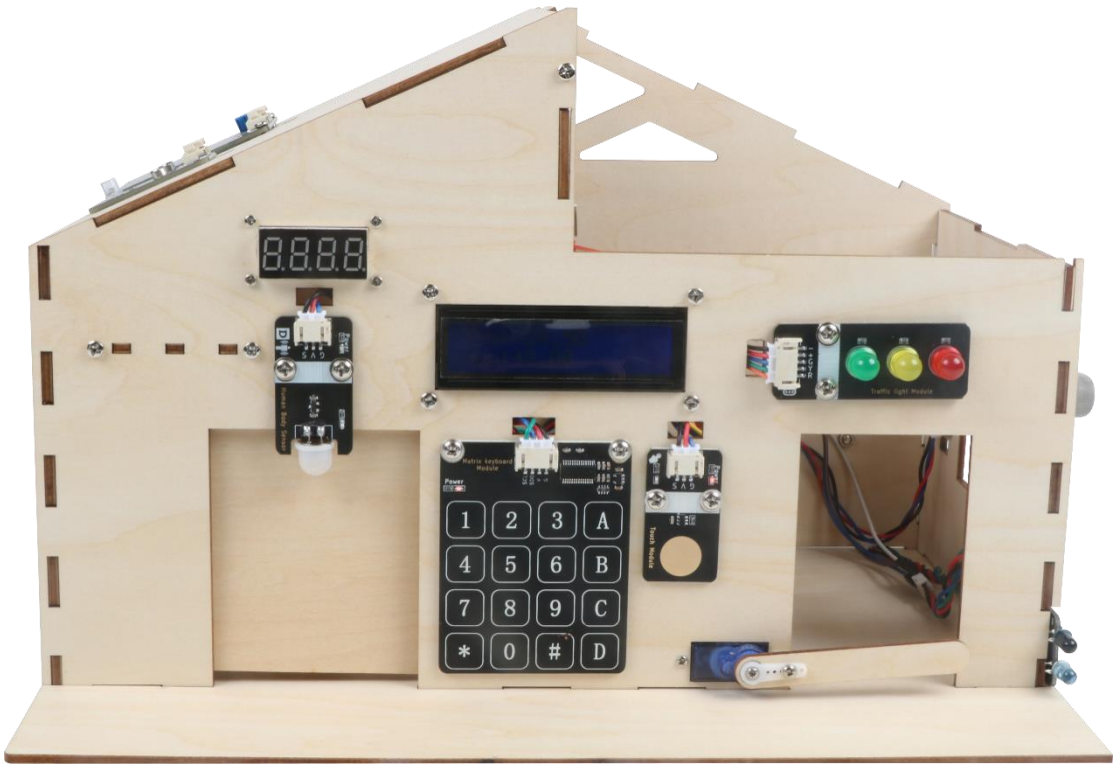
Smart Home Learning Course



SHENZHEN YICHUANG SPACE TECHNOLOGY CO., LTD

Smart Home Course

Contents

Ⅰ Learn about Smart Home

1.What is Smart Home？

Smart home is based on the residential platform, and then uses the generic cabling technology, network communication technology, security technology, automatic control technology and audio and video technology to integrate the equipment related to home life, and then constructs an efficient management system of residential facilities and family schedule affairs, so as to improve the home safety, convenience, comfort and artistry, and realize environmental protection and energy saving conditions of the city.

2. Advantages of Smart Home

1. Intellectualization: Furniture has changed from passive static structure to active intelligent tool.

2. Informatization: It provides a full range of information exchange functions to help families and the outside world maintain smooth information exchange.

3. Humanization: Smart Home emphasizes the subjective initiative of people, pays attention to the coordination between people and the living environment. Users can control the indoor living environment at will.

4. Energy Saving: It can turn off the sleep mode of household appliances and cut off the power completely with one key, thus saving power.

The smart home produced in this course is a work realized by using Arduino open source hardware, sensor module, programming and laser cutting technology. The purpose is to make readers understand the characteristics and principles of sensors, learn Arduino programming, and use sensors to realize intelligent automation of home equipment. From this, we not only have a deeper understanding of the characteristics and scene application of smart home, but also use all kinds of sensors to realize the intellectualization of living home equipment, so as to make people's life safer and more convenient.

3.Demonstration of Steps for Building Smart Home Model1、前侧和

1.The front and left sides are combined as shown in Figure 1-1

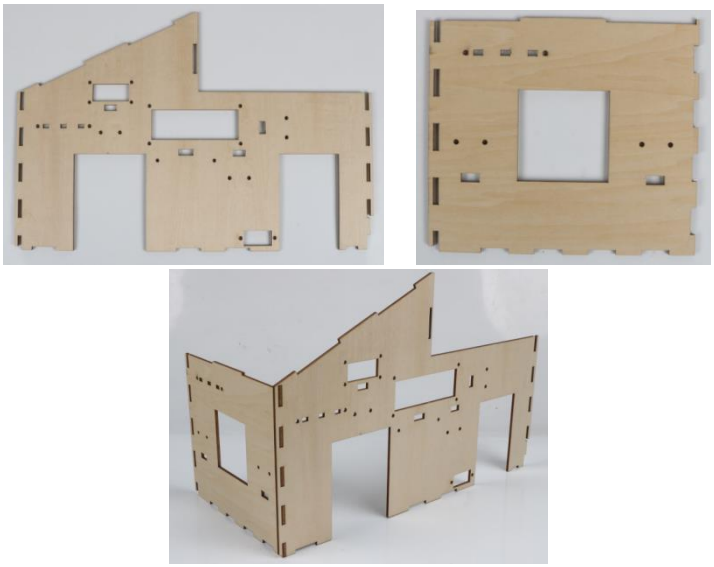


Figure 1-1

2.Assemble the right side, as shown in Figure 1-2

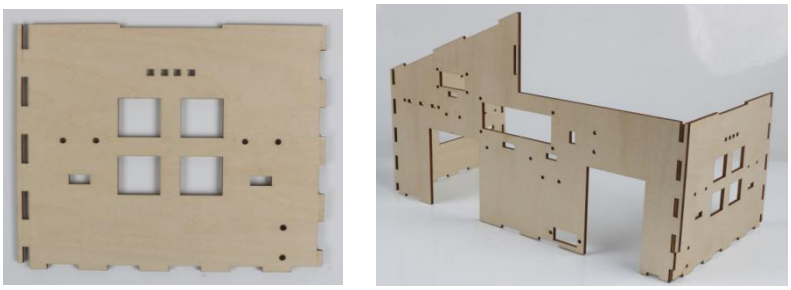


Figure 1-2

3.Assemble the back of the house, as shown in Figure 1-3

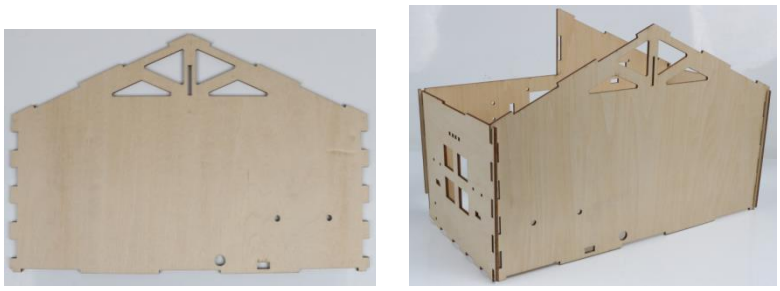


Figure 1-3

4.Insert the four sides of the combined house on the floor, as shown in Figure 1-4

Figure 1-3

5.Assemble the beam, as shown in Figure 1-5

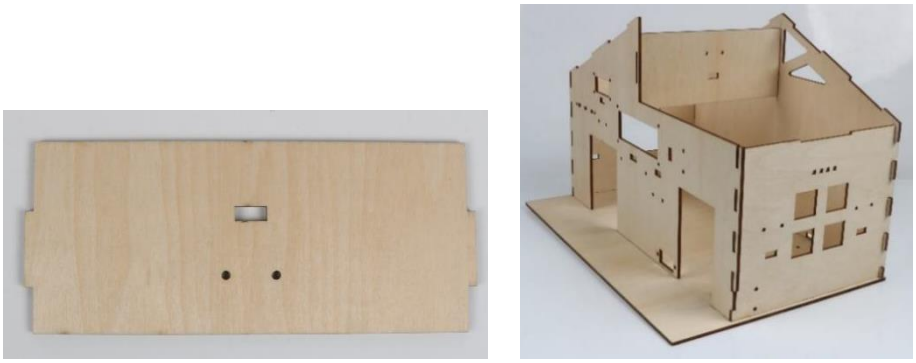


Figure 1-5

6.Finally, close the boards on the roof, and the model of the house is assembled, as shown in Figure 1-6.

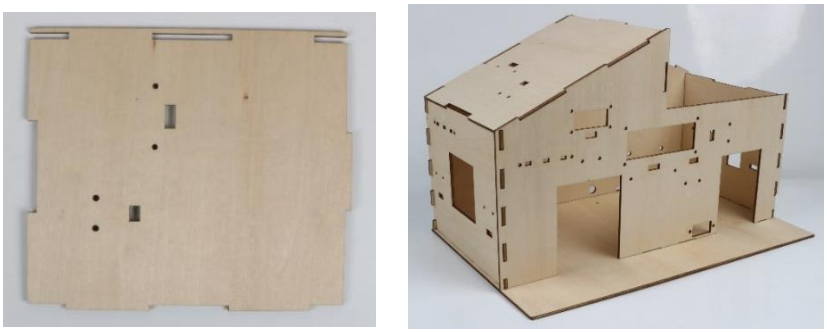
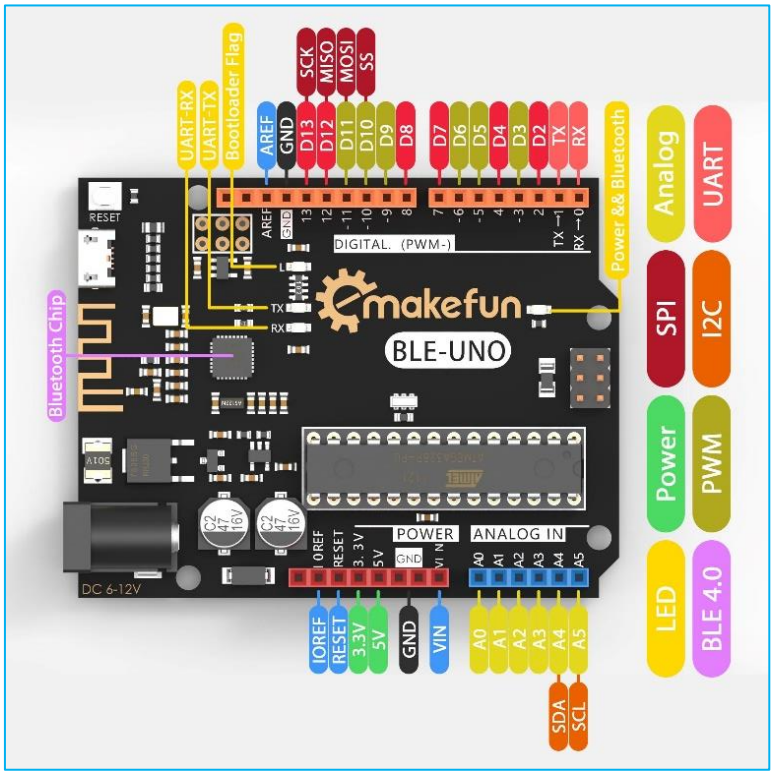


Figure 1-6

Note: The assembly of sensors and other hardware is shown in the later chapters of the course. Due to the limited pins of Arduino, the sensors in the kit can not be fully connected, so the experimental example of the course is operated according to a separate experiment. If scholars want to demonstrate its integrity, they can combine three cases. However, when connecting hardware and programming, they should pay attention to that the interface of sensors cannot be reused, that is, one pin cannot connect different sensors at the same time.

4.Know about Arduino BLE-UNO main board



Arduino BLE-Uno control board is a revolutionary product developed by Emakefun for maker based on Bluetooth 4.0 protocol and perfect combination of Arduino uno R3. The functions and pins are fully compatible with the traditional Arduino uno main board. The operating frequency band is 2.4GHZ, the modulation mode is GFSK, the maximum transmitting power is 0dB, and the maximum transmitting distance is 50m. It is designed with imported original TI CC2540 chip, and supports users to modify and view the device name, service UUID, transmit power, pairing password and other instructions through at command, which is convenient, fast and flexible. The product is very small and suitable for many applications with strict volume restrictions. We provide the mobile demo of Android and IOS system , then you can quickly develop a mobile communication hardware device. Just like the popular wearable mobile peripheral devices, they can be developed with BLE-Uno platform. You can use BLE-Uno to connect with Bluetooth 4.0 devices, and realize wireless transmission between two Bluetooth devices, master and slave settings. It even has a Bluetooth HID connection with a PC. We provide great freedom and support preparation for developers. Users can not only configure BLE-Uno through at command, but also add Arduino compatible expansion board, sensor, motor and steering gear driver on the BLE-Uno controller. Emakefun exclusively develops

Bluetooth master mode automatic connection slave function, and supports more than 20 bytes sending, which makes it more convenient to use.

- **Technical Specifications:**

- It is fully compatible with Arduino uno R3 pin and usage.
- BLE Chip:TI CC2540
- Working Channel: 2.4G
- 50m Transmission Distance: 50m
- Support at Command Configuration BLE
- Support USB virtual serial port, hardware serial port and BLE three-way transmission
- Support Master-slave Switching
- Support Bluetooth automatic connection to slave in host mode
- Support more than 20byte sending
- Interface: Mircor-USB
- Input Voltage: USB power supply, Vin6~12V
- Microprocessor: ATmega328PU
- Bootloader：Newly Arduino1.8.8
- PDimension: 68.6mm x 53.4mm x 12mm
- Weight:25g

- **Parameter Description:**

- ON：Power Indicator. When Arduino BLE-UNO is powered on, the light will be on

The blue light of link logo is Bluetooth and power indicator light. After power supply, the blue light flashes. When Bluetooth is not connected, the blue light flashes. After connection, the blue light is always on

The orange light of L logo is the BootLoader identification indicator. When the computer is connected through USB, the LED light will flash quickly when the port recognizes the board. The LED is connected to pin 13 of Arduino through a special circuit. When pin 13 is in high level or high resistance state, the LED will be on; When it is in low level, it will not be on. The LED can be turned on or off by program or external input signal.

(Note: When the USB cable is connected successfully, the blue LED of link flashes, and the orange light of L logo flashes several times. If only the blue LED of link flashes after connecting the USB cable, but the orange light of L logo does not respond, it means that the USB micro cable is broken, please replace it.)

- The LED light of RX identification is the serial port receiving indicator light. When the serial port receives data, the LED light will flash.

- The LED light marked by TX is the serial port sending indicator light. When the serial port sends data, the LED light will flash.
- Serial: 0 (Rx), and 1 (TX), are used to receive and send serial data. These two pins are connected to ATmega16u2 chip to communicate with computer through serial port.
- External Interrupt: Serial2, and 3, can input external interrupt signal. Interrupt has four trigger modes: low level trigger, level change trigger, rising edge trigger and falling edge trigger.
- PWM Output: 3, 5, 6, 9, 10, 11, (marked with silk screen) can be used to output 8-bit PWM wave. Corresponding Function: analogwrite().
- SPI:10 (SS), 11 (MoSi), 12 (MISO), 13 (SCK), which can be used for SPI communication. You can use the official SPI library to manipulate.
- L-LED: Pin 13 is connected with an LED. When the output of the pin is high, the LED is turned on, and the LED is turned off when the output of the pin is low.
- TWI: A4 (SDA), A5 (SCL) and TWI interface, which can be used for TWI communication and compatible with I²C communication. It can be manipulated with the official wire library. Arduino Uno has 6 analog input pins, which can be used to read analog values by using analogread(). Each analog input has a 10 bit resolution (i.e., 1024 different values). By default, the range of analog input voltage is 0 ~ 5V, and REF can be used to introduce analog. The reference function sets other reference voltages.
- AREF: Analog input reference voltage input pin.
- Reset: Reset port. If the low level is connected, Arduino will be reset. When the reset key is pressed, the port will be connected to the low level, so that Arduino will be reset.
- Vin:Power input pin. This pin can output power supply voltage when using external power supply to supply power through DC power socket.
- 5 V: 5 V power supply pin. When using USB power supply, the 5V voltage provided by USB is directly output; when using external power supply, the 5V voltage after voltage stabilization is output.
- 3V3:3.3V power supply pin. The maximum output capacity is 50mA.
- GND: Ground Pin
- IOREF:I/O Reference voltage. Other devices can identify the development board I/O reference voltage through this pin.

5. Know about Arduino IDE and Its Installation

Arduino IDE is the software editing environment of Arduino products. In short, it is used to write code and download code. Any Arduino product needs to download code to work.

5.1 Download and Installation of Arduino IDE

Open the link of Arduino official website with browser ：https://www.arduino.cc/en/Main/Donate, we can see the interface as shown in Figure 1-7. In this interface, we can see different versions and running environments of IDE. You can download them according to your own computer system.

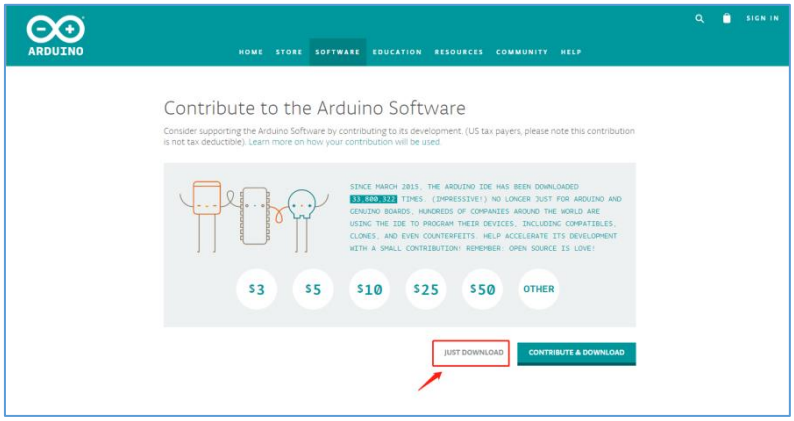


Figure 1-7 Arduino IDE Download Interface

After downloading, we will get the compressed package as shown in Figure 1-8. After decompressing the compressed package, we will get the file as shown in Figure 1-9, in which “drivers” is the driver software, which is installed in the “ arduino.exe” The driver will be installed automatically when the system is running. Becausethe installation of “ arduino.exe ” is very simple. It is not explained here. It is recommended to exit the antivirus software during the installation process, otherwise the IDE installation may be affected. After the installation, click again“ arduino.exe ”.You can enter the IDE programming interface.

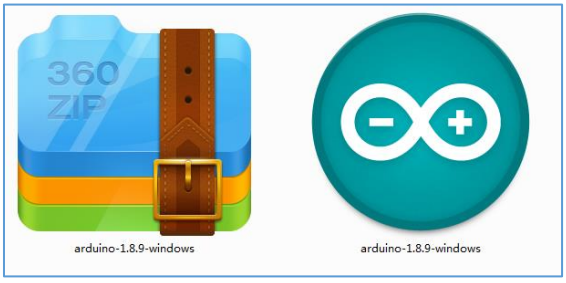


Figure 1-8 Arduino IDE Installation Package

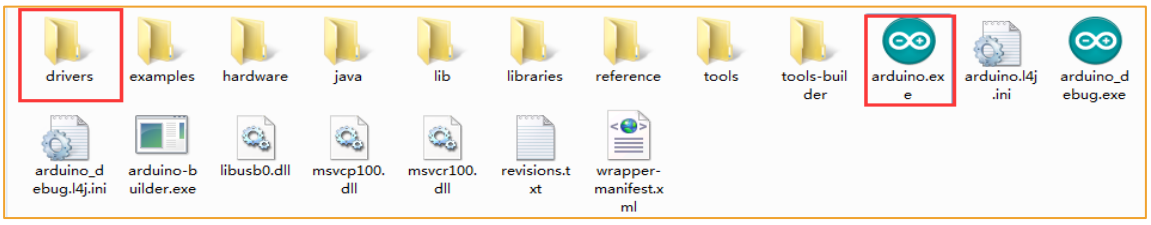


Figure 1-9 Decompressed file

After IDE installation, we connect the Arduino main board, right-click “my computer” →“properties” → “device manager” to view “ports (COM and LTP)”, as shown in Figure 1-10.

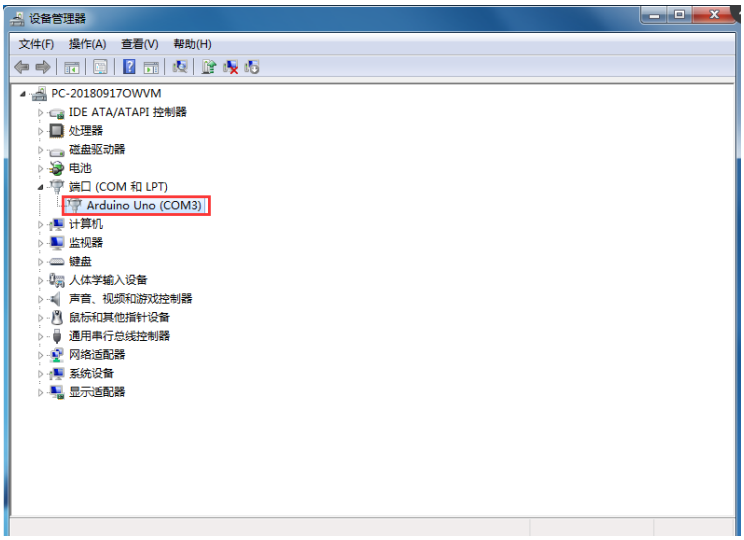


Figure 1-10 Interface of Driver Installation Success

Then the driver has been installed successfully. At this time, we open the IDE and select the corresponding development board model and port in the toolbar. If it appears as shown in Figure 1-11, it means that the computer does not recognize the development board and needs to install the driver itself.

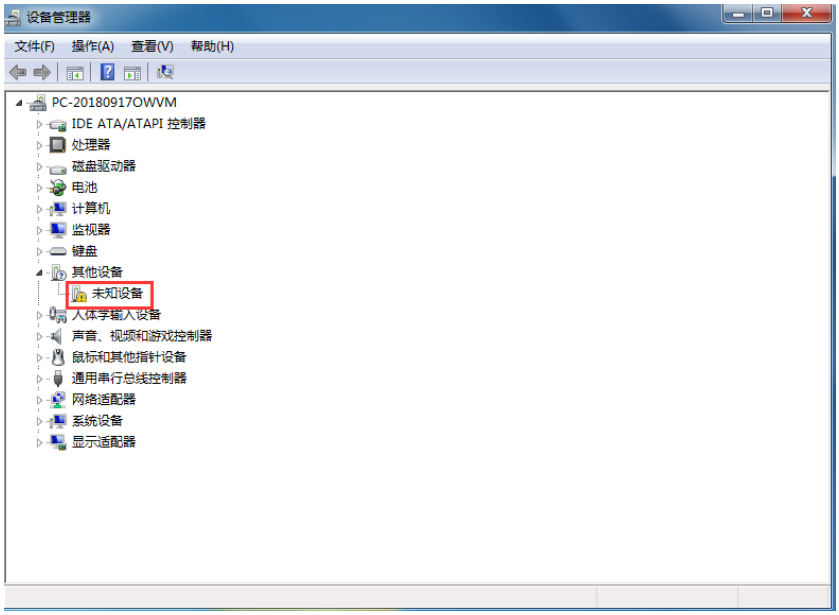


Figure 1-11 Driver failed to install interface

5.2 Driver Installation

5.2.1 Windows system driver installation steps:

1）Right click “my computer” to open device manager to view ports (COM and LPT). You will see a “USB serial port”. Right click “USB serial port” and select the “update driver software” option.

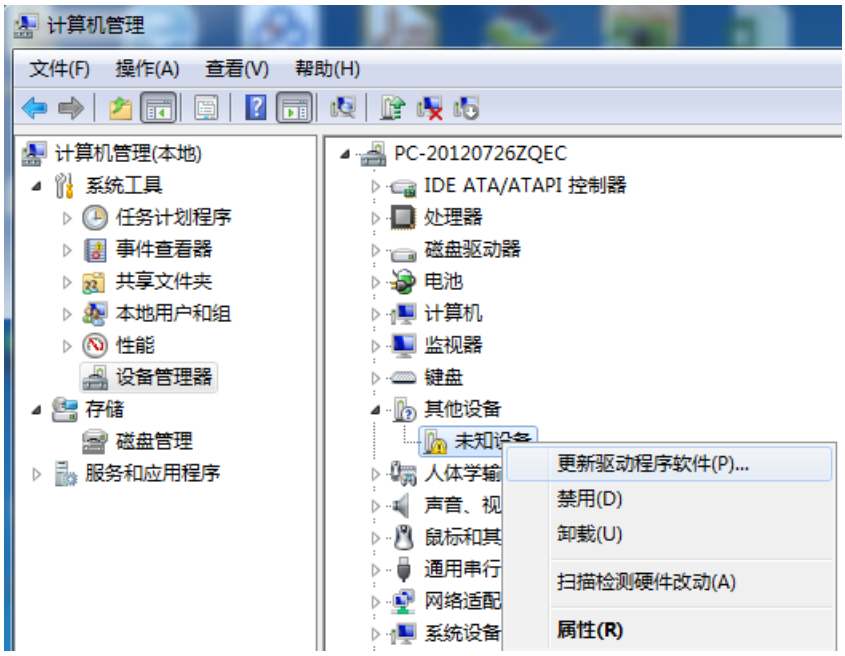


Figure 1-12 Update Driver Interface

2)Next, select the browse computer for driver software option.

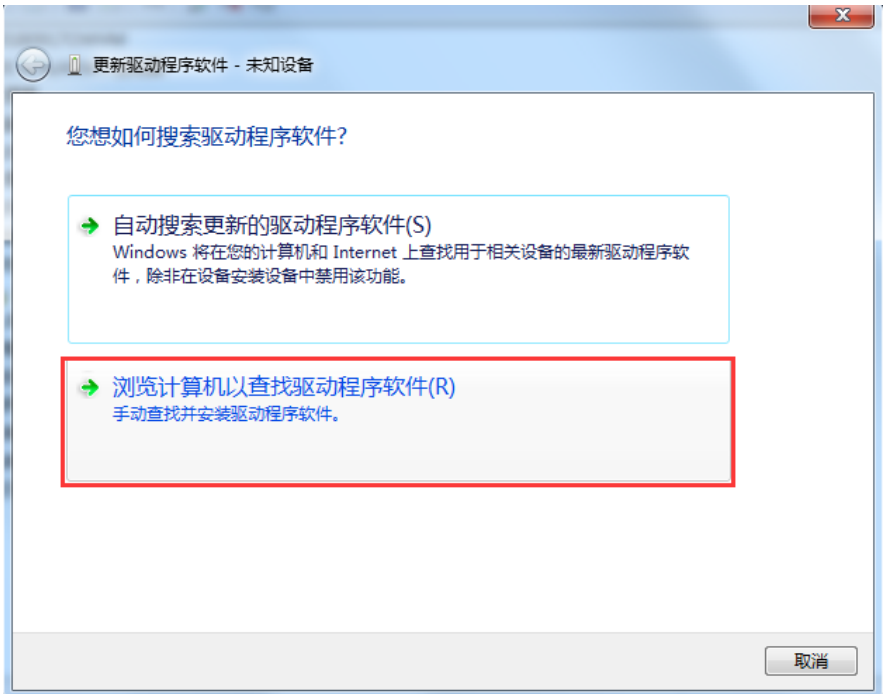


Figure 1-13 Driver update selection interface

3）Finally, select the driver file named “drivers” and locate it in the “drivers” folder of Arduino software download.

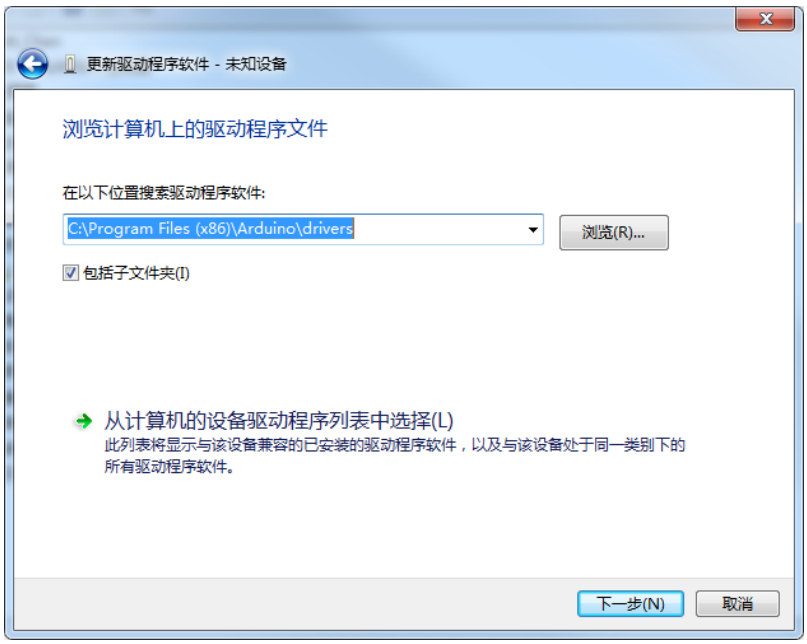


Figure 1-14 Drive Selection

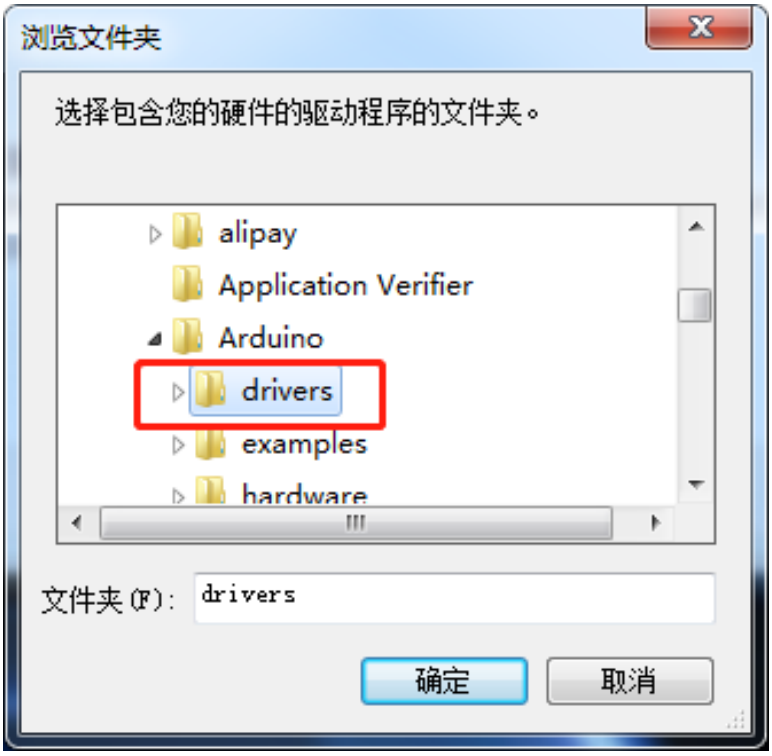


Figure 1-15 driver file selection interface

4)After successful installation, the interface shown in the figure below will appear to inform you that the driver is successful.

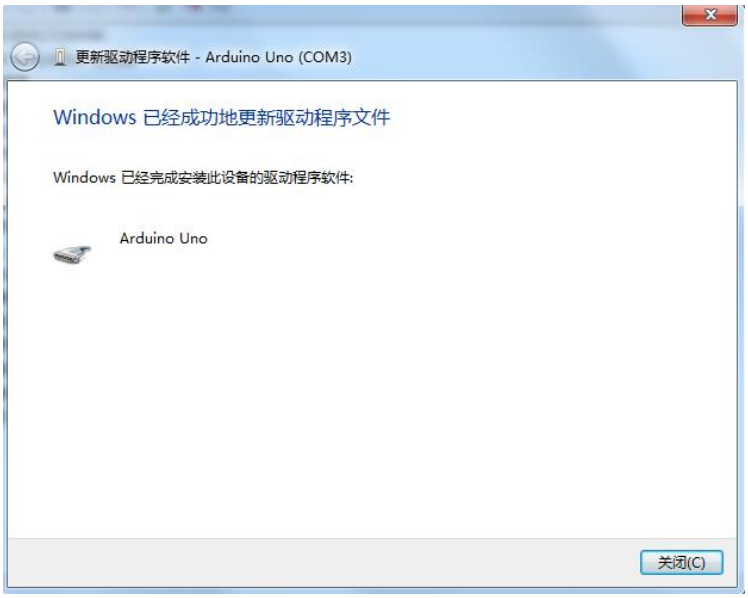


Figure 1-16 Driver Installation Success Interface

We return to the “device manager” interface, and you can see that Arduino has been successfully recognized by the computer, as shown in Figure 1-17 below. Next, open the Arduino compilation environment to start the Arduino journey.

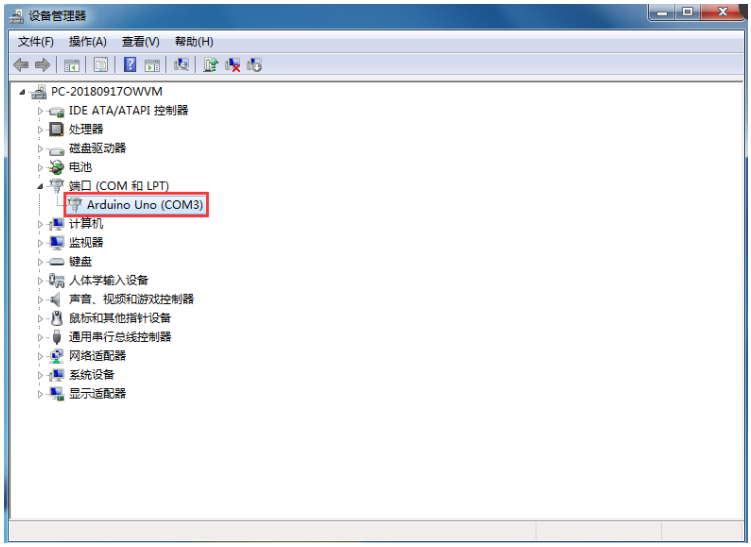


Figure 1-17 driver success recognition interface

Note: In win10 system, after some Arduino are connected to the computer (non genuine chips are difficult to identify), the system will automatically download the corresponding driver without installing the driver itself. However, in win7 system, the driver needs to be installed manually according to the above steps.

As shown in the figure above, we can see that the USB serial port is identified as COM15, but different computers may not be the same. You may have COM4, COM5,

etc., but Arduino Uno must be the same. If the USB serial port is not found, you may have installed it incorrectly or the system is not compatible.

5.3 Interface Introduction of Arduino IDE

After opening the IDE interface of Arduino, you can see the interface as shown in Figure 1-18. The functions of the toolbar buttons are “compile” – “upload” – “new program” – “open program” – “save program” – “serial port monitor”.

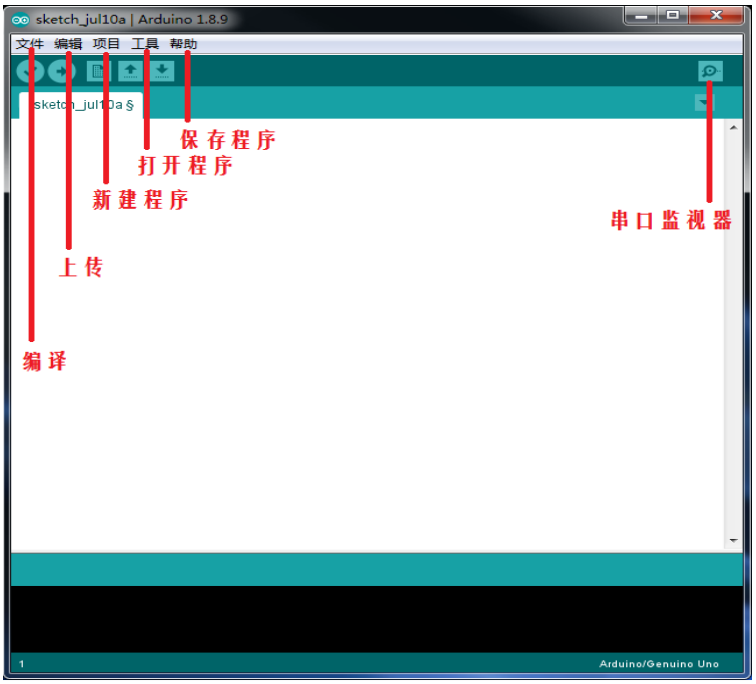


Figure 1-18 Interface introduction of Arduino IDE

There are five menus on the menu bar, but we mainly introduce files and tools. Click on the file to pop up the interface as shown in Figure 1-18. You can see examples and preferences. Examples are some programs that come with Arduino IDE. These programs are compiled correctly and can be used normally. They are very helpful for beginners. Among the preferences, it is mainly the setting of parameters, such as language, font, etc..

6. Learn about Mixly and Its Installation

Mixly is a graphic programming tool for Arduino creative electronics, developed by Fu Qian and his team, who is in charge of maker education laboratory, Ministry of education, Beijing Normal University. It is completely free of charge. It perfectly supports programming in Arduino, MicroPytho, Python and other languages. It also provides the support of contrast display between graphical interface and code interface. Mixly also supports custom third-party extension library, which can expand rich functions.

6.1 Mixly Installation

1)To Mixly website (as shown in Figure 1-19), download address: http://mixly.org/explore/software/mixly-arduino

Figure 1-19

2）Download the Windows version and double-click it Mixly.exe . You can open Mixly software, as shown in Figure 1-20.

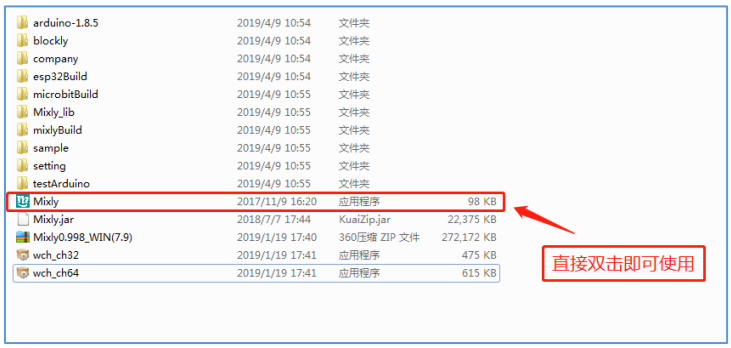


Figure 1-20

3）After the Windows version of misqi software is opened, the interface is shown in Figure 1-21.

Figure 1-21

6.2 Introduction to the Software Interface of Mixly

Figure 1-22

●**Function Area:** Create and save the project file, import, export and manage the library, connect the serial port and upload the program, and select the operation area for the control board.

●**Program Construction Area:** It is the place to place the building blocks dragged from the basic module area and library module area.

●**Code Area:** After dragging out the building block, click "code" to see the corresponding C language code of the module you drag.

●**Language Switching Area:** Chinese simplified, Chinese traditional, English and Spanish can be switched.

●**Zoom Control Area:** The software operation interface can be zoomed.

6.3 Mixly Import Library

When programming with Mixly, the original program building blocks of Mixly may not support our sensors, or there are no building blocks that meet the requirements of sensors. Therefore, we need to import our self-developed sensor library files so that readers can use them better.

Open Mixly software to enter its page, then click “import library” to enter the electronic data file of smart home, and find the information in sensor file sensor.xml Click open to import the library file.

Figure 1-23

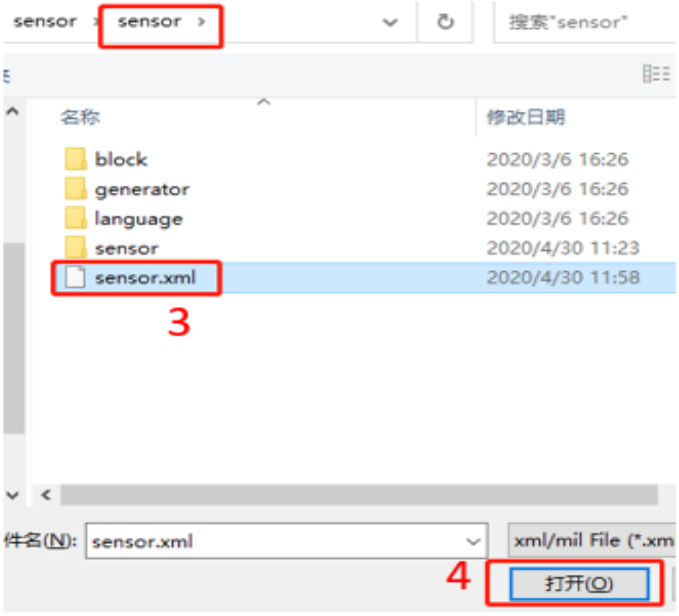


Figure 1-24

7. Know about MagicBlock (Scratch 3.0) and Its Installation

Magicblock is a graphic programming teaching software for steam education developed by Shenzhen Yichuang Space Technology Co., Ltd. based on Scratch3.0. It adds many common sensors and Arduino mainboard graphic programming blocks on the basis of Scratch3.0, and supports stage mode and upload mode. It can write programs for electronic hardware through the construction of graphic blocks to show creativity, which is a program that allows young people to learn programming, quick start programming software.

7.1 Install MagicBlock

1) Browser inputs www.emakefun.com/download and enter the software download page of the official website of Shenzhen Yichuang Space Technology Co., Ltd.. Select the corresponding system version of magic block according to your computer system, and click to download.

Figure 1-25

2）After downloading, double-click the icon to install.

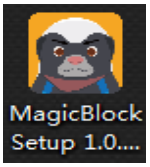


Figure 1-26

3）Click next.

Figure 1-27

4）Select the directory to install. The default is disk C. Continue to click next.

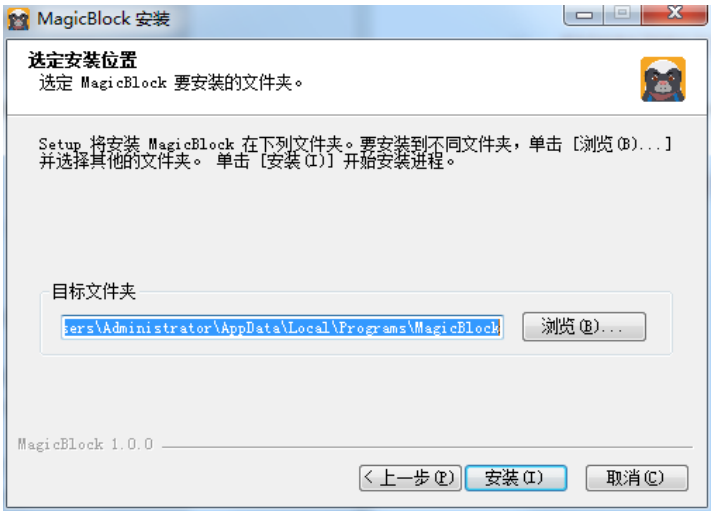


Figure 1-28

7.2 Install the Driver

Double click the software icon to open the software interface, click the settings button in the upper right corner of magic block software, select windows: CH340 driver, and click to install.

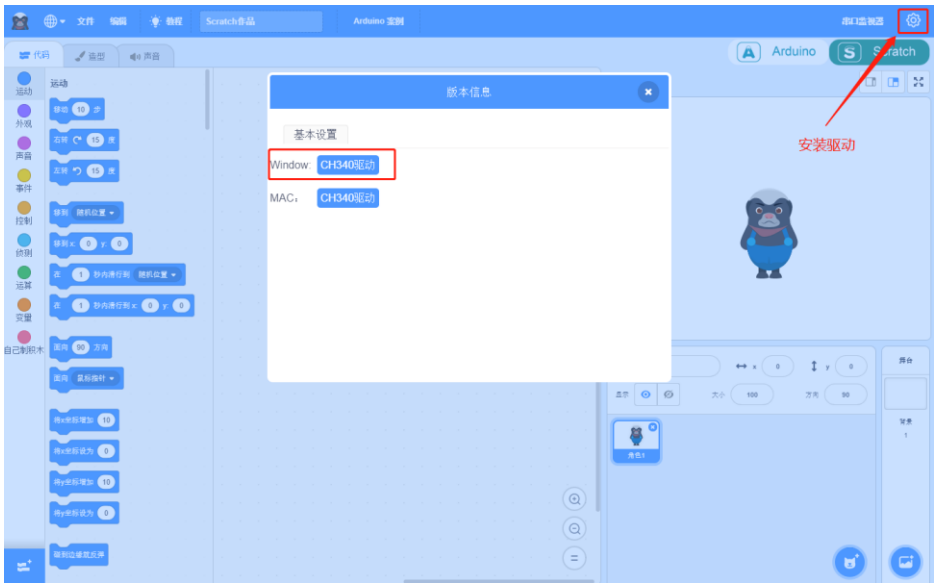


Figure 1-29

8.Write Welcome to smart home program

1) Connect Arduino Ble-Uno with computer through USB;

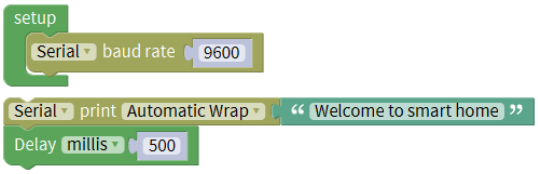
2) Open the programming software you want to use and input the following corresponding sample program, as shown in Figure 1-30.

3) After uploading the program, open the serial monitor, and you can see “welcome to smart home” printed on the screen, as shown in Figure 1-31.

Arduino IDE

```
void setup(){
  Serial.begin(9600);
}

void loop(){
  Serial.println("Welcome to smart home");
  delay(500);

}
```

Mixly Program



MagicBlock

Figure 1-30 Sample Program

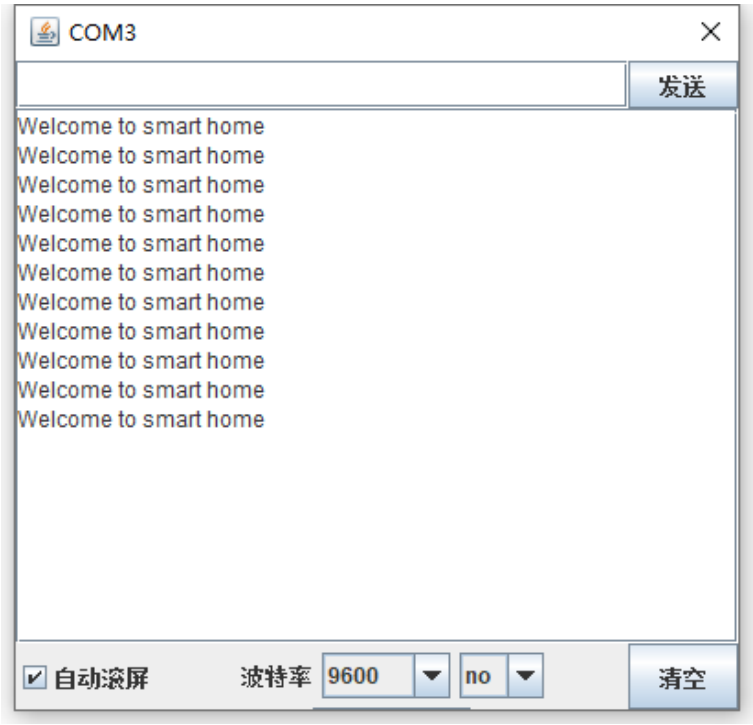


Figure 1-31 Serial port printing

Ⅱ Intelligent Human Body Iinduction Lamp

Task background

In ordinary home, the lighting is controlled by manual switch, and the installation of manual switch is generally a certain height from the ground. If there are old people and children at home, it will be very inconvenient to use. If the lighting becomes automatic induction control, will it be more intelligent and convenient? This is our task in this lesson - to make an intelligent human body induction lamp.

Equipment Preparation

Arduino Ble-Uno mainboard, expansion board, battery box and four No. 5 batteries, body sensor module, traffic light module, connecting cable, USB data cable.

1. Learn about intelligent human body induction lamp

Human body induction lamp is a new technology designed and developed by using infrared and pyroelectric principles to sense human activity information, which is specially used to detect and sense human activity information. When people or objects with temperature enter the sensing range of the module, the sensing module will output a high-level pulse signal or a high-level delay signal. The output induction pulse or delay signal can directly drive the LED indicator light and LED lamp.

The principle of the human body sensor lamp is that when the human body sensor module detects that someone is approaching, the lamp will turn on; otherwise, when the person leaves, the lamp will turn off automatically.

2. Learn about the human body sensor module and traffic light module

2.1 Human body sensor module

The human body sensor module used in this course is hc-sr505 small human body sensor module, which is an automatic control product based on infrared technology, with high sensitivity, strong reliability, ultra-small volume and ultra-low voltage working mode. It is widely used in all kinds of automatic induction electrical equipment, especially in dry battery powered automatic control products. The module has the following two functions:

Full Automatic Induction: When people enter the induction range, they will output high level; when people leave the induction range, they will automatically delay to turn off high level and output low level.

Repeatable Trigger Mode: After the induction output high level, in the delay time period, if a human body is active in its induction range, its output will remain high level until the human leaves.

Human body sensor	Ble-Uno
G	GND
V	VCC
S	D0-D13

Then it will delay to change the high level to low level (After the induction module detects each activity of human body, it will automatically postpone a delay period, and take the time of the last activity as the starting point of the delay time.)

HC-SR505 small body sensing module has three pins, G is GND grounded, V is VCC connected to high level or 5V, S is signal pin, which can be connected to D1-D13 digital interface.

2.2 Traffic Light Module

The traffic light module is composed of red, yellow and green LEDs. The module has five pins -, +, G, y, R, - GND for negative grounding, + VCC or 5V for positive grounding, G for green light, y for yellow light, and R for red light. These three pins can be connected to D1-D13 pins, but they cannot be connected to the same pin at the same time.

3.Installation of body induction lamp

The HC-SR505 small body sensing module is installed above the left door, and the traffic light module is installed on the right door; the main board is combined with the expansion board, and then installed on the bottom board. As shown in Figure 2-1 and figure 2-2.

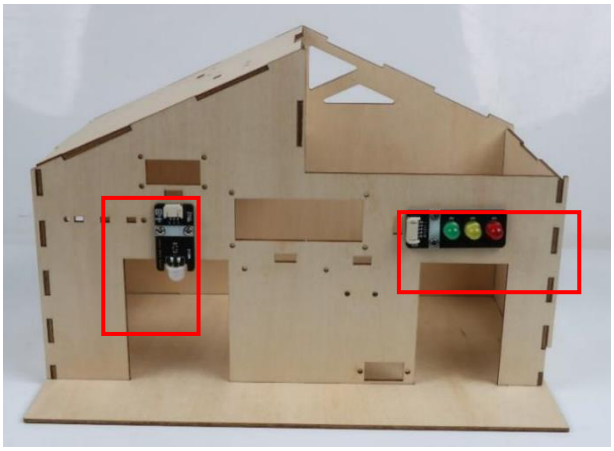


Figure 2-1

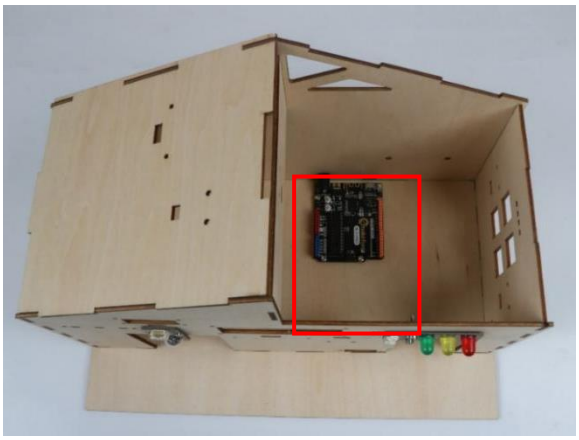
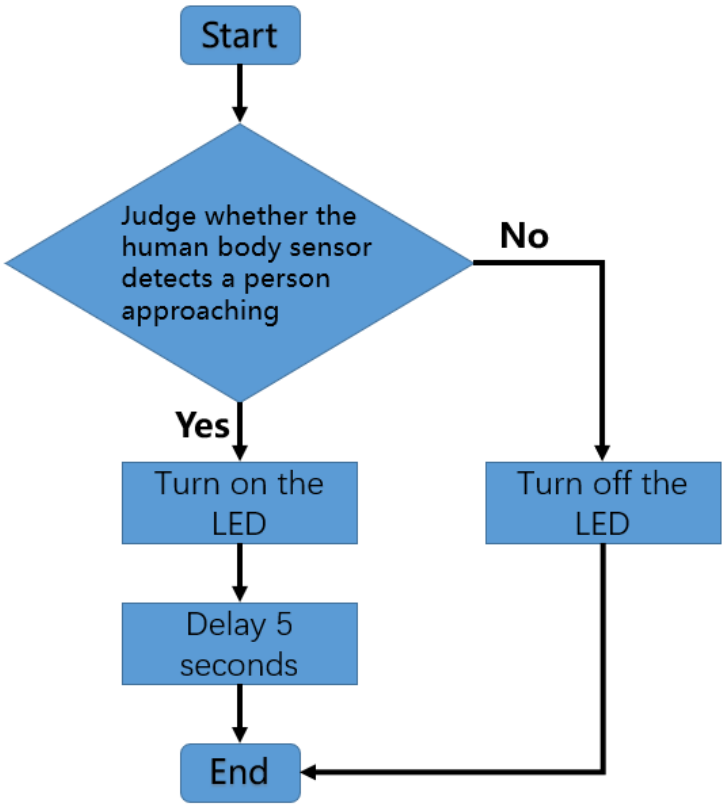


Figure 2-2

4.Programming

4.1 Algorithm Design

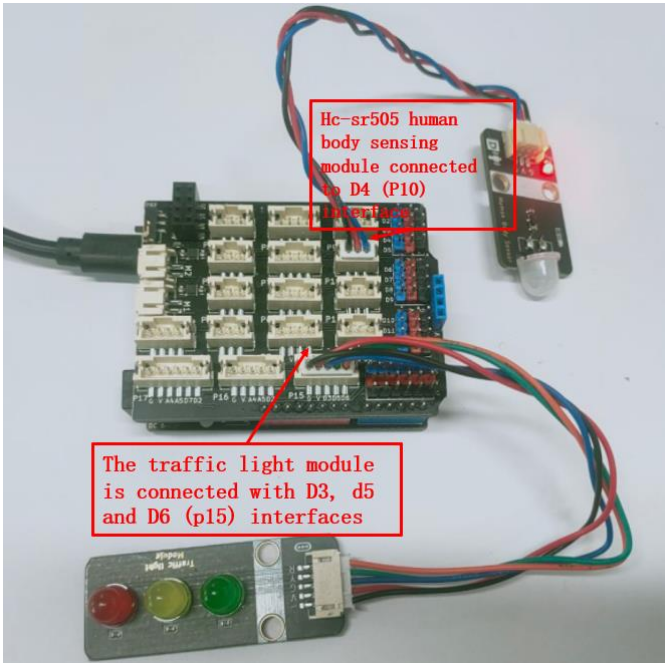
According to the principle of human body induction lamp, when the human body induction sensor senses approaching, the LED lamp will automatically turn on; after a period of time, the LED lamp will automatically turn off; if no one is approaching, the LED will turn off. The algorithm flow chart is as follows.



4.2 Hardware Connection

HC-SR505 body sensing module is connected to pin D4 (P10) of Arduino expansion board, and traffic light module is connected to pin D3, d5 and D6 (p15) of Arduino expansion board.

Sensors and Actuators	Main Control Board
HC-SR505 Body Sensor Module	D4（P10）
Traffic Light Module	D3、D5、D6（P15）

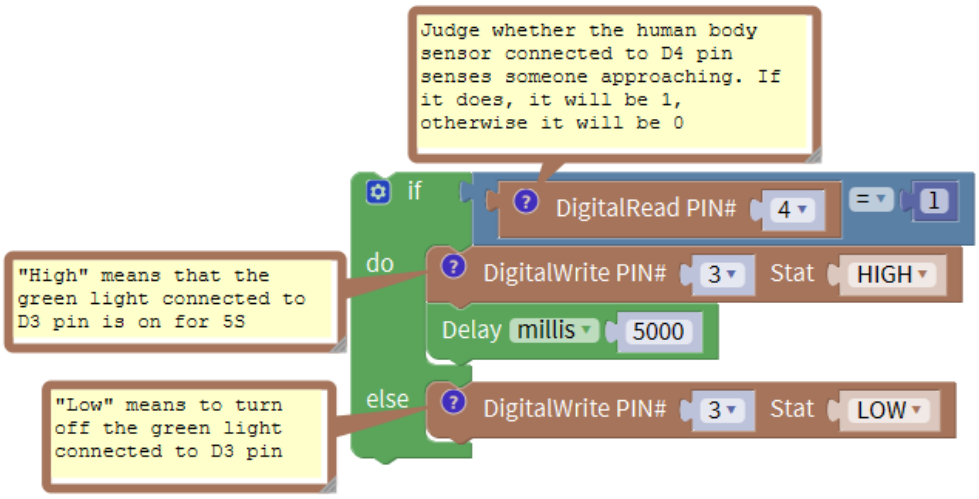


4.3 Program Example

Arduino IDE

```
void setup()
{
    pinMode(4, INPUT);    // Set port 4 as input mode
pinMode(3, OUTPUT);    // Set port 3 as output mode
}
void loop()
{
    if (digitalRead(4) == 1)     // Judge whether the human body is sensed
    {
        digitalWrite(3, HIGH);    // Turn on the light
    } else {
        digitalWrite(3, LOW); // Turn off the light
    }
}
```

Mixly Programming



MagicBlock Programming

Results: Connect the hardware and upload the program to the mainboard. When the human body sensor senses someone, the green light will be on; otherwise, the green light will be off.

5.Conclusion

In this lesson, we learned the principle of intelligent human body induction lamp, understood the characteristics and use of human body induction sensor and traffic light module, and programmed to realize the function of people coming on and people going off.

Ⅲ Music Doorbell

Task Background:

Doorbell is the bell on the door. Its function is to make a sound to remind the host of visitors. Now the more common doorbells in the home are ordinary wireless doorbells, wireless doorbells without batteries and wired doorbells, and their ringtones are also very common. In this lesson, we will make a kind of music doorbell, which is realized by using touch sensor and passive buzzer. It can let guests enjoy the beauty of music while waiting.

Equipment Preparation:

Arduino main board, expansion board, battery box and 4 No. 5 batteries, passive buzzer, touch sensor module, connecting cable, USB data cable.

1.Learn about Touch Sensors and Passive Buzzers

1.1 Touch Sensor

Touch module is a capacitive inching touch module based on touch detection IC (ttp223b). It is similar to the following diagram. When the metal contact of the module is touched, it is equivalent to pressing the key. We can install the module on the surface of non-metallic materials such as plastic and glass. In addition, we can cover the surface of the module with a thin piece of paper (non-metal). As long as the touch position is correct, we can make the buttons hidden in the wall, desktop and other places. When touched, our module outputs high level, otherwise it outputs low level.

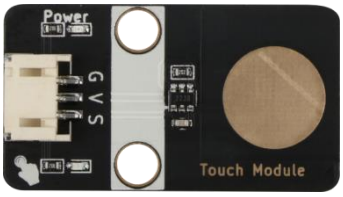
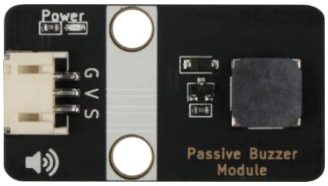


Figure 3-1 physical picture

Figure 3-2 schematic diagram

1.2 Passive Sensor Module



Passive buzzer is a buzzer without an internal oscillator. When it is powered on, the internal oscillator will not emit a buzzing sound. It needs a square wave drive of 2 ~ 5 kHz, and then different frequency waveforms will drive the buzzer to emit the corresponding frequency sound. Some of our common greeting cards will bring a music box. After they are opened, they will play happy birthday and Christmas songs. These tunes are realized through a passive buzzer.

The passive buzzer module used in this course has three pins: G, V and S. G stands for GND grounding, V stands for VCC, which can be connected to 5.5V and 3.3V of main board, S is signal interface, which can be connected to 0-13 digital pin of main board.

Buzzer	Ble-Uno
G	GND
V	VCC
S	D0-D13

2.Doorbell Installation

Use M3 screw to install the touch sensor on the left side of the right door and the passive buzzer on the left side of the right window, as shown in Figure 3-3.

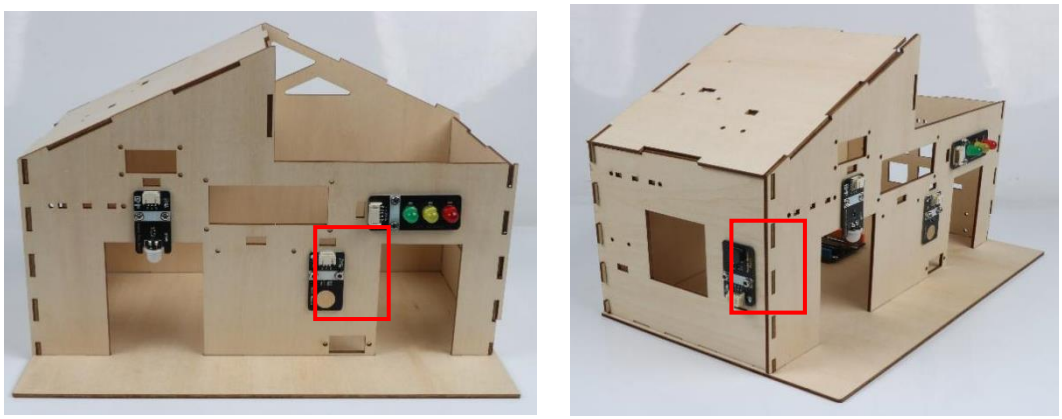
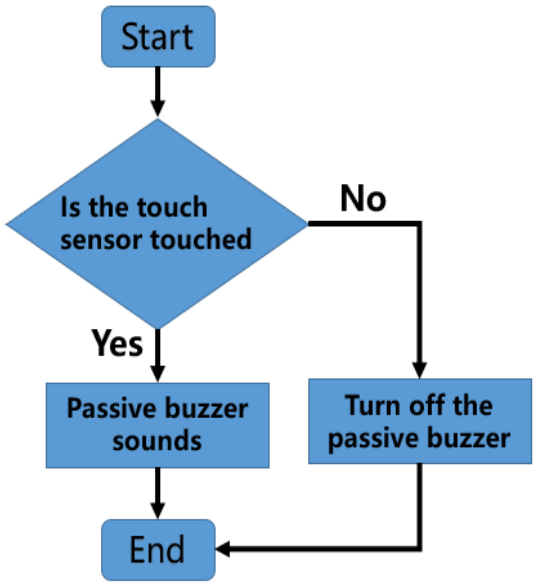


Figure 3-3

3. Programming

3.1 Algorithm Design

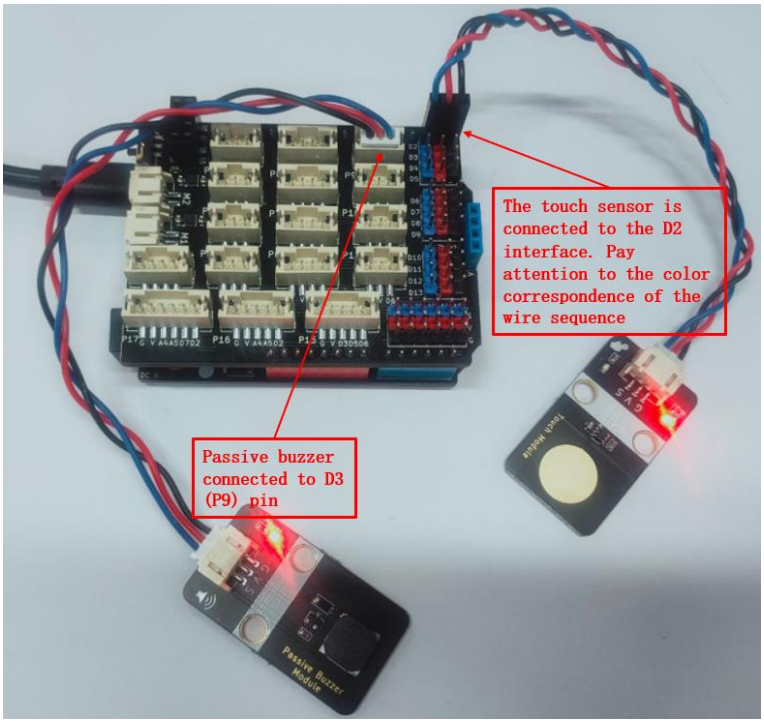
The principle of music doorbell is that when the touch sensor is touched, the passive buzzer will sound; when the touch sensor is not touched, the passive buzzer will not sound. According to the principle, the program flow is as follows:



3.2 Hardware Connection:

The touch sensor is connected to pin D2 of the expansion board with 3pin-PH2.0 wire. Pay attention to the color correspondence of the wire sequence. The passive buzzer is connected to pin D3 (P9) of the Arduino expansion board.

Sensors and actuators	Main control board
Touch Sensor	D2
Passive Buzzer	D3（P9）



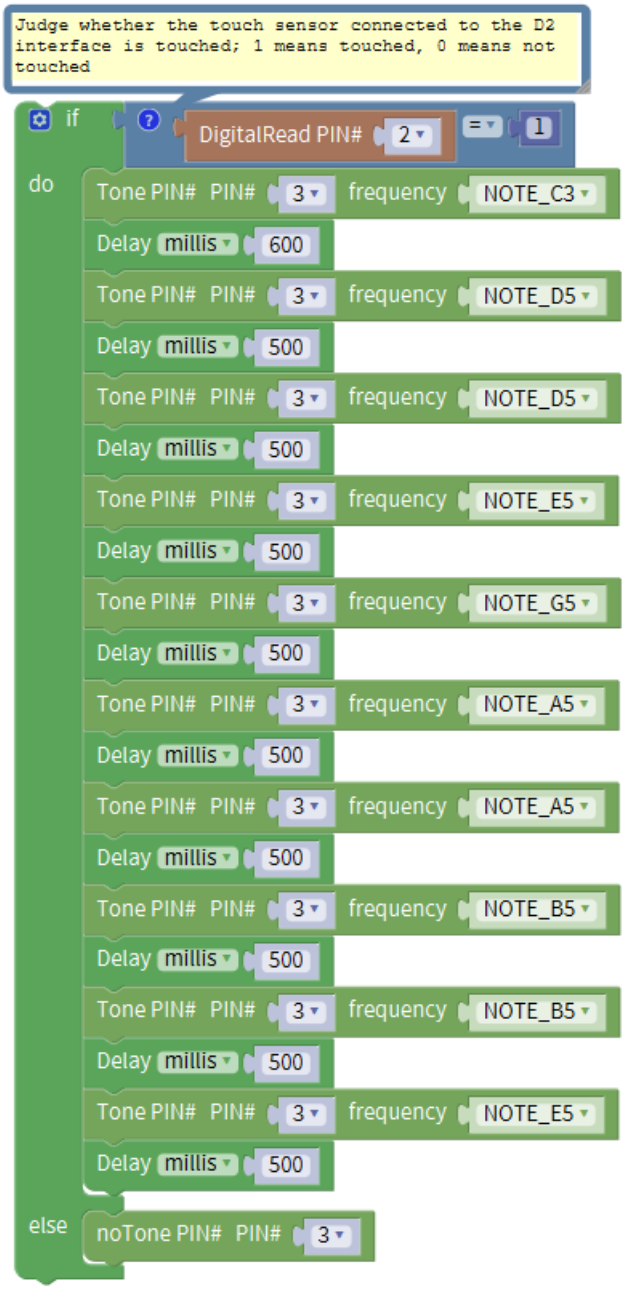
3.3 Program Example:

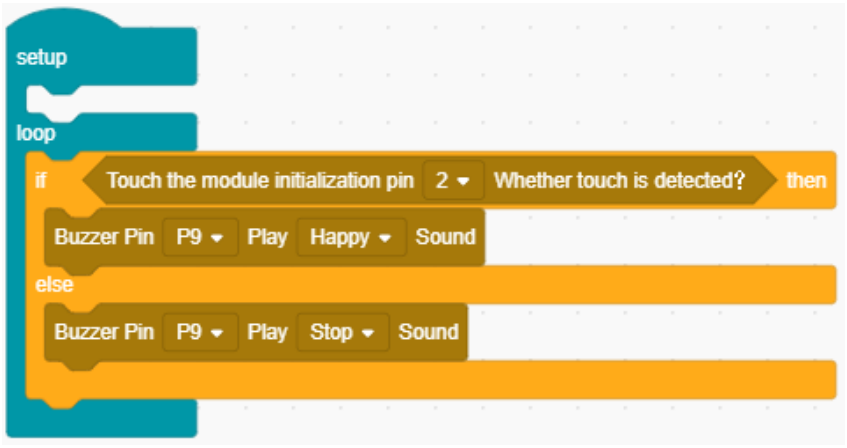
Arduino IDE

```
#include “Buzzer.h”
#include “Sounds.h”
#include "PH20Port.h"
PH20Port buzzerplay(P9);
#include “Buzzer.h”
int touch_PIN2    = 2;
Buzzer mBuzzer = Buzzer(buzzerplay.pin1());
Buzzer buzzer(buzzerplay.pin1());

void setup() {
pinMode(touch_PIN2,INPUT);
```

```
}

void loop()    {
    if (digitalRead(touch_PIN2)==HIGH) {
      mBuzzer.bendTones(1500, 2500, 1.05, 20, 8);
      mBuzzer.bendTones(2499, 1500, 1.05, 25, 8);
   } else {
      buzzer.noTone();
   }
}
```

Mixly Program



MagicBlock Program

Results: Connect the hardware and upload the program to the main board. When the touch sensor is touched, the buzzer will sound music. Because the green light of the traffic light is also connected to the D3 interface last class, the green light will also be on; otherwise, the buzzer will not sound.

4. Conclusion

In this lesson, we learned the characteristics and principles of passive buzzer and touch sensor module, and mastered the programming control of passive buzzer and touch sensor by making music doorbell, so as to deepen the application of passive buzzer and touch sensor.

Ⅳ Intelligent Temperature Control Fan

Task Background:

With the trend of global warming becoming more and more serious, fans and air conditioners become necessary facilities for people's life. But the air conditioning energy consumption is large, and the incidence rate of air conditioning diseases is increasing year by year. So many people will choose fans as the low energy consumption cooling appliances. At present, the fan used in people's daily life is to adjust the speed and wind through the button or knob, but is it possible to adjust the wind according to the indoor environment temperature and humidity information? If the fan can change the size of the wind according to the indoor temperature, it will undoubtedly be more beneficial to human health and save energy. In this lesson, we will make an intelligent temperature control fan to see how it can achieve the function of temperature control.

Equipment Preparation:

Arduino ble uno mainboard, expansion board, battery box, DC motor fan module, temperature and humidity sensor, connecting cable, USB data cable.

1. Learn about Temperature and Humidity Sensor and DC Motor Fan Module

1.1 Temperature and Humidity Sensor Module

Temperature and humidity sensor module is a kind of temperature and humidity composite sensor with calibrated digital signal output. It applies special digital module acquisition technology and temperature and humidity sensing technology to ensure high reliability and excellent long-term stability of the product.

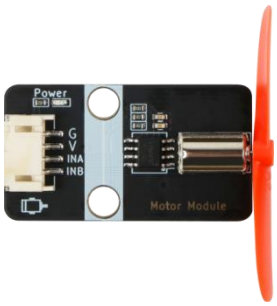
The temperature and humidity sensor module detects the temperature and humidity of the surrounding environment through DHT11. DHT11 includes a resistive humidity sensing element and an NTC temperature measuring element, and is connected with a high-performance 8-bit MCU. It only needs one wire to complete data transmission with Arduino.

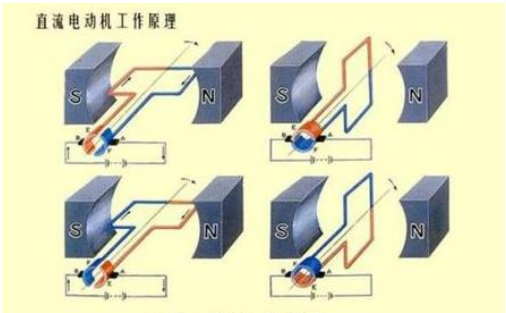
The temperature and humidity sensor module has three pins, G is GND grounded, V is VCC connected to high level or 5V, S is signal line, which can be connected to analog port A0-A5.

Temperature and humidity sensor	Ble-Uno
G	GND
V	VCC
S	A0-A5

1.2 DC Motor Fan Module

DC motor is a kind of motor that converts DC electric energy into mechanical energy. Because of its good speed regulation performance, it is widely used in electric drive. According to the excitation mode, DC motor can be divided into permanent magnet, separate excitation and self excitation, and self excitation can be divided into parallel excitation, series excitation and compound excitation. When the DC power supply is supplied to the armature winding through the brush, the conductor under the N pole of the armature surface can flow through the current in the same direction, and according to the left-hand rule, the conductor will be subject to the torque in the counterclockwise direction; the conductor under the S pole of the armature surface also flows through the current in the same direction, and also according to the left-hand rule, the conductor will be subject to the torque in the counterclockwise direction. In this way, the whole armature winding, that is, the rotor, will rotate counterclockwise, and the input DC electric energy will be converted into the output mechanical energy on the rotor shaft. It is composed of stator and rotor, stator: base, main magnetic pole, commutation pole, brush device, etc.; rotor (armature): armature core, armature winding, commutator, shaft and fan, etc..





The motor fan module has four pin interfaces, G means GND grounded, V means VCC connected to high level, INA and INB are input pins, which can be connected to the digital port of Arduino control board. If the Arduino development board outputs different voltage signals at the pins of INA and INB, the forward and reverse rotation of the motor can be realized; The current can be controlled to control the force on the conductor in the magnetic field. The greater the current is, the greater the force is, and the faster the speed is.

INA	INB	Motor status
0	0	release
1	0	Forward rotation
0	1	reversal
1	1	Stop (brake)

2.Installation of Temperature Control fan

First, remove the roof board, install the motor fan module on the beam with M3 * 8 screws, and install the temperature and humidity sensor on the right side of the right window, as shown in Figure 4-1.

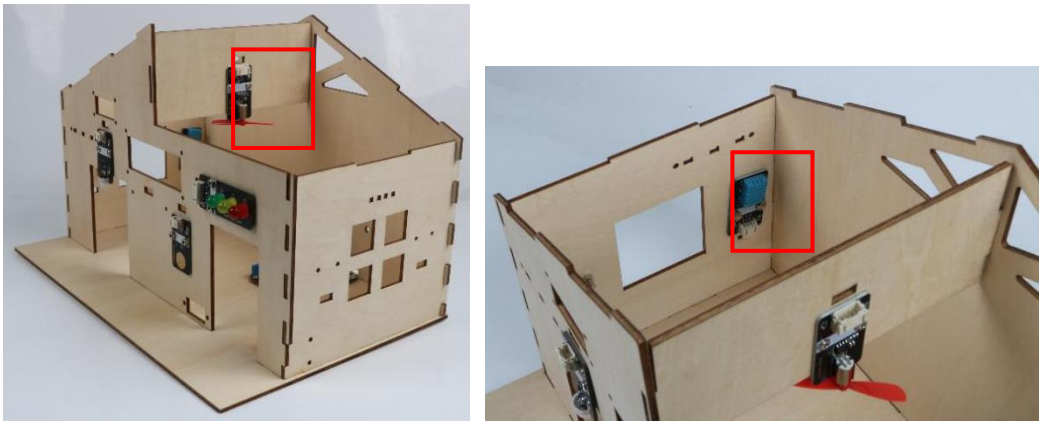
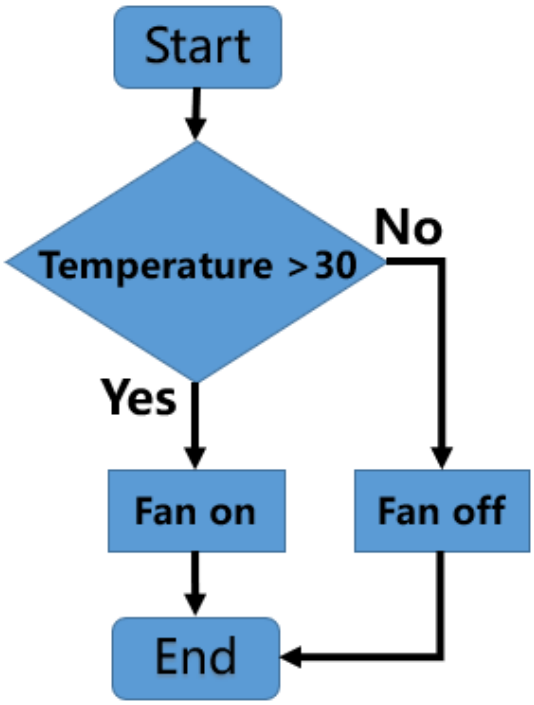


Figure 4-1

3. Programming

3.1 Algorithm Design:

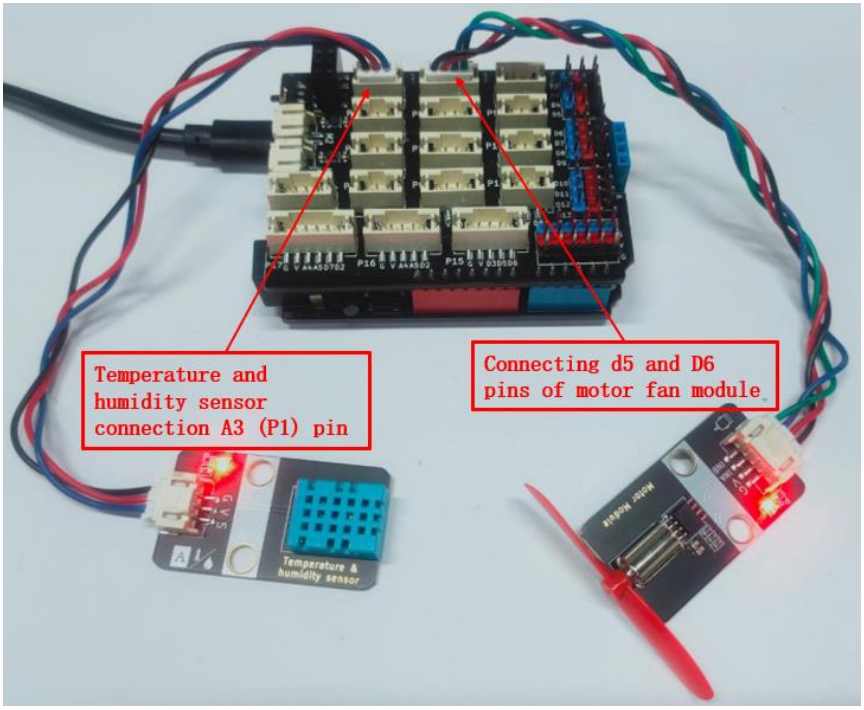
The principle of temperature control fan is to use the temperature and humidity sensor to detect the change of heat around the fan, to change the speed of the fan itself, and to change the flow of air (exhaust volume). The principle of the program is that when the temperature is higher than the threshold, the fan starts; when the temperature is lower than the threshold, the fan turns off. The program flow is shown in the figure.



3.2 Hardware Connection:

The temperature and humidity sensor is connected to the A3 (P1) pin of the expansion board, and the DC motor fan module is connected to the D5 and D6 (P8) pins of the expansion board.

Sensors and Actuators	Main Control Board
Temperature and Humidity Sensor	A3（P1）
DC Motor Fan Module	D5、D6（P8）



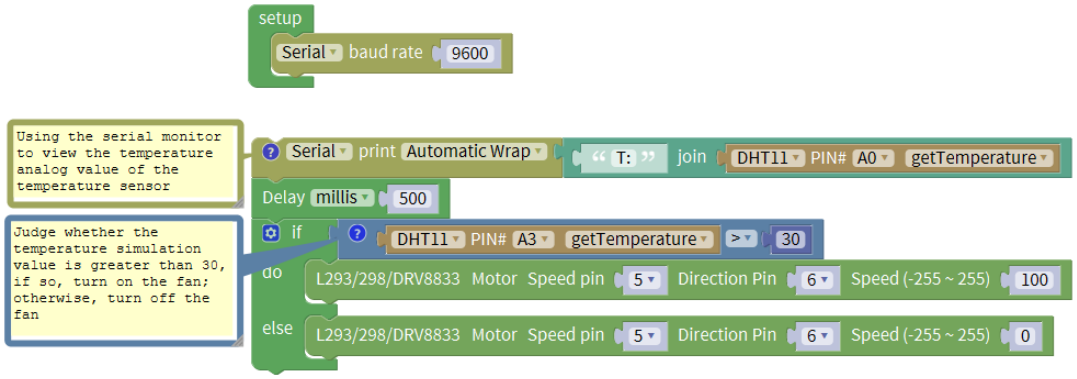
3.3 Program Example:

Arduino IDE

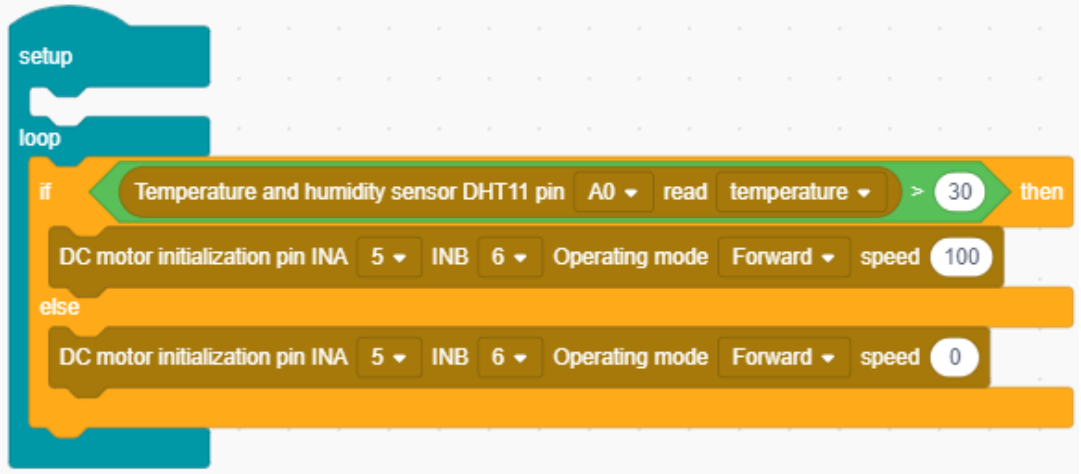
```
#include <DHT.h>
DHT dhtA0(A0, 11);
DHT dhtA3(A3, 11);

void setMotor8833(int speedpin,int dirpin, int speed)
{
  if (speed == 0)
  {
    digitalWrite(dirpin, LOW);
    analogWrite(speedpin, 0);
  }
  else if (speed > 0)
  {
```

```
        digitalWrite(dirpin, LOW);
        analogWrite(speedpin, speed);
    }
    else
    {
        digitalWrite(dirpin, HIGH);
        analogWrite(speedpin, 255 + speed);
    }
}

void setup(){
    Serial.begin(9600);
     dhtA0.begin();
     dhtA3.begin();
    pinMode(5, OUTPUT);
    pinMode(6, OUTPUT);
    digitalWrite(5, LOW);
    digitalWrite(6, LOW);
}

void loop(){
    // Using the serial monitor to view the temperature analog value of the temperature sensor
    Serial.println(String("T:") + String(dhtA0.readTemperature()));
    delay(500);
    /*Judge whether the temperature simulation value is greater than 30, if so, turn on the fan; otherwise, turn off the fan*/
    if (dhtA3.readTemperature() > 30) {
        setMotor8833(5, 6, 100);
    } else {
        setMotor8833(5, 6, 0);
    }
}
```

Mixly Program



MagicBlock Program



Results: Connect the hardware and upload the program to the main board. When the temperature simulation value is higher than 30, the fan will turn on automatically. Because the yellow light of the traffic light is also connected to the D5 pin, the yellow light will also turn on at the same time; otherwise, the fan will not turn.

4.Conclusion

In this lesson, we learned the principle of temperature control fan, understood the principle and use of temperature and humidity sensor and DC motor, mastered the programming control of temperature and humidity sensor and DC motor by making temperature control fan, and realized the function of using temperature to control the fan to start and close automatically.

Ⅴ Automatic Garage Door

Task Background

Smart home means that household equipment should be intelligent and automatic, so how can travel not be convenient? In this lesson, we are going to make a garage door that can automatically sense, so that you can start the car to go out, and the car can enter the garage directly at the door. You don't have to spend time to open and close the garage door.

Equipment Preparation

Arduino Ble-Uno main board, expansion board, battery box, S90 steering gear, infrared obstacle avoidance sensor, connecting cable and data cable.

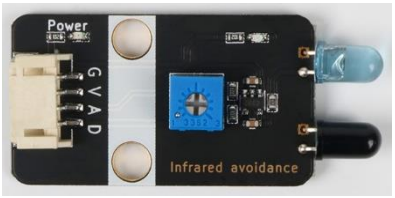
1. Learn about automatic garage doors

Automatic garage door control methods mainly include wireless remote control, induction, manual switch control, etc. Automatic garage door is now mainly classified as: rolling shutter garage door and flap garage door.

The garage automatic door in this lesson is realized by using the steering gear and infrared obstacle avoidance sensor. Its principle is that when the infrared obstacle avoidance sensor car approaches, the steering gear lifts the fence.

2. Learn about infrared obstacle avoidance sensor and steering gear

2.1 Infrared obstacle avoidance sensor



The infrared obstacle avoidance sensor module has a pair of infrared transmitting tubes and receiving tubes, and the transmitting tubes emit a certain frequency of infrared. Infrared is an electromagnetic wave whose wavelength is between microwave and visible light. Its wavelength is between 760 nm and 1 mm, which is longer than red light. When the detection direction meets an object or an obstacle (reflecting surface), the infrared reflection is received by the receiving tube. After being processed by the comparator circuit, the green indicator light will be on. At the same time, the signal output interface outputs a digital signal (a low-level signal). The detection distance can be adjusted by the potentiometer knob. The effective distance range is 2 ~ 30cm, and the working voltage is 3.3v-5v.

Infrared obstacle avoidance sensor uses infrared, so it has strong anti-interference ability, small interference, and high measurement accuracy when the distance is moderate. In addition, the module is easy to assemble and use, and can be widely used

in robot obstacle avoidance, obstacle avoidance car, assembly line counting, black and white line tracking and many other occasions.

Infrared obstacle avoidance sensor	Ble-Uno
G	GND
V	VCC
A	A0-A5
D	D0-D13

The infrared obstacle avoidance sensor has four pins, G for GND grounding, V for high level, 5V or 3.3V, A for analog input pin, D for digital input pin. But when programming, only one A and D interface can be used, and the other one can be ignored.

2.1 SG90 Steering Gear

Steering gear is a kind of position (angle) servo driver, which can rotate to any angle between 0 and 180 degrees, and then stop accurately according to your command. It is suitable for those control systems that need to change and maintain the angle. At present, it is widely used in high-end remote control toys, such as aircraft model, submarine model and remote control robot. Steering gear is an unprofessional name. In fact, it is a kind of servo motor, a set of automatic control device, which is composed of DC motor, reduction gear set, sensor and control circuit. What is automatic control? The so-called automatic control continuously adjusts the output deviation by using the closed-loop feedback control circuit to make the system output constant.

servo motor	Ble-Uno
G	GND
V	VCC
S	PWM pin (D3,D5,D6,D9, D10,D11

This lesson uses the S90 steering gear, which has three pins. G means GND is grounded, V means VCC is connected to high level, S means signal pin. Its rotation angle is realized by adjusting the duty cycle of PWM (pulse width modulation) signal. Therefore, the S-end pin needs to be controlled by the PWM pin of BLE-UNO main control board (before the digital with a sign "～", such as pin 3, 5, 6, 9, 10, 11).

The control of the actuator usually needs a time base pulse of about 20 ms, and the high-level part of the pulse is generally the angle control pulse in the range of 0.5 ms ~ 2.5 Ms. Taking 180 degree angle servo as an example, the corresponding control relationship is as follows:

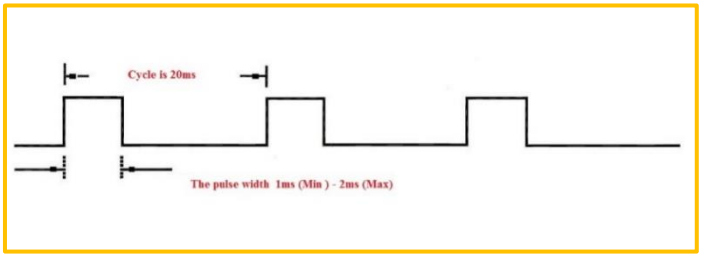
0.5ms-0 degree;

0 ms-45 degrees;

1.5ms-90 degrees;

2.0ms-135 degrees;

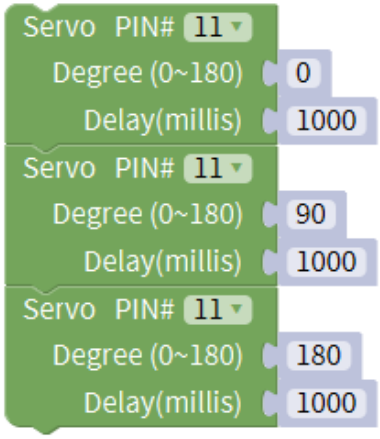
2.5ms-180 degrees;



3. Automatic garage door installation

Before installing the automatic door, first of all, the steering gear should be adjusted to zero, and the rotation angle of the steering gear should be clear. So it can be installed on the house model, to avoid the failure in the later operation. Connect the steering gear to D3 pin, then open the software and input the following code to see the swing direction of the steering gear.

Mixly Program

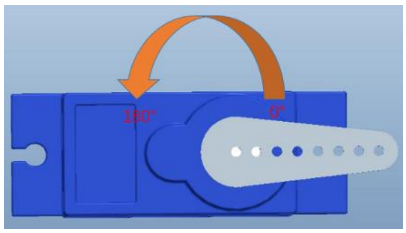


MagicBlock Program

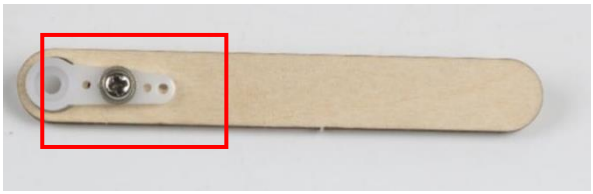
Arduino Program

```
#include <Servo.h>
Servo servo_11;

void setup(){
  servo_11.attach(11);
}

void loop(){
  servo_11.write(0);
  delay(1000);
  servo_11.write(90);
  delay(1000);
  servo_11.write(180);
  delay(1000);
}
```

After uploading the program to the Ble-Uno main board, swing the steering arm of the steering gear from 0° to 180° as shown in the right figure. When the steering gear swings to 0° turn off the power, determine the swing direction of the steering gear, and then install it on the house model according to the following steps:



1. Connect and fix the rudder arm and fence bar with self tapping screw, as shown in Figure 5-1.



2. After zeroing the steering gear, fix it under the right side door of the house with M2 screw, as shown in Figure 5-2.

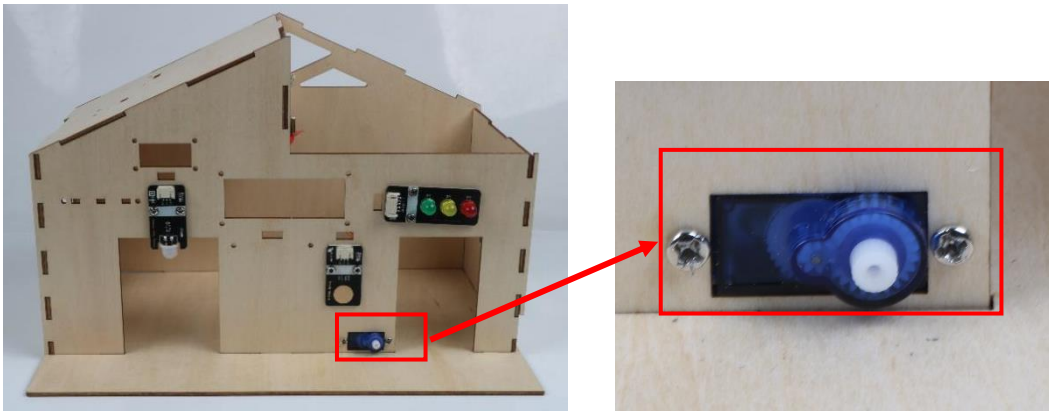


Figure 5-2

3. Fix the fence bar on the steering gear, as shown in Figure 5-3

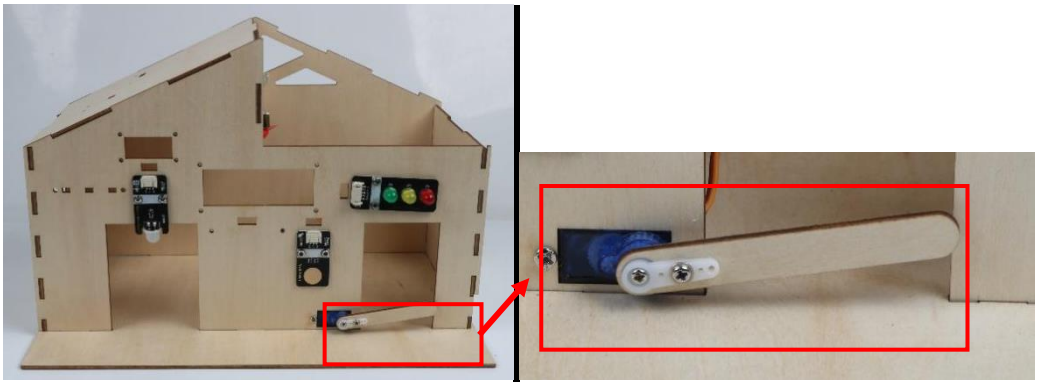


Figure 5-3

4. The infrared obstacle avoidance sensor is installed on the right side, as shown in Figure 5-4.

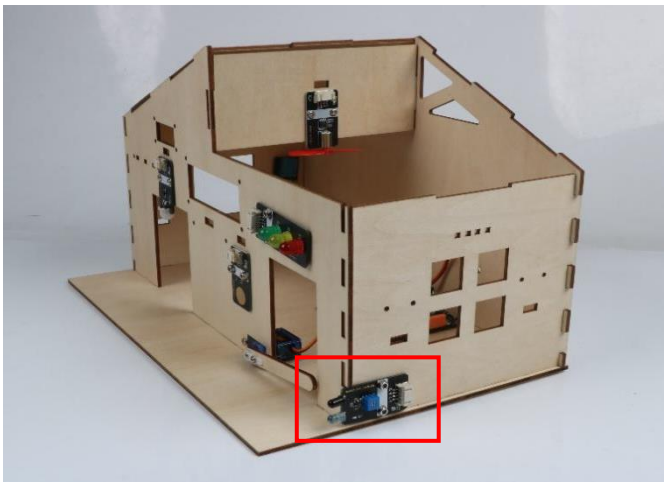


Figure 5-4

4.Programming

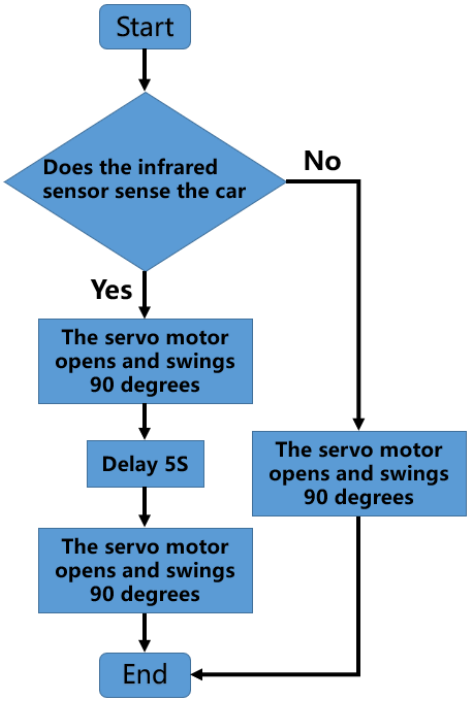
4.1 Algorithm Design

According to the principle of automatic garage door, the algorithm design of automatic garage door is as follows:

Step 1: Set the pin of the steering gear to D3 and the pin of the infrared obstacle avoidance sensor to D4;

Step 2: Judge whether the infrared obstacle avoidance sensor detects the vehicle. When the infrared obstacle avoidance sensor detects the vehicle, the return value is 0, then the steering gear swings 90 degrees; otherwise, the return value is 1, then the steering gear swings 0 degrees;

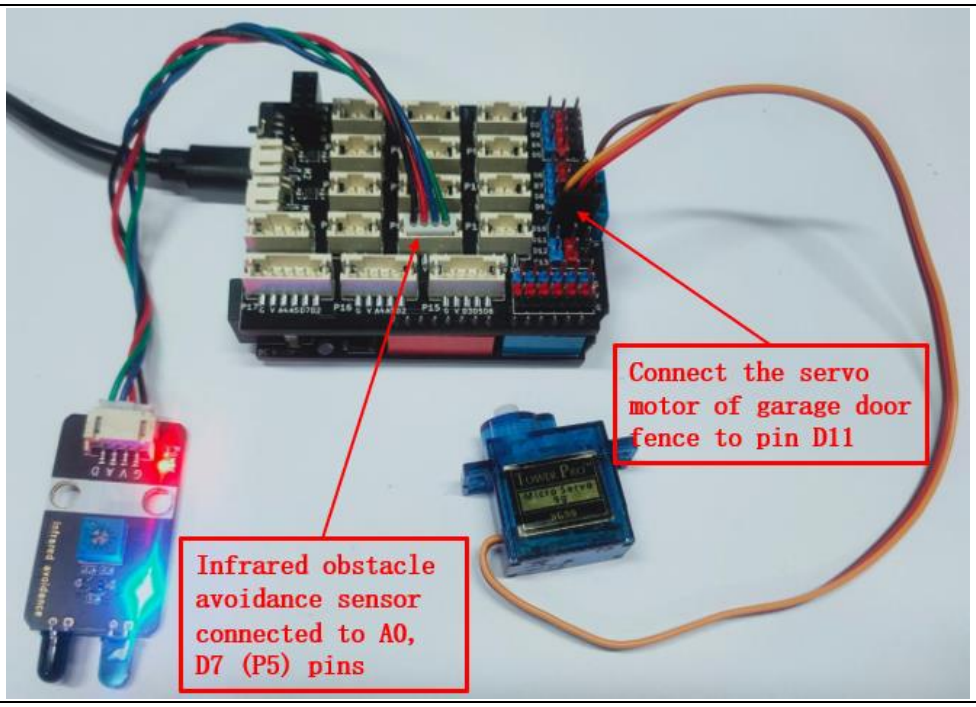
Step 3: When the steering gear swings 90° to open the fence, after a period of time, the automatic swing will be 0° to end the program.



4.2 Hardware Connection:

The steering gear controlling the garage door fence is connected to pin D11 of the expansion board, and the infrared obstacle avoidance sensor is connected to pin A0 and D7 (P5) of the expansion board, and uses pin D7 to read data.

Sensors and Actuators	**Main Control Board**
Infrared Obstacle Avoidance Sensor	A0, D7 (P5), use D7 to read data
Steering Engine	D11

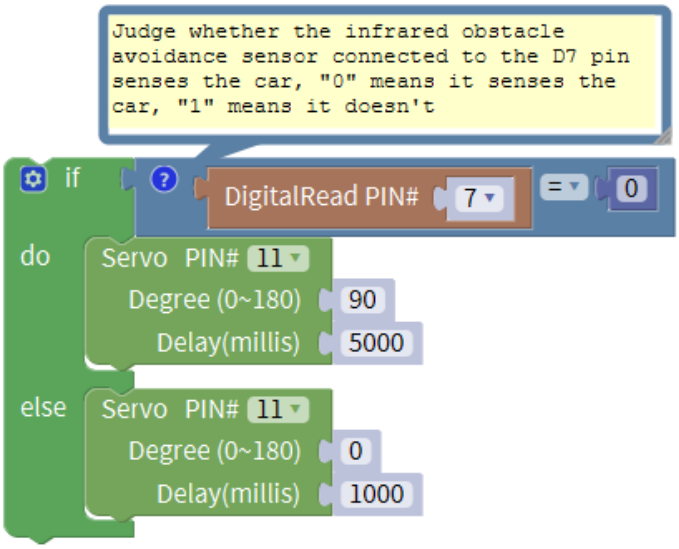


4.3 Program Example:

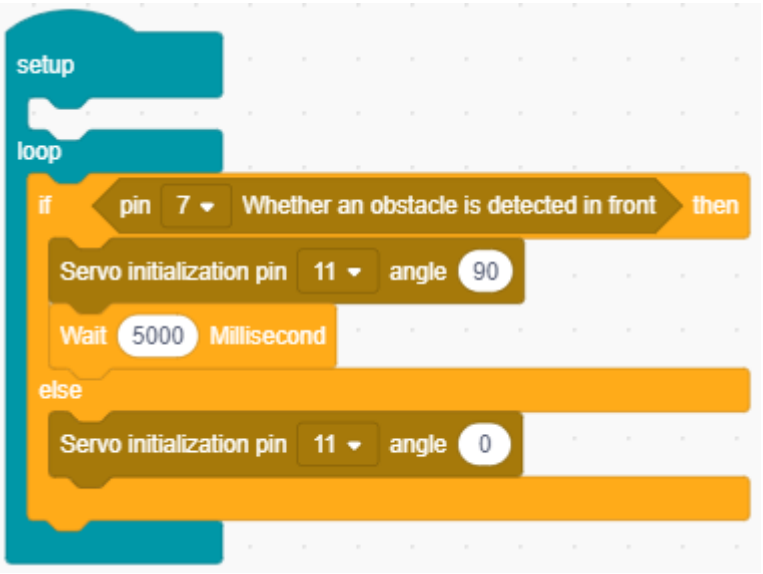
Arduino IDE Code

```
#include <Servo.h>
Servo servo_11;
void setup(){
  pinMode(7, INPUT);
  servo_11.attach(11);
}
void loop(){
  /*Judge whether the infrared obstacle avoidance sensor connected to the D7 pin senses the car, "0" means it senses the car, "1" means it doesn't  */
if (digitalRead(7) == 0) {
    servo_11.write(90);
    delay(5000);
  } else {
    servo_11.write(0);
    delay(1000);
  }
}
```

Mixly Program

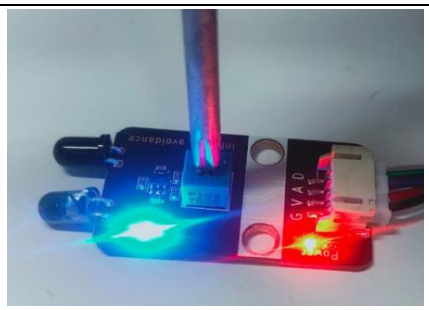


MagicBlock Program



Results: connect the hardware and upload the program. When the infrared obstacle avoidance sensor senses the vehicle, the rudder will lift the fence; otherwise, the fence will not lift.

Note: when the car is sensed by infrared obstacle avoidance, the blue light on the module will be on; when the car is not sensed, the blue light will be off; if the module is not sensitive, it can be adjusted by adjusting the rheostat on the module with a screwdriver.



5. Conclusion

In this lesson, through the production of automatic garage door, we understand the principle of infrared obstacle avoidance sensor and steering gear, and master how to program to obtain the detection data of infrared obstacle avoidance sensor and control the swing of steering gear, so as to realize the automatic detection, opening and closing of garage door.

Ⅵ Intelligent Access Control

Task Background

In order to protect their home and private property, people invented the door lock. In ancient times, people locked the door with ropes or wooden bars, and then developed to use the key to lock the door. However, people often left the key at home or lost it, resulting in the distress of not being able to open the door, and its security is not very high. Therefore, fingerprint lock, password lock and other more intelligent, safe and convenient locks came into being. The task of this lesson is to make an intelligent password automatic door. Let's understand the principle and operation of this access control operation.

Equipment Preparation

Arduino ble uno mainboard, expansion board, battery box, S90 steering gear, matrix keyboard sensor module, connecting line and data line.

1. Learn about Intelligent Door Lock

Intelligent door lock is an improved lock based on traditional mechanical lock, which is more intelligent and simple in user safety, identification and management. Intelligent door lock is the executive part of door lock in access control system. It uses non mechanical key as the mature technology of user identification ID, such as password lock, fingerprint lock, iris recognition access control, etc., which is mainly used in smart home, smart hotel / hotel, intelligent building and other systems.

The intelligent password automatic door access control made in this course is a password electronic lock realized by using matrix keyboard sensor module and S90 steering gear. Its function is to input the correct password on the matrix keyboard sensor module to open the door.

2. Learn about the Matrix Keyboard Sensor Module

The matrix keyboard consists of 16 keys, 4 rows and 4 columns. Each of the original four keys is joined together to form a line, and so is each column.There are a total of eight rows, four rows and four columns. Each key is equivalent to a touch module; our module uses IIC communication mode of capacitive inductive touch chip TTP229, which simplifies our wiring mode.

When touching the corresponding key of the keyboard, the module will output the corresponding value, as shown in the table below.

Keyboard Value	Hexadecimal Value	Keyboard Value	Hexadecimal Value	Keyboard Value	Hexadecimal Value
1	0xFFFE	7	0xFEFF	D	0x7FFF
2	0xFFFD	8	0xFDFF	C	0xF7FF
3	0xFFFB	9	0xFBFF	B	0xFF7F
4	0xFFEF	*	0xEFFF	A	0xFFF7
5	0xFFDF	0	0xDFFF		
6	0xFFBF	#	0xBFFF		

The matrix keyboard sensor module has four pins G, V, SDO and SCL, which can be connected to digital and analog interfaces. Generally, we connect to IIC (A4, A5) interfaces.

3. Intelligent Access Control Installation

In this lesson, the S90 steering gear is used as the power mechanism of the door switch. Therefore, before installing the steering gear, the steering gear should be zeroed to make sure the swing angle range of the steering gear, and then installed on the house. The installation steps are as follows:

1) Zero the steering gear and determine the swing direction of the rudder arm. The method is the same as the garage door in the previous lesson.

2)Assemble and fix the door lever and rudder arm with self tapping screws, as shown in Fig. 6-1.

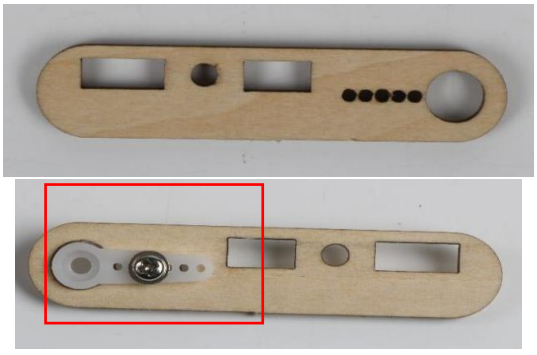


Figure 6-1

3)Assemble and connect the steering gear and steering gear bracket with M2 screw, as shown in Fig. 6-2.

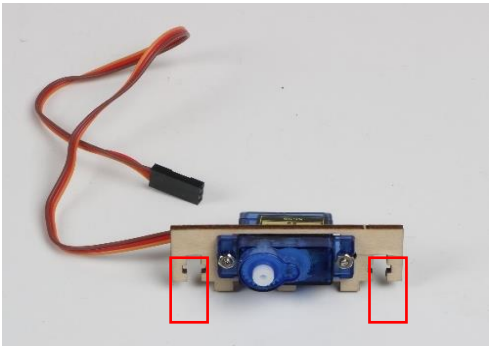


Figure 6-2

4）Then install the mast on the steering gear, as shown in Figure 6-3.

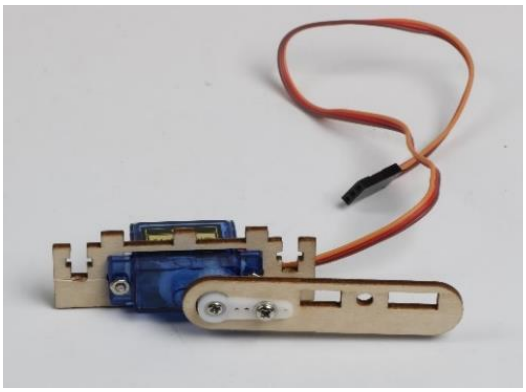


Figure 6-3

5)First install the nut in the door body, then install the door body on the door rod, and fix it with M3 * 12 screw, as shown in Figure 6-4.

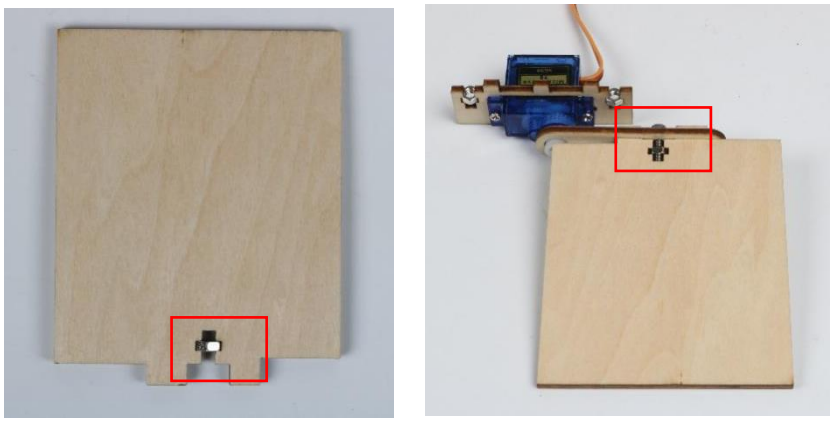


Figure 6-4

6) Install the assembled steering gear bracket and the door body on the left door, as shown in Figure 6-4.

7) Finally, install the matrix touch keyboard next to the door, as shown in Figure 6-5.

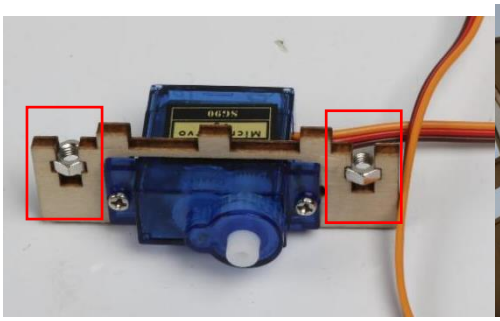


Figure 6-4

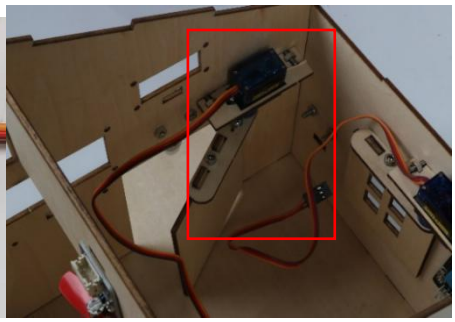


Figure 6-5

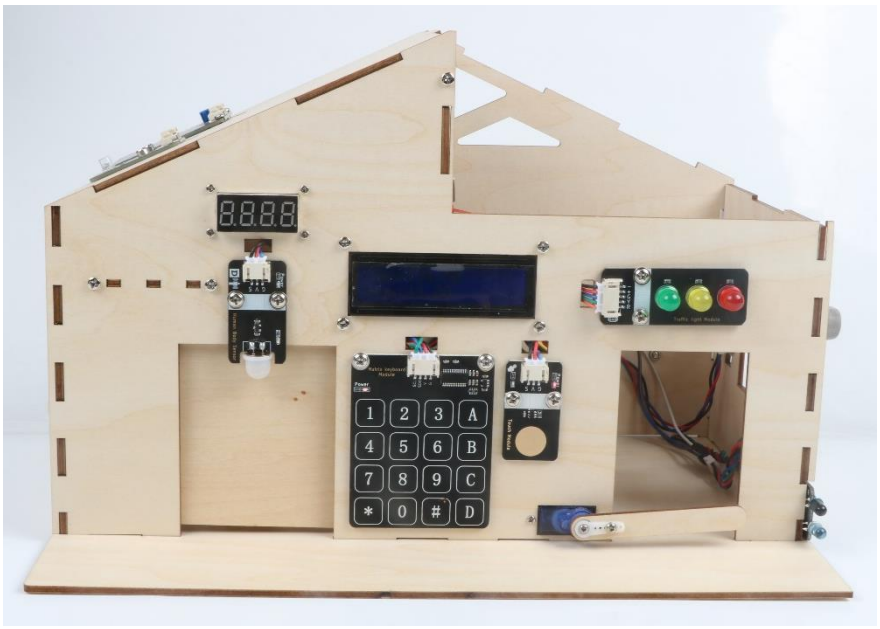


Figure 6-6

4. Programming

4.1 Algorithm Design

The principle of the intelligent password automatic door is that when the matrix keyboard sensor module inputs the correct password, the steering gear swings to open the door. Otherwise, the door is always closed. The algorithm is designed as follows：

Step 1: First, create an array, set the password for opening the door, such as 123, and then store it in the array;

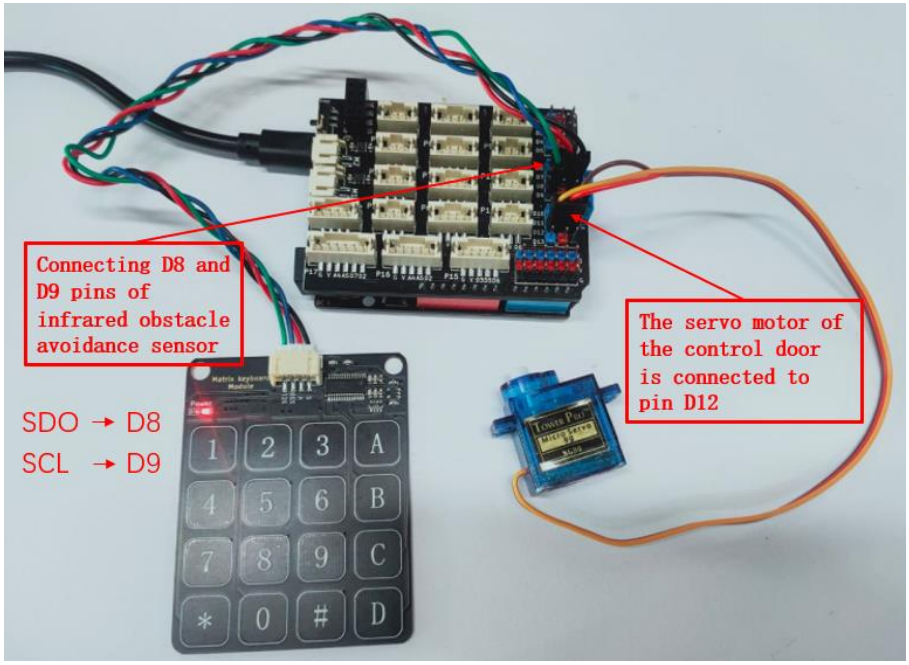
Step 2: Read the input value of matrix keyboard and judge. If the password is correct, the steering gear swings to open the door; otherwise, the door is closed;

The third step is to end the procedure.

4.2 Hardware Connection:

Connect the matrix keyboard to the D8 and D9 pins on the Arduino expansion board with 4pinPH2.0 transfer wire. Pay attention to the color correspondence of wire sequence, SDO pin corresponds to the D8 pin, SCL pin corresponds to the D9 pin; the steering gear of the control door body connects to the D12 pin on the expansion board.

Sensors and Actuators	Main Control Board
Matrix Keyboard Sensor Module	D8、D9
Steering Engine	D12



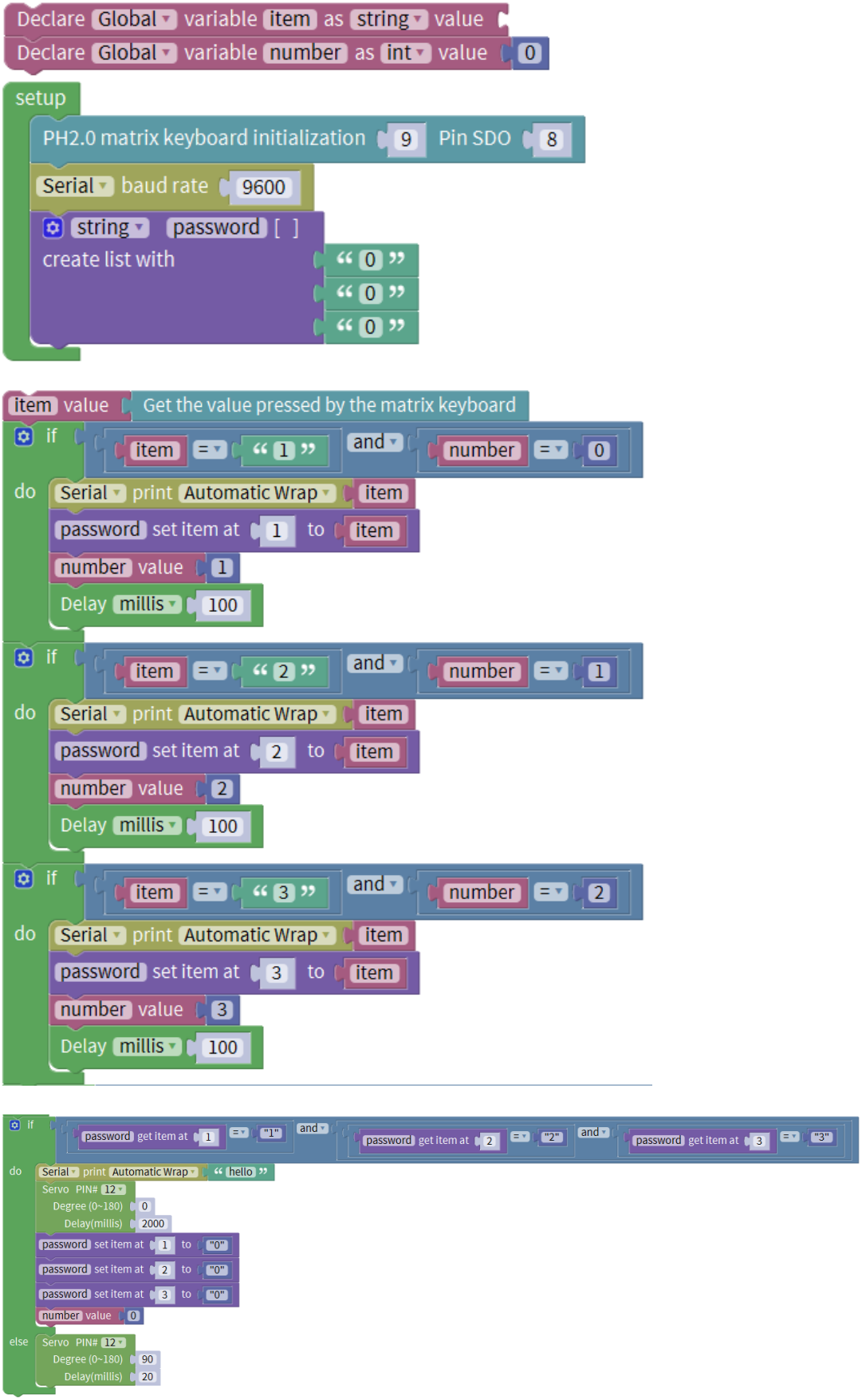
4.3 Program Example:

Arduino IDE Program

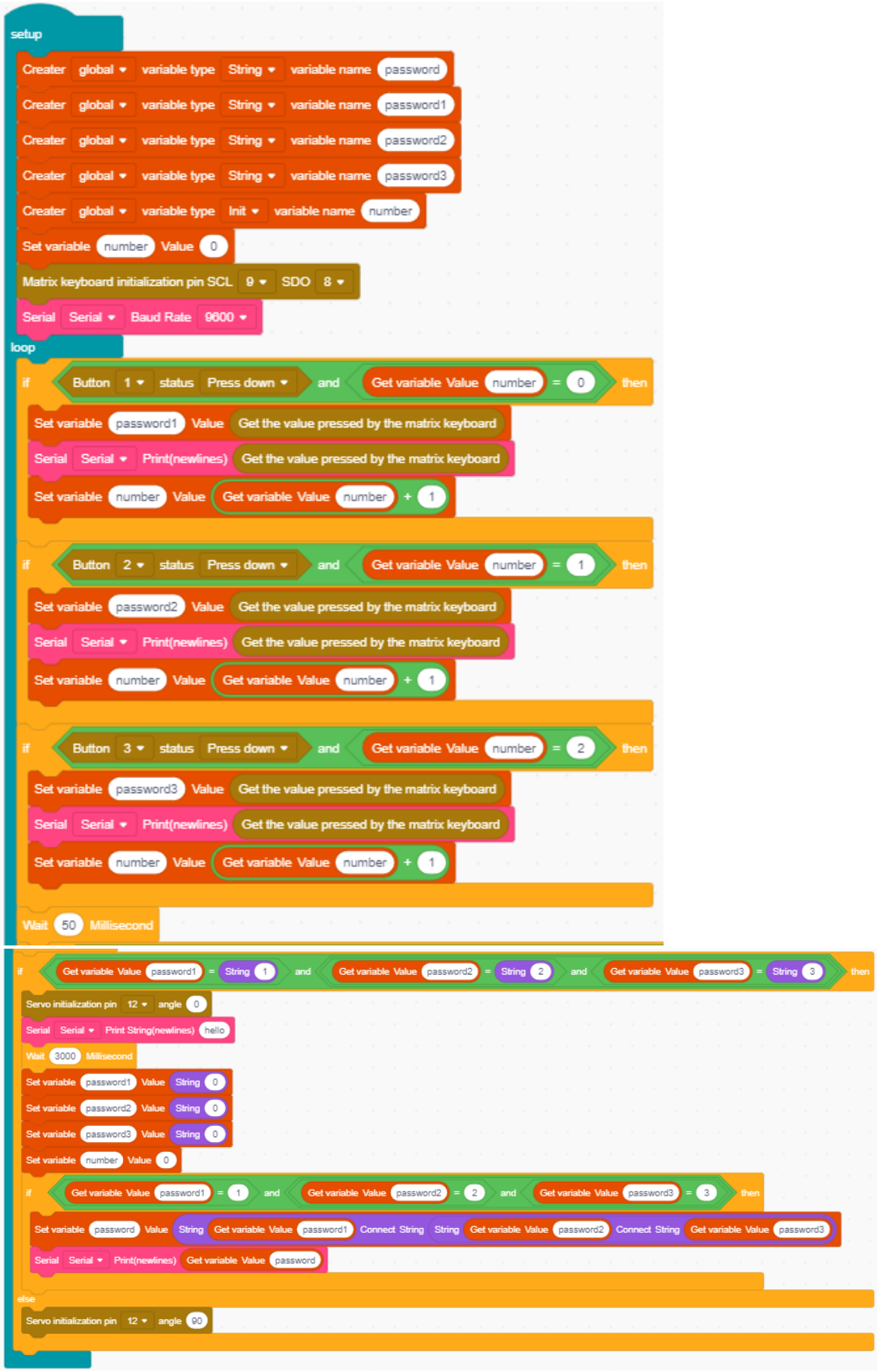
```
#include "EM_TTP229.h"
EM_TTP229 mTTP229;
int SCLPin = 9, SDOPin = 8;
String Read_Key () {
  String key_name = mTTP229.GetKeyMap();
  char * result = (char *)key_name.c_str();
  return result;
}
#include <Servo.h>
String item;
volatile int number;
String password[]={"0", "0", "0"};
Servo servo_12;
```

```
void setup(){
  item = "";
  number = 0;
  mTTP229.initTTP229(SCLPin, SDOPin);
  Serial.begin(9600);
  servo_12.attach(12);
}

void loop(){
  item = Read_Key();
  if (item == "1" && number == 0) {
    Serial.println(item);
    password[(int)(0)] = item;
    number = 1;
    delay(100);
  }
  if (item == "2" && number == 1) {
    Serial.println(item);
    password[(int)(1)] = item;
    number = 2;
    delay(100);
  }
  if (item == "3" && number == 2) {
    Serial.println(item);
    password[(int)(2)] = item;
    number = 3;
    delay(100);
  }
  if (password[(int)(0)] == "1" && (password[(int)(1)] == "2" && password[(int)(2)] == "3")) {
    Serial.println("hello");
    servo_12.write(0);
    delay(2000);
    password[(int)(0)] = "0";
    password[(int)(1)] = "0";
    password[(int)(2)] = "0";
    number = 0;
  } else {
    servo_12.write(90);
    delay(20);
  }
}
```

Mixly Program



MagicBlock Program



Results: Connect the hardware and upload the program to the main board. When the touch matrix keyboard is touched by keys 1, 2 and 3 in turn, the steering gear will open the door, and other operations will not respond.

5. Conclusion

In this lesson, we understand the characteristics and principles of matrix keyboard through the production of intelligent entrance guard of smart home, and master the programming logic of password door opening, and realize the function of password door opening through programming.

Ⅶ Light Control Automatic Window

Task Background

As a kind of windows that can realize intelligent control, smart home windows are more convenient and safer than traditional windows. In this lesson, we will make a light controlled automatic window, which has the function of automatically sensing the light intensity, so as to automatically adjust the opening and closing of the window according to the change of light.

Equipment Preparation

Arduino main board, expansion board, battery box, S90 steering gear, raindrop sensor module, connecting line, data line.

1. Learn about the Principle of Light Control Automatic Window

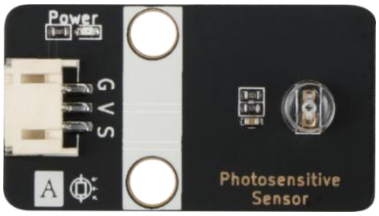
The light control automatic window made in this course is realized by using photosensitive sensor, digital tube display and steering gear. Its principle is to use the digital tube display photosensitive sensor to feel the change of external light intensity and judge whether the light intensity is suitable for opening the window. If the light intensity is suitable, then control the steering gear to open the window; otherwise, if the light intensity is not suitable for opening the window, then close the window Close the window.

2. Learn about the Photosensitive Sensor and Digital Tube Display

2.1 Photosensitive Sensor

Photoresistor is a special resistor made of CDs or CdSe semiconductor materials. Its working principle is based on the internal photoelectric effect. The stronger the light, the lower the resistance. With the increase of light intensity, the resistance decreases rapidly, and the bright resistance can be as low as 1K Ω. Photoresistors are very sensitive to light. When there is no light, they are in a high resistance state, and the dark resistance is generally up to 1.5m Ω. With the development of science and technology, the special properties of photoresistors will be widely used. Photosensitive sensor can also be widely used in various light control circuits, such as controlling and adjusting light. Photoresistors are most sensitive to ambient light and are generally used to detect the brightness of the surrounding light.

The photosensitive sensor used in this course has three pins: G, V and S. G is GND grounded, V is VCC connected to high level, S is data transfer pin, which can be connected to A0-A5 analog pin.



Photosensitive sensor	Ble-Uno
G	GND
V	VCC
S	A0-A5

2.2 Digital Tube Display

Digital tube, also known as glow tube, is an electronic device that can display numbers and other information.

The 4-bit 7-segment nixie tube used in this course is composed of a 12 pin 4-bit 7-segment common anode nixie tube and a control chip TM1650. This product can be used in the display of digital devices.

The 4-bit 7-segment common cathode nixie tube connects the cathodes of 8 LEDs of each bit, as shown in Figure 7-1. This module drives the 4-bit 7-segment nixie tube through TM1650 chip and adopts two-wire serial communication. DP is the decimal point. Please refer to the chip data manual for the detailed parameters of tm1650.

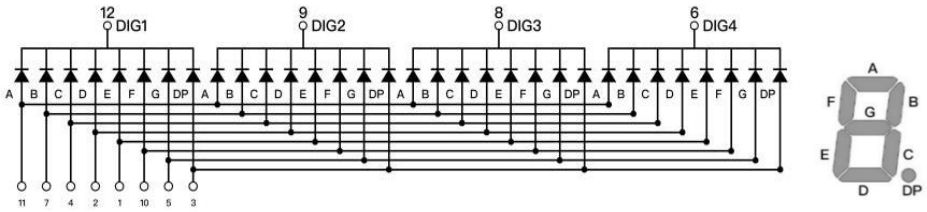


Figure 7-1

The 4-bit 7-segment nixie tube has G, V, DIO and CLK pins. G stands for GND and needs to be grounded. V stands for VCC and can be connected to 5.5V and 3.3V of main board. DIO stands for data line, which is used for data transmission. CLK stands for clock line, which is used to provide clock signal. It can be connected to IIC (A4, A5) interface of Arduino main board.

Digital tube	Ble-Uno
G	GND
V	VCC
DIO	A4
CLK	A5

3. Light Control Automatic Window Installation

The window in the course uses S90 steering gear as the power mechanism of the door switch. Therefore, before installing the steering gear, the steering gear should be zeroed to make clear the swing angle range of the steering gear, and then installed on the house. The installation steps are as follows:

1) Zero the steering gear and determine the swing direction of the rudder arm

2) Assemble and fix the window cross bar and rudder arm with self tapping screws, as shown in Fig. 7-2.

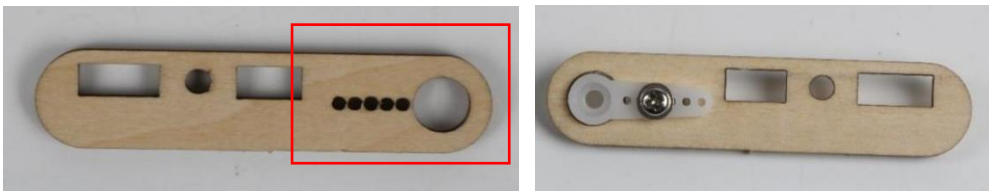


Figure 7-2

3）Assemble and connect the steering gear and steering gear bracket with M2 screw, as shown in Figure 7-3.

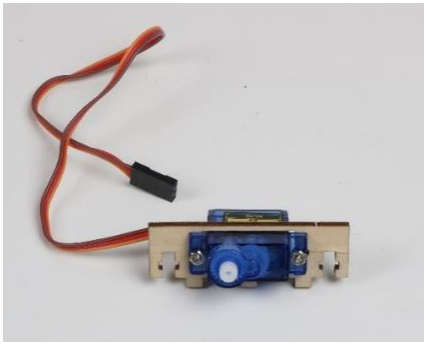


Figure 7-3

4）Then install the mast on the steering gear, as shown in Figure 7-4.

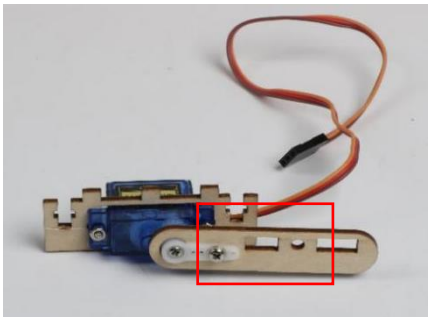


Figure 7-4

5）Install the nut on the window, and then install the window crossbar on the steering gear, as shown in Figure 7-5.

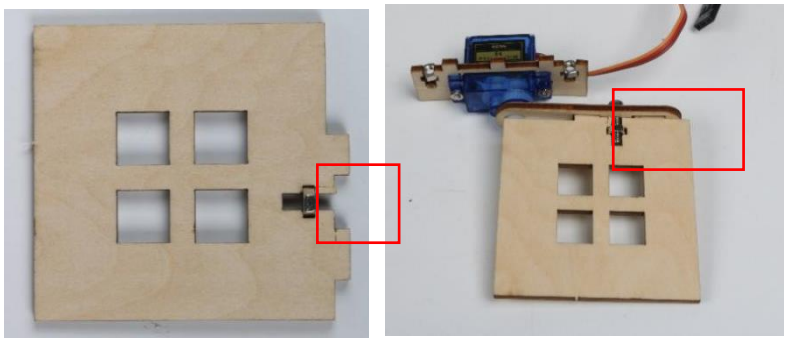


Figure 7-5

6)Install the nut on the window, and then install the window crossbar on the steering gear, as shown in Figure 7-6.

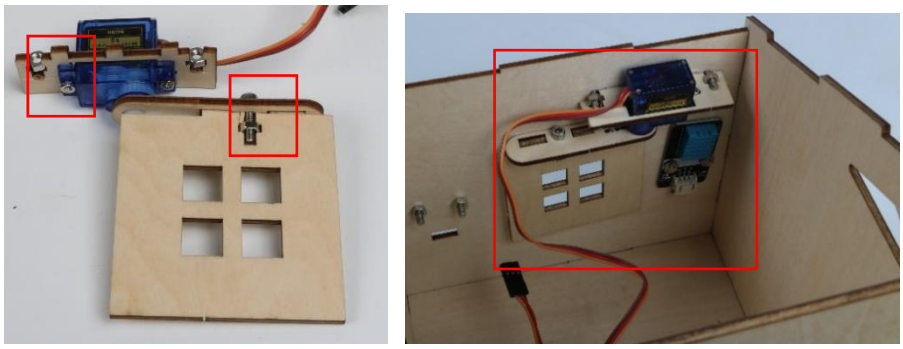


Figure 7-6

5）Then install the photosensitive sensor on the roof board, as shown in Figure 7-7

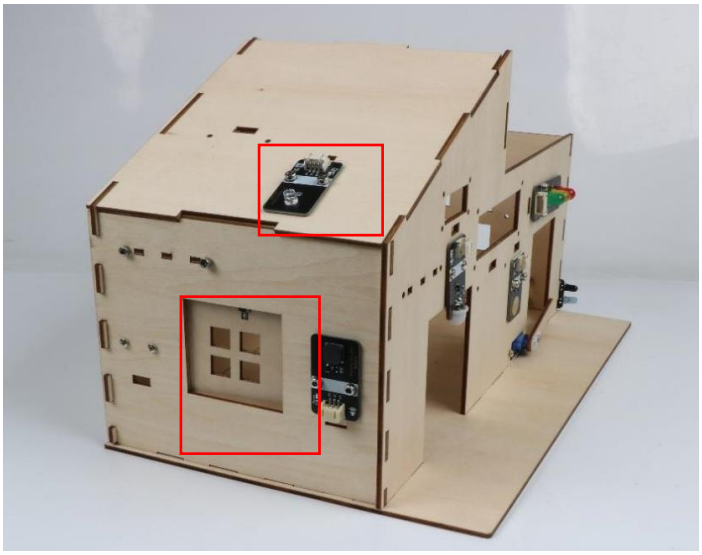


Figure 7-7

7）Finally, fix the nixie tube display to the front with M2 * 8 screws, as shown in Figure 7-8.

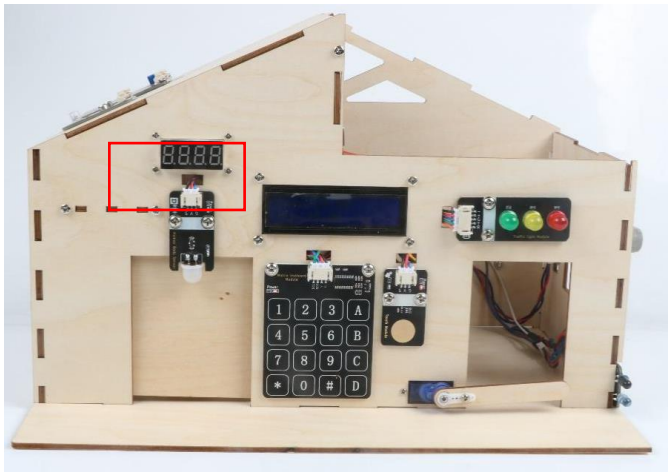


Figure 7-8

4. Programming

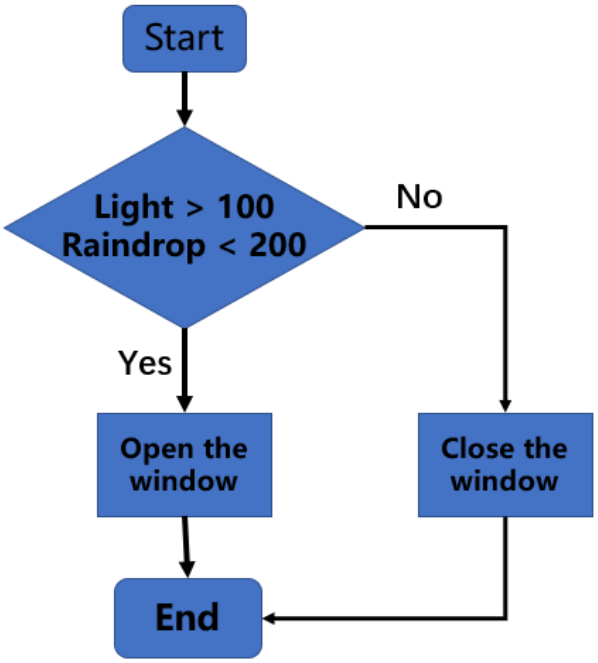
4.1 Algorithm design

According to the principle of light controlled automatic window, the algorithm is designed as follows：

Step 1：Set the threshold of the light intensity (Threshold learners should set according to the actual test conditions);

Step 2:The digital tube displays the light intensity value, and compares the surrounding light intensity with the light intensity threshold. If it is greater than the light intensity threshold, the window opens; if it is less than the light intensity threshold, the window closes;

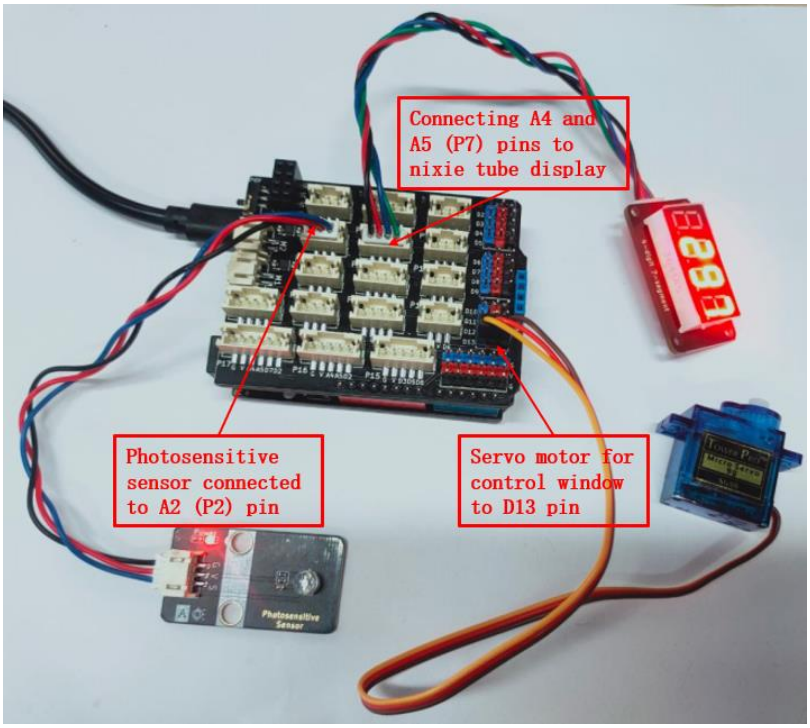
Step 3: End the procedure.



4.2 Hardware Connection

The photosensitive sensor is connected to the A2 (P2) pin on the Arduino expansion board, the nixie tube display module is connected to the A4 and A5 (P7) pins on the expansion board, and the steering gear of the control window is connected to the D13 pin on the expansion board.

Sensors and Actuators	Main Control Board
Photosensitive Sensor	A2（P2）
Digital tube display	A4、A5（P7）
Steering Engine	D13



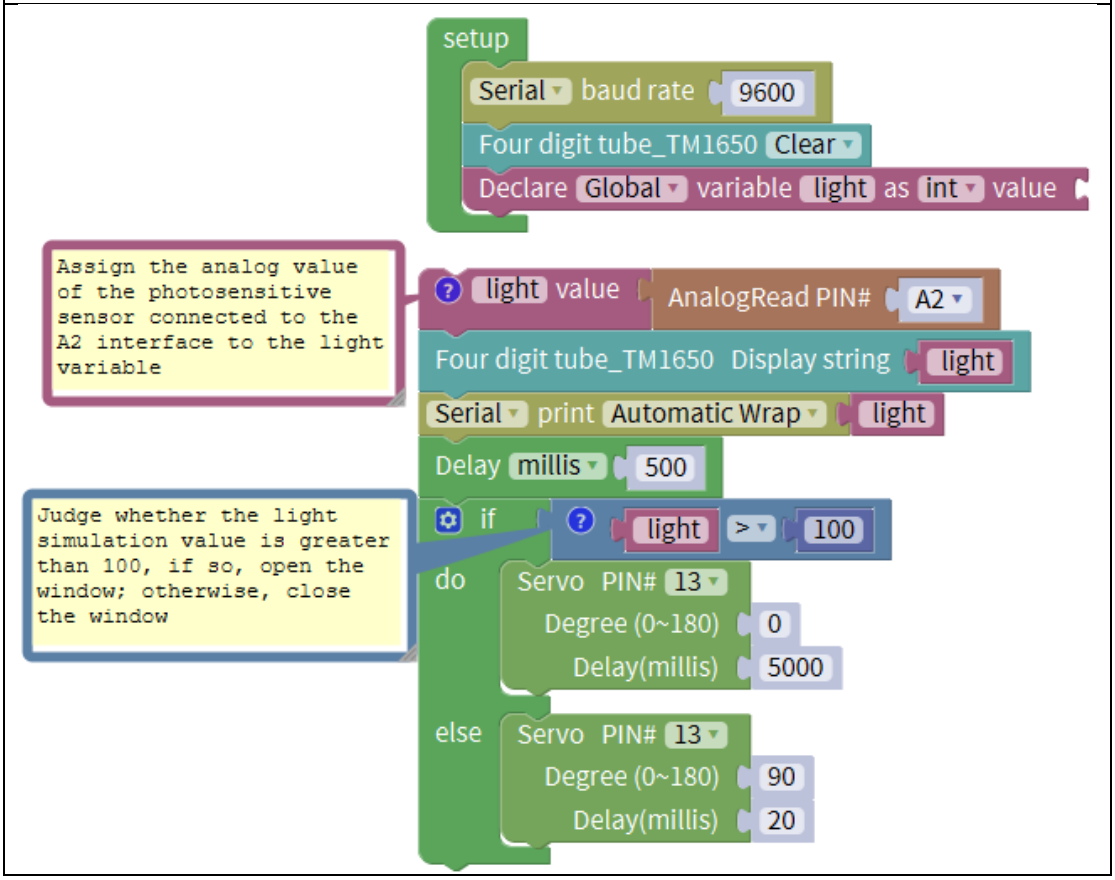
4.3 Sample Program

Arduino IDE Program

```
#include <Wire.h>
#include "TM1650.h"
#include <Servo.h>

TM1650 tm_4display;
volatile int _light;
Servo servo_13;

void setup(){
  Serial.begin(9600);
  Wire.begin();
  tm_4display.init();
  _light = 0;
  tm_4display.clear();
  servo_13.attach(13);
}

void loop(){
  /* Assign the analog value of the photosensitive sensor connected to the A2 interface to the light variable */
  _light = analogRead(A2);
  tm_4display.displayString(_light);
```

```
    Serial.println(_light);
    delay(500);
    /* Judge whether the light simulation value is greater than 100, if so, open the window; otherwise, close the window */
    if (_light > 100) {
      servo_13.write(0);
      delay(5000);
    } else {
      servo_13.write(90);
      delay(20);
    }
}
```

Mixly Program



MagicBlock Program

Results: After connecting the hardware and uploading the program, you can see the analog value of light intensity displayed on the nixie tube. If the analog value is greater than 100, the steering gear will swing to open the window; otherwise, the window will be closed.

5. Conclusion

In this lesson, we learned the characteristics and use of photosensitive sensor and digital tube, and understood the principle of light control window. By making light control automatic window, we mastered the programming of photosensitive sensor digital tube, and realized the function of opening the window when the light is strong, otherwise, closing the window.

Ⅷ Intelligent Rain Control Window

Task Background

In the last lesson, we learned and made intelligent light control windows. Since the opening and closing of windows can be controlled according to the brightness of light, when it's windy and rainy, no one will close the windows at home. Can we also make a rain control window, so that we don’t have to worry about no one closing the windows at home, and the rain will enter the room, causing indoor humidity and other troubles. Now let’s make an automatic intelligent rain control window to see what principle it uses to operate.

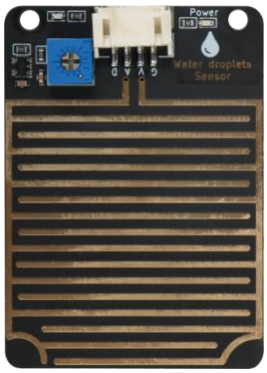
Equipment Preparation

Arduino Ble-Uno main board, expansion board, battery box, S90 steering gear, raindrop sensor module, connecting cable and data cable.

1. Principle of Intelligent Rain Control Window

The automatic intelligent window of this course is realized by using the raindrop sensor and steering gear as the mechanism. We can add the raindrop sensor on the basis of last lesson. The principle is that when the light is sufficient, if the raindrop sensor does not sense the rain, the steering gear will swing to open the window; if it senses the rain, the window will be closed; if the light is not sufficient, the window will be closed. In this case, the window is always closed, no matter whether rain is sensed or not.

2. Learn about Raindrop Sensors



Raindrop sensor is used to detect whether it rains and the size of rainfall, and is widely used in auto wiper system, intelligent lighting system and intelligent skylight system. Output Form: digital value output (0 and 1) and analog value a voltage output. LM393 dual voltage comparator is used. When the sensor is connected to 5V power supply, there is no water drop on the induction board, and D output is at high level. When a droplet is dropped, the D output is at a low level. If we brush off the droplets, the output will return to a high level.

The raindrop sensor module has four pins G, V, A and D. The analog output of A can detect the size of raindrops above. D digital output can detect whether there is rain, and adjust D digital output by adjusting the threshold value. The larger the raindrop is, the smaller the analog value is.

3. Automatic Intelligent Window Construction

We have assembled the windows in the last lesson, so we won't repeat the steps in this lesson. Just install the raindrop sensor on the roof board, as shown in Figure 8-1.

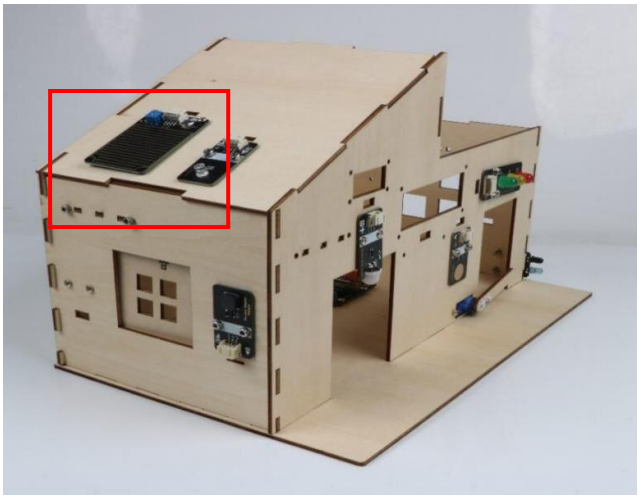


Figure 8-1

4.Programming

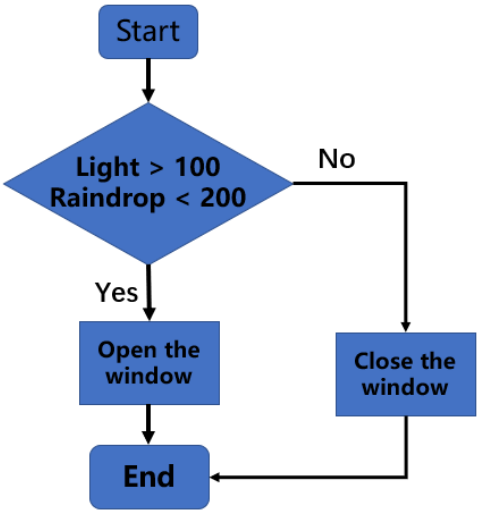
4.1 Algorithm Design

According to the principle of automatic intelligent window, the algorithm is designed as follows:

The first step is to declare the state variables of light sensor and raindrop sensor;

Step 2: Judge whether the simulated value of light is greater than 100, and then judge whether the return value of raindrop sensor is less than 200. If it is less than 200, the window will be closed. Otherwise, open the window. If there is not enough light, close the window.

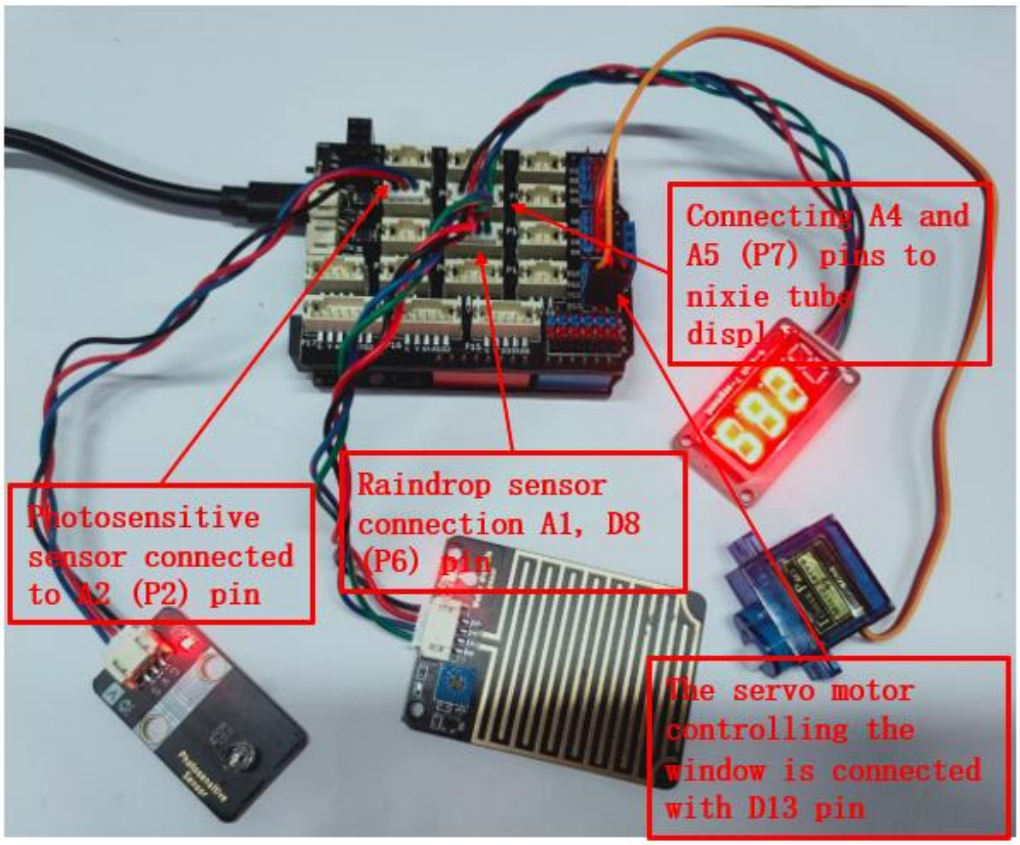
Step 3: End the procedure.



4.2 Hardware Connection:

The steering gear is connected to D3 pin, and the raindrop sensor module is connected to A0 and D7 (P5) pins of the expansion board, and uses D7 pin to read data.

Sensors and actuators	Main control board
Raindrop Sensor Module	A0, D7 (P5) use D7 to read data
Steering Engine	D3



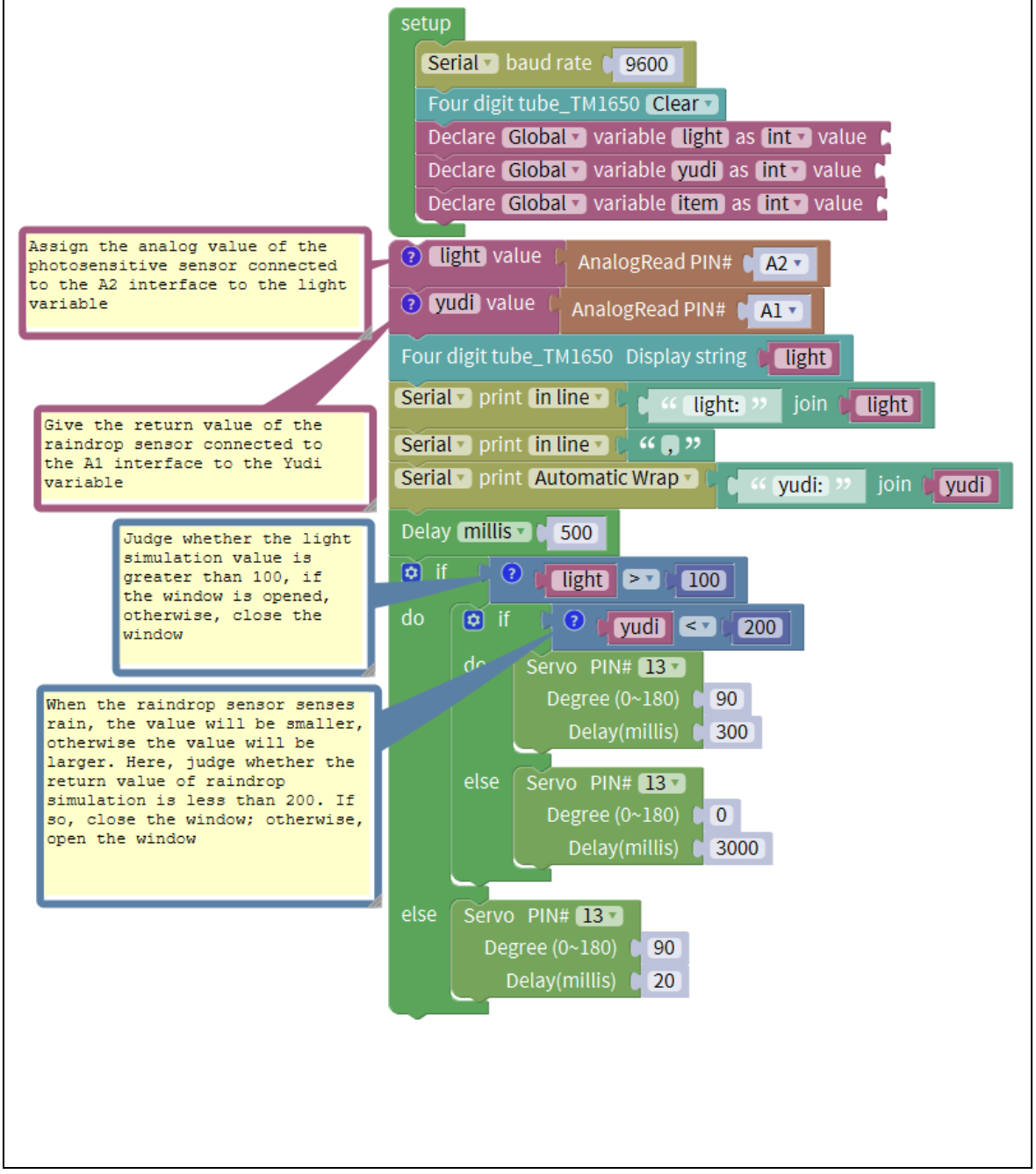
4.3 Program Example:

Arduino IDE

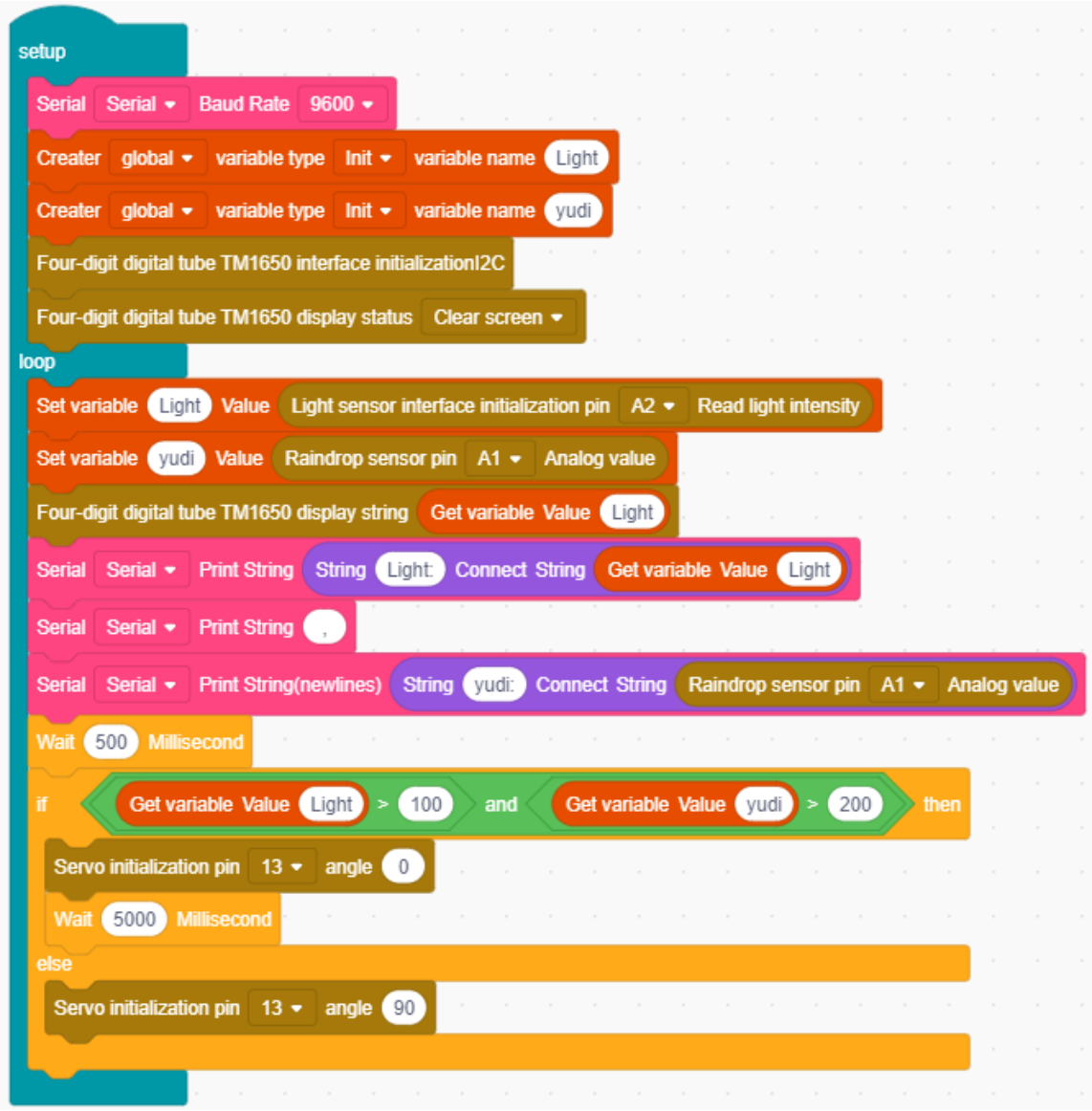
```
#include <Wire.h>
#include <TM1650.h>
#include <Servo.h>
TM1650 tm_4display;
volatile int _light;
volatile int yudi;
volatile int item;
Servo servo_13;
void setup(){
  Serial.begin(9600);
  Wire.begin();
  tm_4display.init();
  _light = 0;
  yudi = 0;
  item = 0;
  tm_4display.clear();
  servo_13.attach(13);
}
void loop(){
  // Assign the analog value of the photosensitive sensor connected to the A2 interface to the light variable
  _light = analogRead(A2);
  // Assign the return value of raindrop sensor connected to A1 interface to Yudi variable
  yudi = analogRead(A1);
  tm_4display.displayString(_light);
  Serial.print(String(" light:") + String(_light));
  Serial.print(",");
  Serial.println(String("yudi:") + String(yudi));
  delay(500);
  /*Judge whether the light simulation value is greater than 100, if the window is opened, otherwise, close the window */
  if (_light > 100) {
    /*When the raindrop sensor senses rain, the value will be smaller, otherwise the value will be larger. Here, judge whether the return value of raindrop simulation is less than 200. If so, close the window; otherwise, open the window.*/
    if (yudi < 200) {
      servo_13.write(90);
      delay(300);
    } else {
      servo_13.write(0);
      delay(3000);
    }
```

```
  } else {
    servo_13.write(90);
    delay(20);
  }
}
```

Mixly Program



MagicBlock Progam



Results: Connect the hardware, upload the program, when the light is sufficient, if there is no rain, open the window. Otherwise, close the window. When there is not enough light, close the window.

5.Conclusion

In this lesson, we learned the characteristics and principles of the raindrop sensor, and understood the principle of the rain control window. Through programming to control the movement of the raindrop sensor and the steering gear, the window can sense the change of the weather and realize the opening or closing.

Ⅸ Intelligent Smoke Alarm

Task Background:

Life is fragile and priceless. Only when we are alive can we pursue the next step of life. With the increasing number of household safety accidents reported by the society, people pay more attention to the safety of living environment. Some alarms are also widely used, especially for fire prevention and alarm system. We will finish making an intelligent smoke alarm in that lesson.

Equipment Preparation:

Arduino main board, expansion board, battery box, passive buzzer, smoke sensor, motor fan, flame sensor, connecting cable, USB data cable.

1. Intelligent Smoke Alarm

Smoke alarm is also known as fire alarm, its role is to detect whether there is a fire in the home, timely alarm to remind people, to avoid heavy property losses and personal safety caused by fire.

In fact, the smoke alarm mainly depends on the sensor. When the smoke reaches a certain concentration, it will judge that there is a fire, and the controller of the smoke alarm can be connected to the network and communicate with each other. When the smoke reaches a certain concentration, it will interfere with the normal operation of our smoke alarm, and the voltage and current will change Therefore, the electronic balance of the smoke alarm is destroyed. At this time, the host will receive the information, and then transmit the alarm signal through the wireless transmitter.

The intelligent smoke alarm made in this course is composed of smoke sensor, flame sensor, fan motor and passive buzzer.

2. Know about Gas Sensors and Flame Sensors

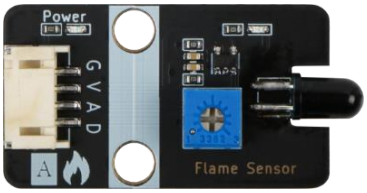
2.1 Gas Sensor

The gas sensing material used in gas sensor is tin dioxide (SnO2) with low conductivity in clean air. When there is combustible gas in the environment, the conductivity of the sensor increases with the increase of combustible gas concentration in the air. Using a simple circuit, the change of conductivity can be converted into the output signal corresponding to the gas concentration. When the gas sensor detects the corresponding gas, it will output a low-level digital signal and the corresponding analog signal.

The gas sensor has four pins G, V, A and D. The A pin can be connected to the A0-A5 analog pin of the main board, and the D pin can be connected to the D0-D13 analog pin of the main board.

Gas sensor	Ble-Uno
G	GND
V	VCC
A	A0-A5
D	D0-D13

2.2 Flame Sensor



Flame sensor is a kind of sensor device which uses infrared sensitive to flame to detect flame. When there is a fire, there will be a very strong infrared radiation. The flame sensor uses a special infrared receiver to detect the flame, which is very sensitive to the flame. It will react under the illumination of the infrared light of a specific band, and then convert the brightness of the flame into the level signal of high and low variation. In use, the sensor should keep a certain distance from the flame to avoid high temperature damage to the sensor. The distance range of the lighter test flame is 80cm. The larger the flame is, the farther the detection distance is.

The flame sensor has four pins G, V, A and D, which can be connected with the digital interface or analog interface of the main board. If the analog port is connected, the analog value of the flame sensor will decrease according to the size of the flame and the distance from the flame; if the digital port is connected, the digital value of the flame sensor will output low level (0) when the read analog value is less than the threshold value, and high level (1) when it is greater than the valve value. The threshold value can be adjusted by adjusting the adjustable resistance.

Flame sensor	Ble-Uno
G	GND
V	VCC
A	A0-A5
D	D0-D13

3. Installation of Smoke Alarm

Install the smoke sensor and flame sensor next to the right window with M3 * 8 screw, as shown in Figure 9-1.

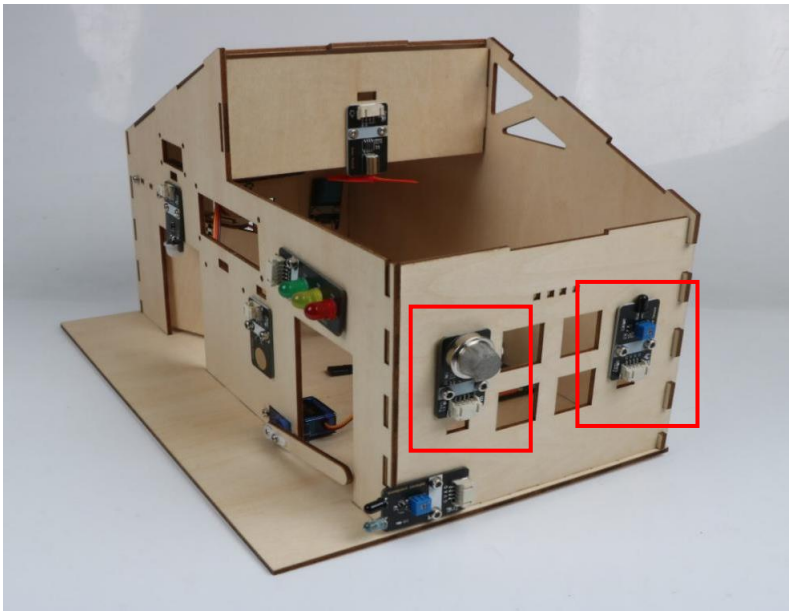
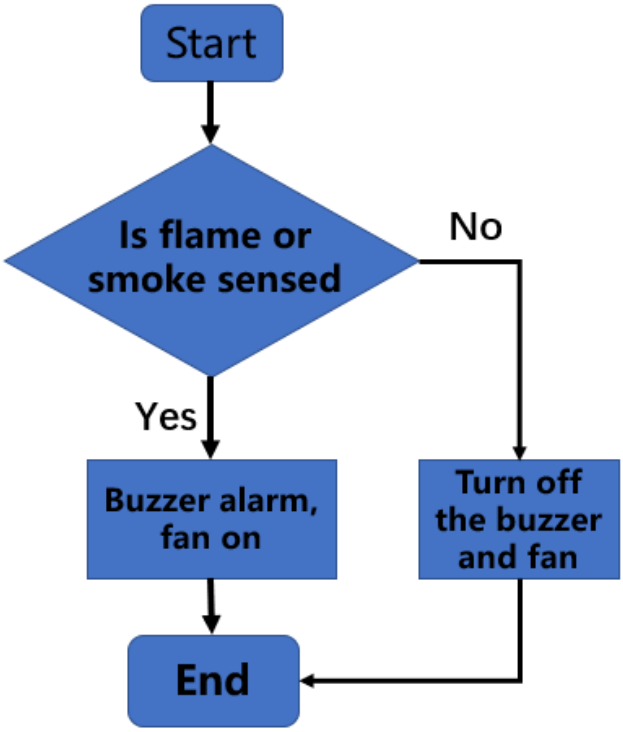


Figure 9-1

4. Programming

4.1 Algorithm Design:

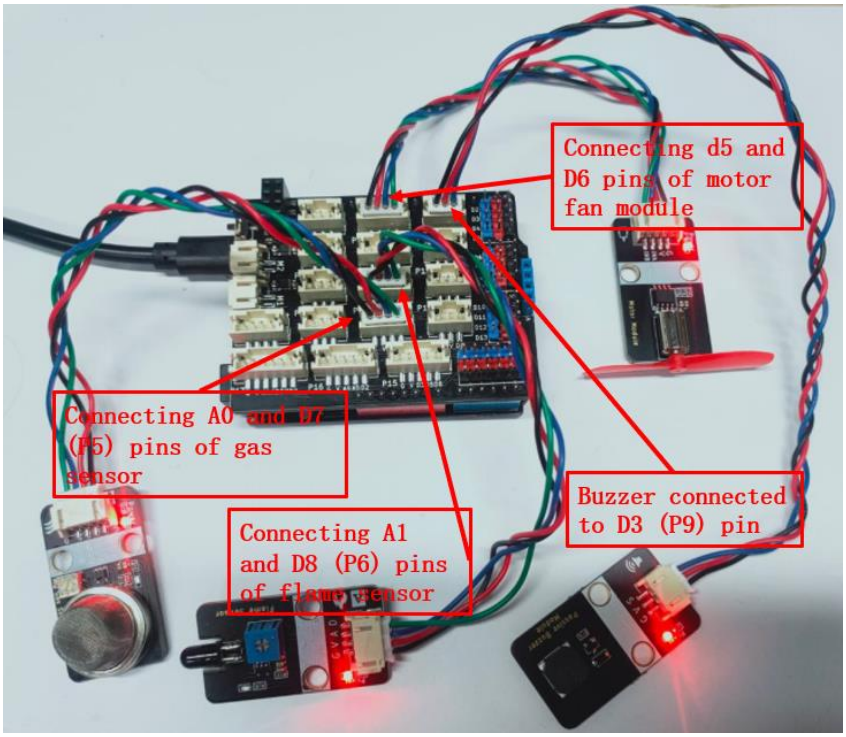
When there is a fire, there will be flame and smoke. The smoke alarm made in this course is to use the gas sensor to sense the concentration of smoke generated around or the flame sensor to sense the intensity of the flame, and then use the passive buzzer to give an alarm and turn on the fan to disperse the smoke. The program flow chart is as follows:



4.2 Hardware Connection

Because Arduino pins are limited and a pin can not connect different sensors at the same time. In this case, we need to remove the infrared obstacle avoidance sensor and raindrop sensor connected to the previous course, connect the gas sensor to the A0 and D7 (P5) pins of the expansion board, simultaneous interpreting the data with the A0 pins, and connect the A1 and D8 (P6) of the expansion board with the flame sensor. ） The passive buzzer is connected to the D3 (P9) pin of the expansion board, and the DC motor fan module is connected to the D5 and D6 (P8) pins of the expansion board.

Sensors and Actuators	Main Control Board
Gas sensor	A0, D7 (P5) use A0 pin to read data
Flame Sensor	A1, D8 (P6) use D8 pin to read data
Passive Buzzer	D3（P9）
DC Motor Fan Module	D5、D6（P8）



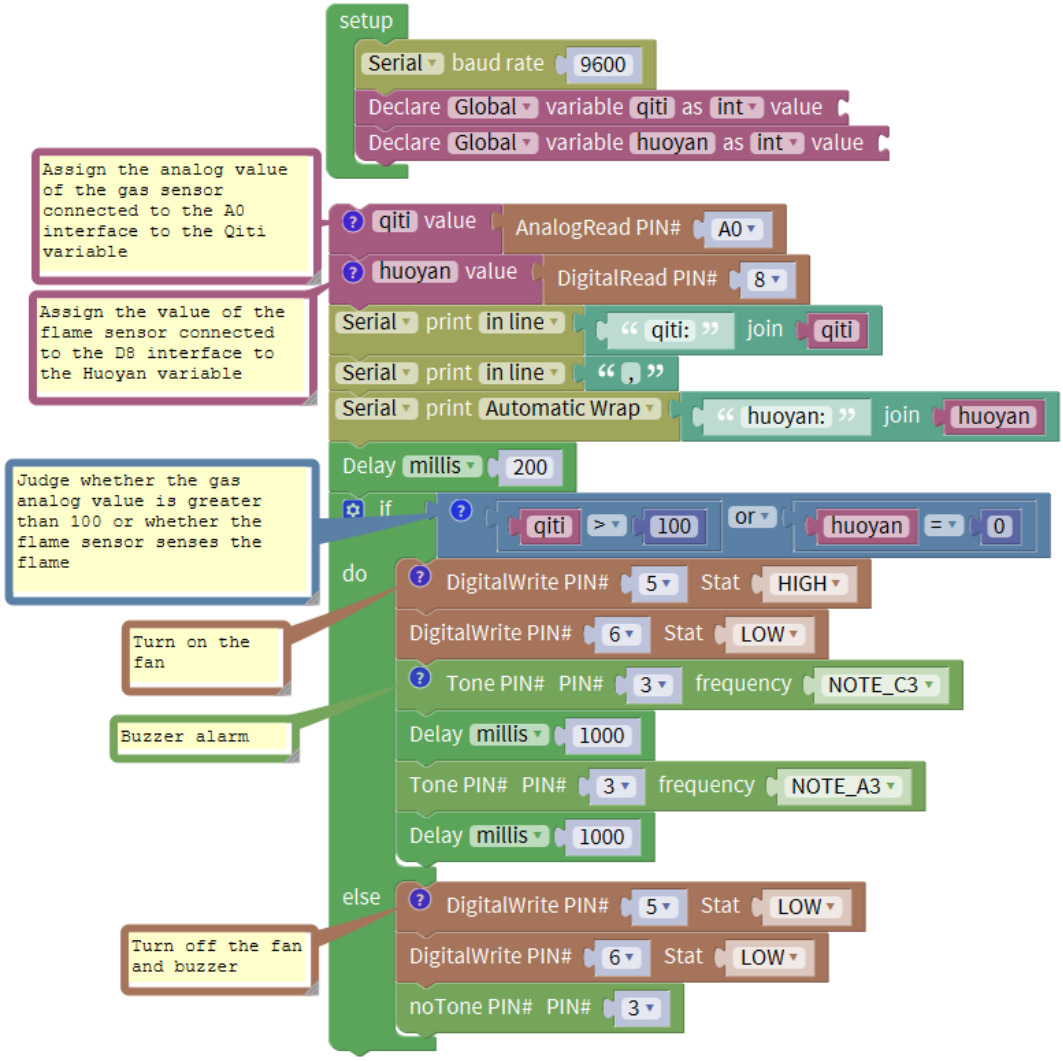
4.3 Program Sample：

Arduino IDE

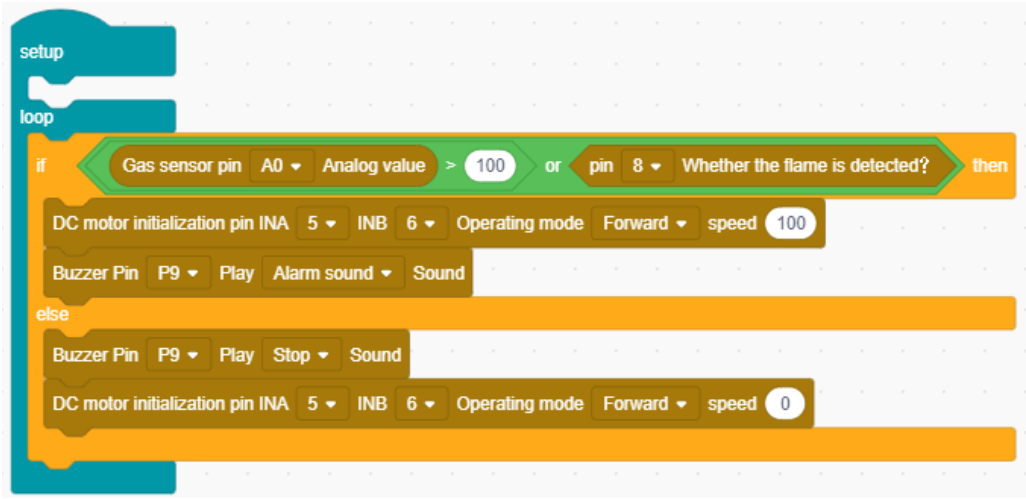
```
volatile int qiti;
volatile int huoyan;
void setup(){
  Serial.begin(9600);
  qiti = 0;
  huoyan = 0;
```

```
    pinMode(8, INPUT);
    pinMode(5, OUTPUT);
    pinMode(6, OUTPUT);
    pinMode(3, OUTPUT);
}
void loop(){
    // Assign the analog value of the gas sensor connected to the A0 interface to the Qiti variable
    qiti = analogRead(A0);
    // Assign the value of the flame sensor connected to the D8 interface to the Huoyan variable
    huoyan = digitalRead(8);
    Serial.print(String("qiti:") + String(qiti));
    Serial.print(",");
    Serial.println(String("huoyan:") + String(huoyan));
    delay(200);
    /*Judge whether the gas analog value is greater than 100 or whether the flame sensor senses the
flame*/
    if (qiti > 100 || huoyan == 0) {
        // Turn on the fan
        digitalWrite(5,HIGH);
        digitalWrite(6,LOW);
        // Buzzer alarm
        tone(3,131);
        delay(1000);
        tone(3,220);
        delay(1000);
    } else {
        // Turn off the fan and buzzer
        digitalWrite(5,LOW);
        digitalWrite(6,LOW);
        noTone(3);
    }
}
```

Mixly Program



MagicBlock Program



Results: Connect the hardware and upload the program. When the analog value of the gas sensed by the gas sensor is greater than 100 or the flame sensed by the flame

sensor, the fan will turn on and the buzzer will sound an alarm; otherwise, turn off the fan and buzzer.

5. Conclusion

In this lesson, we learned the characteristics and principles of smoke sensor and flame sensor, and then through the production of smoke alarm, we can master the programming usage of smoke sensor and flame sensor, so as to realize the function of timely alarm in case of fire.

Ⅹ Air Quality Detection System

Task Background:

With the continuous improvement of living standards, people pay more and more attention to health, Therefore, the smart home air quality detection system is concerned and adopted by more and more families. The task of this lesson is to complete an air quality detection system.

Equipment Preparation:

Arduino Ble-Uno main board, expansion board, battery box, DC motor fan module, temperature and humidity sensor, connecting cable, USB data cable.

1. Learn about the Air Quality Detection System

Air quality detection system is the use of sensor technology, ZigBee technology and other short-range wireless communication technology, and voice synthesis technology (TTS Technology) and air quality intelligent analysis software to achieve indoor air quality detection, analysis and alarm, and intelligent open air purifier, to give the family a healthy air environment.

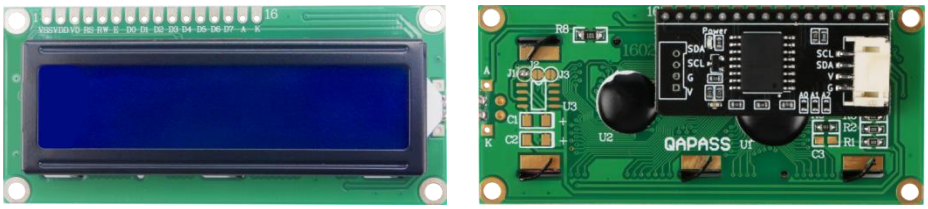
Its principle is to detect the air quality through different indoor air quality sensor modules, and use ZigBee module or Bluetooth module to transmit it to the computer. The computer is equipped with air quality analysis software, which can automatically analyze the quality around us and what measures to take to improve the air quality. These information can be broadcast through the voice announcer It indicates that the owner needs to take air purification measures and turn on the air purifier intelligently.

The air quality detection of this course is composed of temperature and humidity sensor and LCD display, which can display various indicators of smart home. If the indoor air does not meet the standard, the buzzer will give an alarm to remind people that the fan starts to purify the indoor air.

2.Learn About the LCD Displays

The display used in this course is LCD1602 display, which is a character LCD module specially used for displaying letters, numbers and symbols. It is widely used in industry, such as electronic clock, temperature display. “1602” means 2 lines and 16 characters per line. LCD1602 display with adapter uses IIC communication, which saves a lot of I/O ports. 1602 liquid crystal display (1602 LCD) is a common character

LCD, which is named because it can display 16 * 2 characters. Generally, the 1602 LCD we use integrates the word library chip. Through the API provided by LiquidCrystal class library, we can easily use 1602 LCD to display English letters and some symbols.



In this module, we use IIC LCD1602 module to integrate IIC I/O expansion chip pcf8574, which makes the use of LCD 1602 easier. Through the two-wire IIC bus (serial clock line SCL, serial data line SDA), the display of LCD 1602 can be controlled by Arduino IIC. It not only simplifies the circuit, but also saves the I/O port, so that Arduino can achieve more functions. By setting jumper, you can also set address: 0x20-0x27. It enables Arduino to control multiple LCDs 1602.

The connection pins on the back of LCD1602 display are GND, VCC, SDA and SCL (SDA and SCL are the data line and clock line of IIC communication respectively).

3.Installation of Air Detection System

The temperature and humidity sensor has been installed in the previous content of the course. In this lesson, you only need to install the LCD display. Install the LCD monitor in front of the house with M3 * 12 screws, as shown in Figure 10-1.

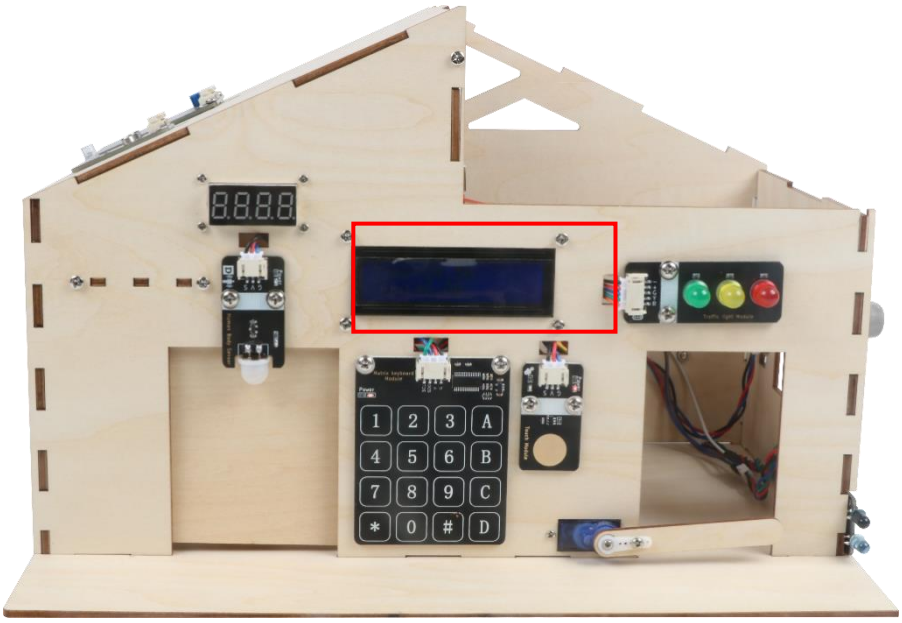
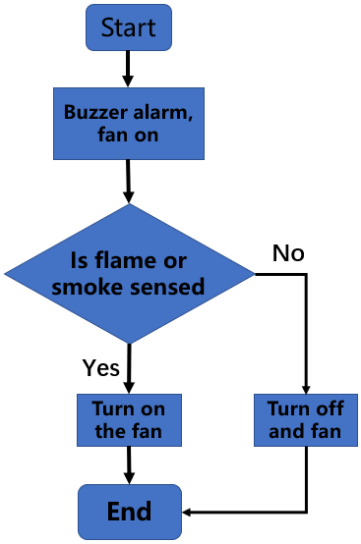


Figure 10-1

4. Programming

4.1 Algorithm Design:



First, use the temperature and humidity sensor to read the surrounding temperature and humidity data, and then display it on the LCD display, and judge whether the temperature and humidity value is greater than the set threshold, then start the fan; otherwise, turn off the fan. The procedure is as follows:

Step 1: The display shows the change of temperature and humidity.

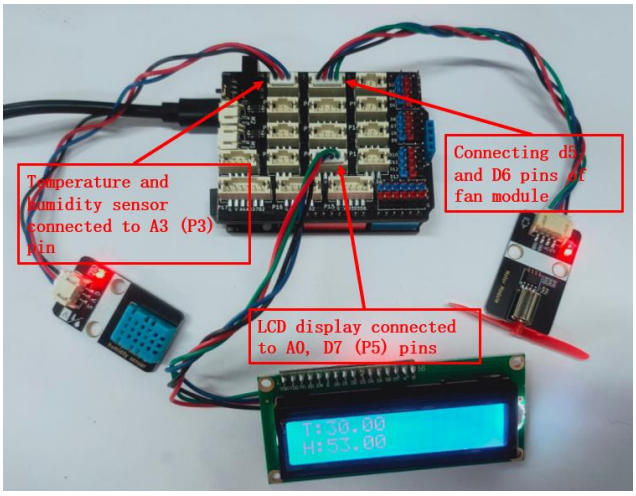
Step 2: Judging whether the temperature or humidity is greater than the threshold (the threshold can be set according to the actual situation). If so, turn on the fan; otherwise, turn off the fan;

Step 3: End the procedure.

4.2 Hardware Connection:

In the previous course, the temperature and humidity sensor has been connected to pin A3 (P1) of the expansion board; the DC motor fan module is connected to pin d5 and D6 (P8) of the expansion board. Due to the limited interface of Arduino, it is necessary to unplug the gas sensor cable first, and then connect the LCD display to A0 and D7 (P5) interfaces.

Sensors and Actuators	Main Control Board
LCD Display	A0、D7（P5）
Temperature and Humidity Sensor	A3（P1）
DC Motor Fan Module	D5、D6（P8）

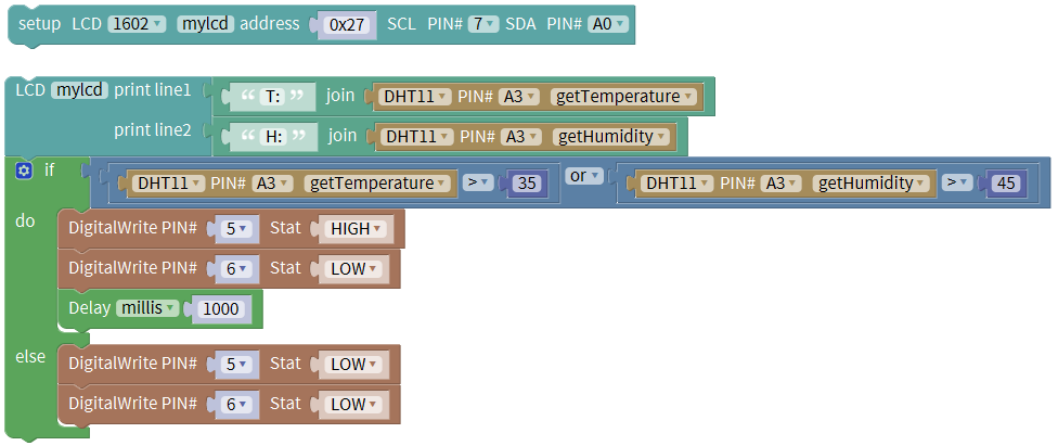


4.3 Program Example:

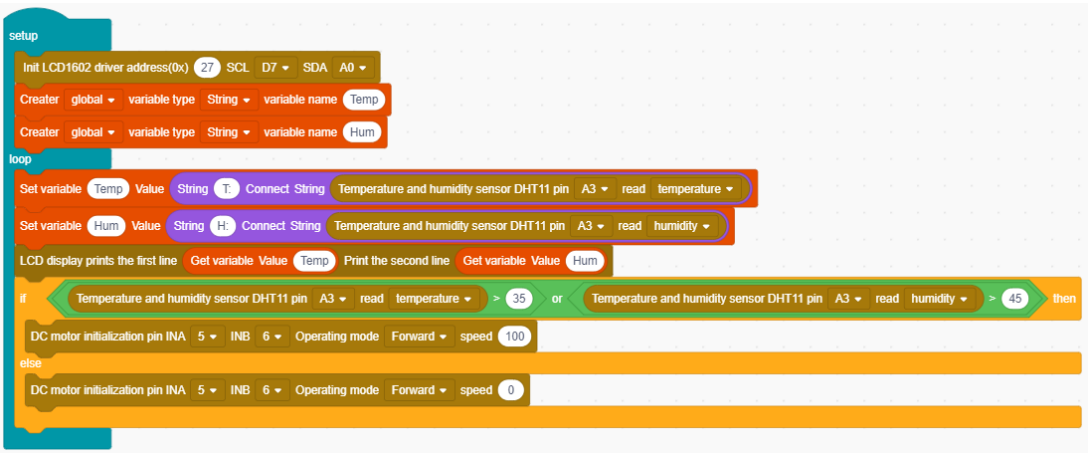
Arduino IDE

```
#include <SoftI2CMaster.h>
#include <LiquidCrystal_SoftI2C.h>
#include <DHT.h>
LiquidCrystal_SoftI2C mylcd(0x27,16,2,7,A0);
DHT dhtA3(A3, 11);

void setup(){
   mylcd.init();
   mylcd.backlight();
    dhtA3.begin();
   pinMode(5, OUTPUT);
   pinMode(6, OUTPUT);
}

void loop(){
   mylcd.setCursor(0, 0);
   mylcd.print(String("T:") + String(dhtA3.readTemperature()));
   mylcd.setCursor(0, 1);
   mylcd.print(String("H:") + String(dhtA3.readHumidity()));
   if (dhtA3.readTemperature() > 35 || dhtA3.readHumidity() > 45) {
      digitalWrite(5,HIGH);
      digitalWrite(6,LOW);
      delay(1000);
   } else {
      digitalWrite(5,LOW);
      digitalWrite(6,LOW);
   }
}
```

Mixly Program



MagicBlock Program



Results: Connect the hardware and upload the program. When the temperature simulation value of the temperature and humidity sensor is greater than 35 or the humidity simulation value is greater than 45, turn on the fan and yellow light; otherwise, turn off the fan and yellow light.

5. Conclusion

In this lesson, we learned the principle of air detection system, using temperature and humidity sensor, LCD display, motor fan module to make a system that can understand the change of indoor temperature and humidity at any time, and realize the function of automatic air purification. In this process, we also mastered the principle of LCD display and programming control use.

XI Wireless Remote Control System

Task Background:

Smart home, as its name implies, is that home appliances and equipment are all intelligent remote control, such as electric curtain, remote control fan, remote control electric lamp, etc. They can be controlled by remote control, which greatly facilitates people's lives. The task of this lesson is to make a wireless control system, which uses remote control to control the household appliances.

Equipment Preparation:

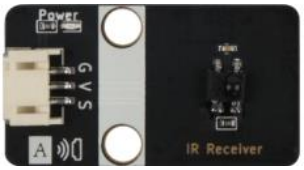
Arduino Ble-Uno main board, expansion board, battery box, remote control, remote control receiver, motor fan, traffic light module, steering gear, connecting cable, USB data cable.

1. Learn about Wireless Remote Control System

The function of the wireless remote control system in this lesson is to use the remote control to control the fan, led, windows and other household devices. The principle is to use the remote control to send out infrared signals, and then the remote control receiver receives the corresponding signals, so as to control the switch of household appliances.

2.Learn about Infrared Remote Control and Infrared Receiver

Infrared receiver is a device which directly converts electric energy into near infrared light, which belongs to diode class. Its structure and principle are similar to the general led, but the semiconductor materials are different. Infrared receiver is a receiving, amplifying and demodulating device. The internal integrated circuit has been demodulated and the output is a digital signal. The infrared receiver consists of IC and PD. IC is the processing element of the receiver, mainly composed of silicon crystal and circuit. It is a highly integrated device. PD is a photodiode, and its main function is to receive optical signals. Infrared reception needs to be demodulated first. The demodulation process is received by infrared receiver. The basic working process is: when the infrared receiving module receives the modulation signal, it outputs high level, otherwise the output is low level, which is the inverse process of modulation. The original data signal output by the infrared receiver



is just in the reverse direction of the transmitter. That is, the original signal of the transmitter is high before, and the receiver outputs low level, otherwise.

The signal from the infrared remote control is a series of binary pulse codes. In order to avoid the interference of other infrared signals in the process of wireless transmission, it is usually first modulated on a specific carrier frequency - 38kHz, and then transmitted through the infrared transmitting diode. The infrared sensor integrated receives and modulates the infrared. The infrared receiver needs to filter out other clutter, receive the signal of the specific frequency and restore it to binary pulse code, that is demodulation.

The infrared receiving module has three pins, G is GND grounded, V is VCC connected to high level 5V, S is signal pin, which can be connected to D1-D13digital interface.

EM Remote Control Key Value Corresponding Table

EM Infrared Remote Control Key Value Corresponding Table								
Keys	**Decimal Value**	**Hexadecimal Value**	**Keys**	**Decimal value**	**Hexadecimal value**	**Keys**	**Decimal Value**	**Hexadecimal Value**
1	12	0x0C	8	82	0x52	A	69	0x45
2	24	0x18	9	74	0x4A	B	70	0x46
3	94	0x5E	0	22	0x16	C	71	0x47
4	8	0x08	UP	64	0x40	D	68	0x44
5	28	0x1C	DOWN	25	0x19	OK	21	0x15
6	90	0x5A	LEFT	7	0x07	+	67	0x43
7	66	0x42	RIGHT	9	0x09	-	13	0x0D

3.Wireless Remote Control Installation

Install the infrared receiver on the beam with M3 * 8 screw, as shown in Figure 11-1.

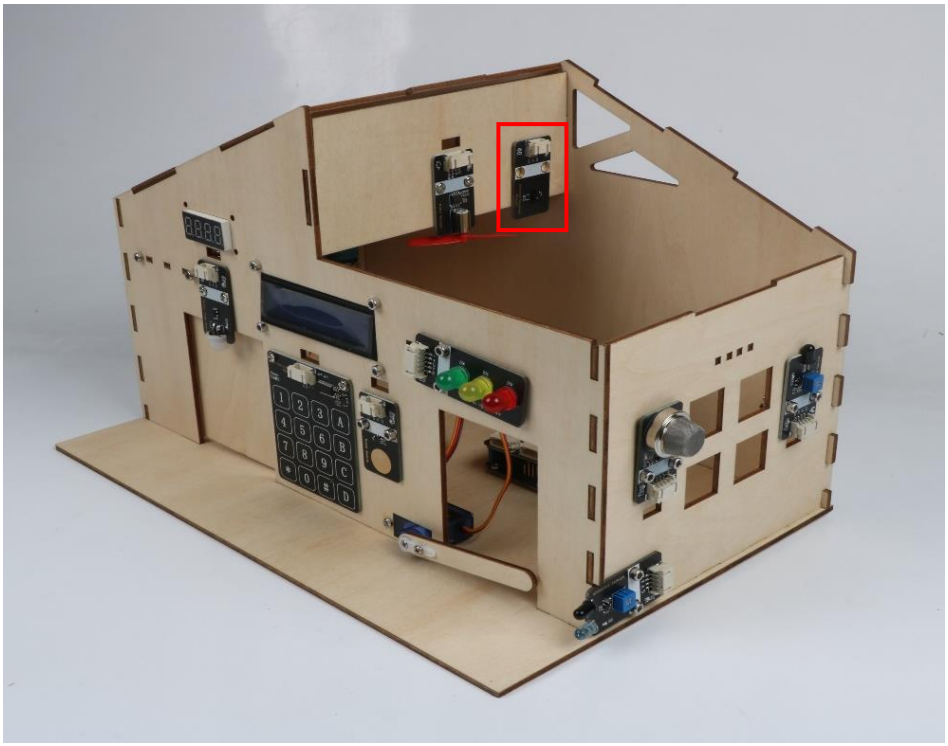


Figure 11-1

4.Programming

4.1 Algorithm Design:

The first step: Set the control signal of the control lamp or fan;

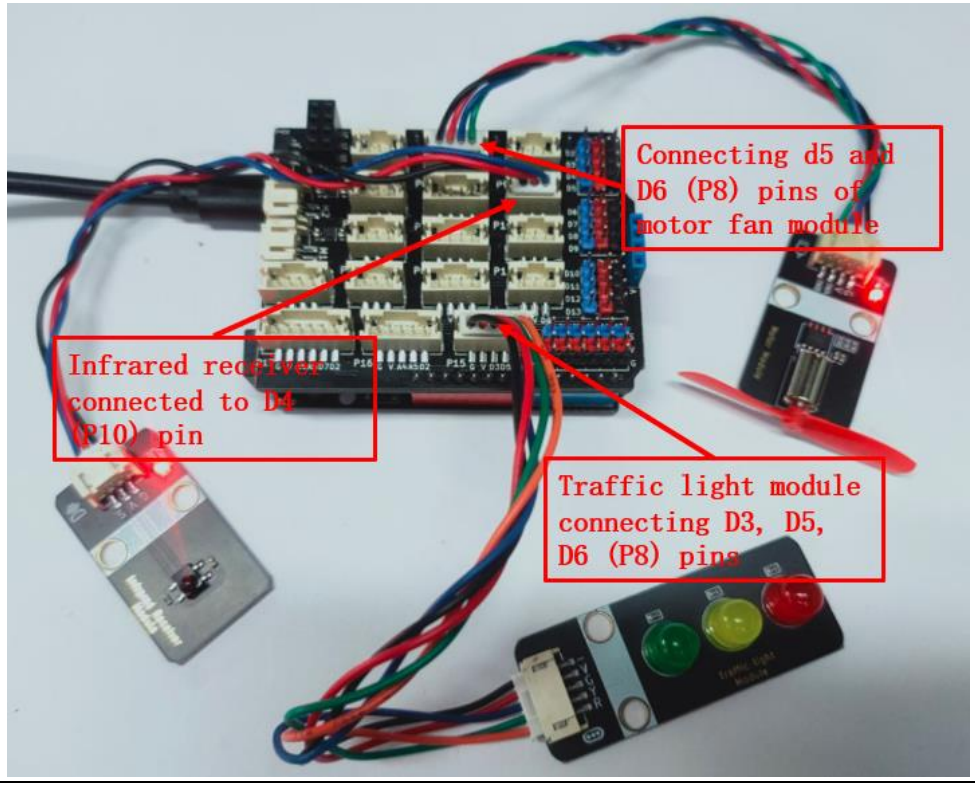
Step 2: Judge whether the infrared receiver receives the signal from the remote control to control the fan or lamp. If so, turn it on; otherwise, turn it off;

Step 3: End the procedure.

4.2 Hardware Connection:

Due to the limited pins of Arduino BLe-Uno main board, take out the sensor connected to D4 pin first, and then connect it to the infrared receiver; in the previous course, the DC motor fan module has been connected to D5 and D6 (P8) pins of the expansion board, the traffic light module has been connected to D3, D5 and D6 (P15) pins, and the steering gear of the control door and window is D12 and D13 pins respectively.

Sensors and Actuators	Main Control Board
Infrared Receiver Module	D4（P10）
DC Motor Fan Module	D5、D6（P8）
Traffic Light Module	D3、D5、D6（P15）
Steering Gear for Control Door	D12
Steering Gear for Windows	D13



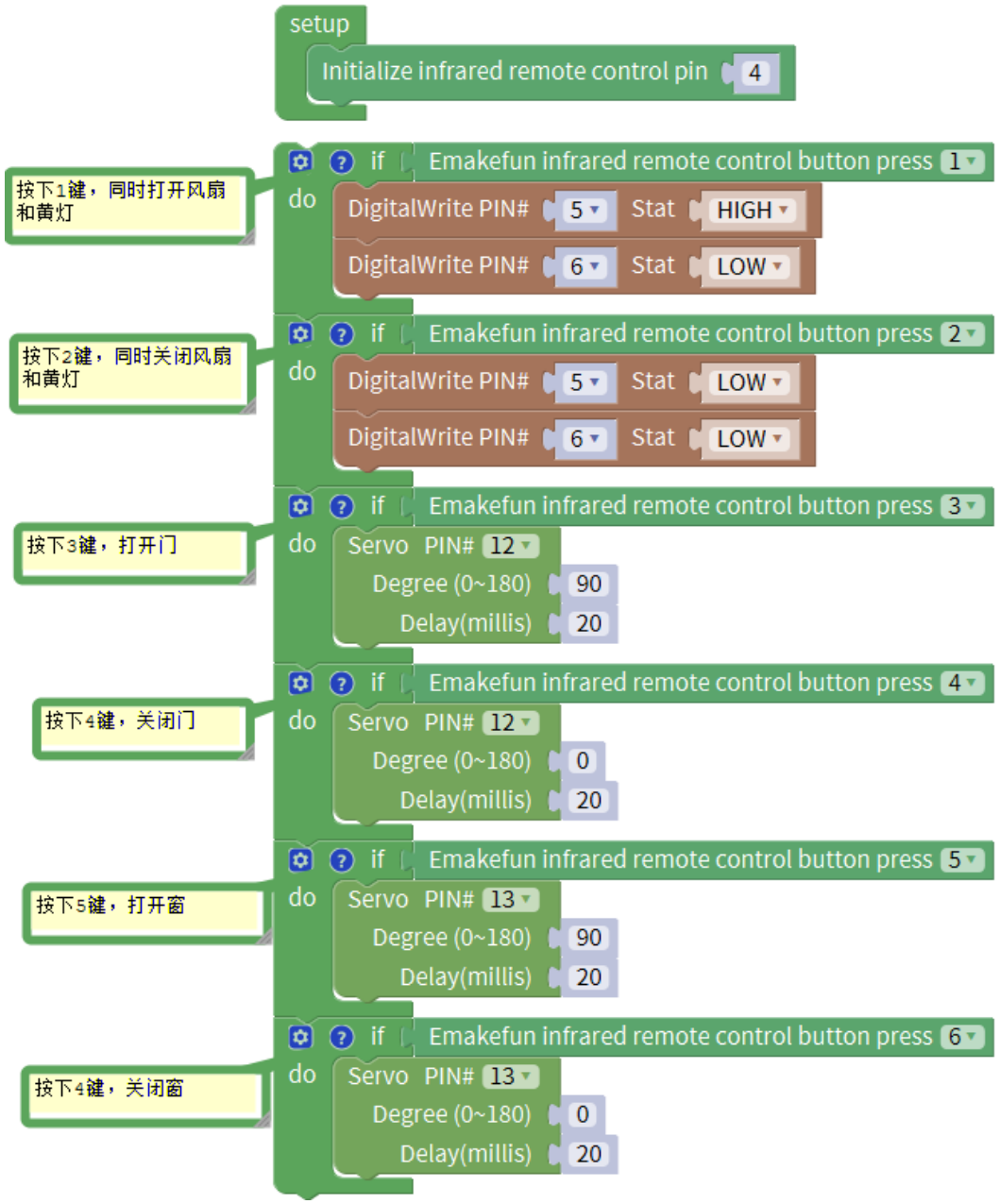
4.3 Sample Program:

Arduino IDE Proram

```
#include "IR_remote.h"
#include "keymap.h"
IRremote ir(4);
#include <Servo.h>
Servo servo_12;
Servo servo_13;

void setup(){
  ir.begin();
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
  servo_12.attach(12);
  servo_13.attach(13);
}

void loop(){
  // Press the 1 key to turn on the fan and yellow light at the same time
  if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_1) {
    digitalWrite(5,HIGH);
    digitalWrite(6,LOW);
```

```
    }
    // Press key 2 to turn off the fan and yellow light at the same time
    if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_2) {
        digitalWrite(5,LOW);
        digitalWrite(6,LOW);
    }
    // Press key 3 to open the door
    if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_3) {
        servo_12.write(90);
        delay(20);
    }
    // Press key 4 to close the door
    if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_4) {
        servo_12.write(0);
        delay(20);
    }
    // Press 5 to open the window
    if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_5) {
        servo_13.write(90);
        delay(20);
    }
    // Press the 4 key to close the window
    if (ir.getIrKey(ir.getCode(),2) == EM_IR_KEYCODE_6) {
        servo_13.write(0);
        delay(20);
    }
}
```

Mixly Proram



Magic Block

5.Conclusion

In this lesson, we learned the principle of smart home wireless remote control system, using infrared remote control and receiver to realize the control of fans, windows and other home devices. We also mastered the programming and principle of infrared remote control and infrared receiver.

XII Initial APP Production

Task Background:

Smart home app is the medium for mobile management and control of smart home. It can be said that smart home without app is not a real smart home. The application of APP provides a new control mode for smart home and is an integral part of smart home. The emergence of smart home app has greatly changed the living habits of some families. It not only gives users a comfortable experience process, but also is a good helper of home life. The task of this lesson is to understand the smart home app and its production process and principle.

1. Learn about the Basic Functions of Smart Home APP:

Smart home app is designed to manage and control smart home. Therefore, when designing smart home app, it should have the following basic functions:

1. Information Feedback: The data of the running status of smart devices at home can be fed back to the mobile app in real time. When there is an abnormal situation, the alarm information can be sent to the mobile app remotely.

2. Equipment Control: It mainly includes timing, remote, linkage, scene, etc., such as timing switch air conditioning, remote turn off TV and lighting, etc.

3. Security Protection: Smart home appliance app development in order to make the majority of users' home life more secure. It launched a set of security protection system; check home security issues anytime and anywhere.

2.Learn About App Inventor 2

App inventor 2 software tools are used to develop app. App inventor 2 is abbreviated as AI. In order to distinguish it from artificial intelligence, it is abbreviated as lowercase. AI can only make Android applications at present. Due to the limitation of IOS specification, AI can only make Android applications for a long time in the future.

AI is a visual Android application production platform. Users can open the AI platform website (APP inventor 2 WxBit Chinese version, abbreviated as WxBit version) with a browser. It provides components such as Gaode map, Gaode positioning, Baidu speech synthesis and recognition, camera preview box, etc. It supports multi touch, dynamic creation of components and general events, as well as more details optimization, Chinese version and enhanced app Inventor 2 server.) Like scratch

programming, Android applications can be programmed by dragging and dropping components and logic blocks.

AI partner, the real-time debugging tool provided by AI platform, can connect and debug the Android Application in production through AI connection code after the installation of mobile phone or Android simulator.

Before you start to make an app, install the AI2 Companion (mobile version, computer version) for your site. If you install other versions of AI2 companion on your phone, you need to uninstall it first, otherwise you can't install it due to name conflict.

3.Learn About App Inventor 2

App inventor 2 must use Google browser, QQ browser, Firefox, Safari and other non IE browsers to open AI website: WxBit Chinese version. Note: Some browsers need to register an account. Just register by email. There is no need to repeat here. After you complete the registration, the browser will prompt you to verify your account and log in to another device. At this time, you only need to download the same browser on your mobile phone.

This document is demonstrated by the browser of Firefox. The specific operation steps are as follows:

1. Go to app inventor 2 online website: https://app.wxbit.com/

2. Log in with QQ account, as shown in Figure 12-1.

Figure 12-1

1. If you have logged in QQ on your computer, your QQ number will be automatically detected and you can click it directly, as shown in Figure 12-2.

Figure 12-2

2. After logging in, enter the app inventor 2 interface, as shown in Figure 12-3.

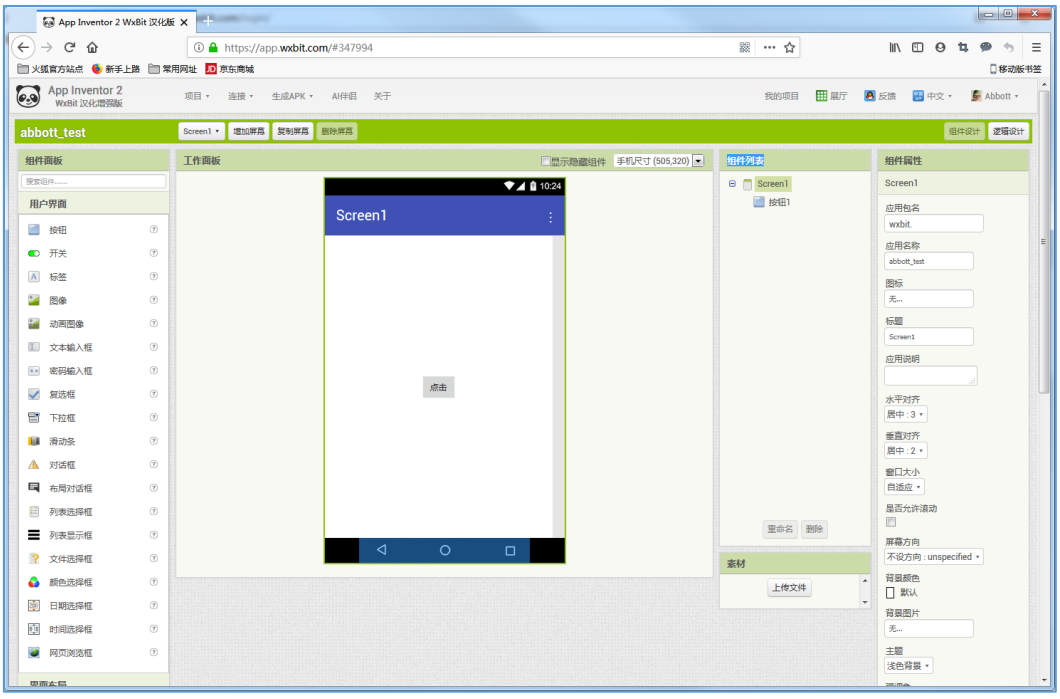


Figure 12-3

3. Click the label “help” in the upper left corner of APP inventor 2 interface, and then click “download AI partner”, the window of downloading AI partner will appear, and the version to download will be selected, as shown in Figure 12-4 and 12-5:

Figure 12-4

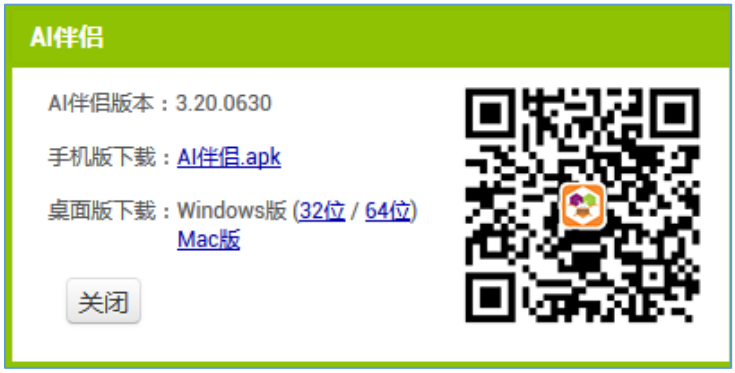


Figure 12-5

When choosing to download AI companion version:

1)If you choose to install AI partner on your mobile phone, you can download it by scanning QR code. However, it is slow to download by scanning QR code. You can also download AI partner.apk through your computer, and then find the downloaded AI partner.apk on your computer. As shown in figure 12-6, you can install the downloaded installation package through QQ or copy it to your Android mobile phone.

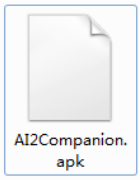


Figure 12-6

2)If you choose to install AI partner on your computer, choose the appropriate version according to your computer system.

If the computer is a Windows 32-bit system, click the desktop version shown in figure 12-7 to download: Windows Version (32-bit).

If the computer is a Windows 64 bit system, click the desktop version shown in figure 12-7 to download: Windows Version (64 bit).

If the computer is an apple system, click the desktop version shown in figure 12-8 to download: Mac version.

3)After downloading the AI partner installation package, find the downloaded installation package on the computer, as shown in figure 12-7.

Figure 12-7

6. Then double-click and click “next” to start the installation, as shown in figure 12-8. After a while, the installation is completed, as shown in Figure 12-9.

Figure 12-8

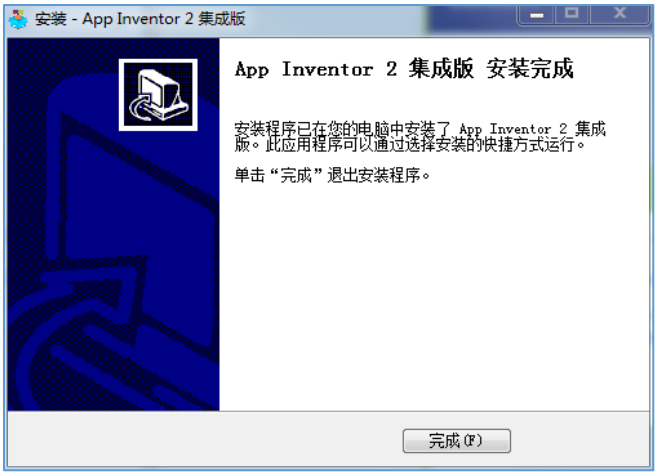


Figure 12-9

7.By now, all the tools of APP inventor 2 have been installed. If you install the computer version (integrated version), three icons will appear on your computer desktop, as shown in Figure 12-10

图 12-10 Figure 12- 10

a) “AI2 Chinese version” is opened with its own Chrome browser https://app.wxbit.com. Do not use this shortcut, use your favorite browser to open the above URL, and the effect is the same. This shortcut is just convenient for users who don’t have the right browser and don’t bother to remember the URL.

b) The shortcut “AI2 integrated version” will launch AI2 companion and AI2 Chinese version at the same time.

c) “AI2 companion” is an AI companion that uses a browser to simulate running. Some computers cannot be started because the graphics card is not supported or compatible. If others stay in the icon interface for a long time, please try “run with administrator privileges”. Some computers need to select a folder as the external storage (SDCard) of AI partner when running AI partner for the first time. The “Appinventor” directory in this folder is used to save the material files of debugging application. Be sure to select, otherwise it will not start. The first time some computers run, they will be prompted to update their AI2 partners. After running, they can wait for the update to complete.

Figure 12-11Computer version of AI companion interface

Figure 12-12Mobile AI companion interface

4. Learn the development environment of APP inventor

The programming environment of APP inventor includes the following three important components, as shown in Figure 12-13:

●Design View: As shown in figure 12-13a, the component designer runs in the browser and is used to select components and set properties during application creation;

●Logic Design View: As shown in figure 12-13b, like the component designer, the block editor also runs in the browser to create the behavior of the component;

●Test Device: In the process of application development, you can use Android devices to run and test the application synchronously; if you don’t have Android devices on hand, you can use the Android simulator integrated in the system to test the application.

Figure 12-13A Design View: used to set the appearance of the app

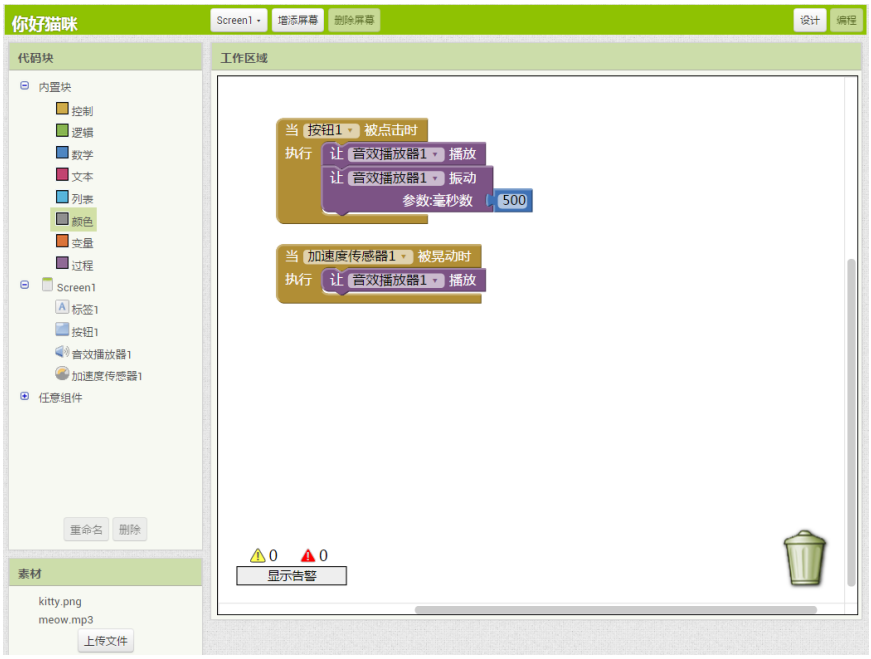


Figure 12-13B Programming View: used to set the behavior of the application

If you are visiting AI2 for the first time appinventor.mit.edu You'll see the project page, which is mostly empty because you haven't created any projects yet. Click the menu "project → new project" in the upper left corner of the page to create a project, enter smart home" as the project name (note that there are no spaces), and then click the "OK" button.

The first window opened after creating a new project is design view. At this time, you can click the logical design button in the upper right corner of the window to switch to logical design view.

App inventor is a development tool based on cloud computing. That is to say, when you are developing a project, all the information in the project is saved on the network server. Therefore, when you close app inventor and then reopen it, the project is still there. You don't need to save any information on the local computer like Microsoft Word.

5. Making "welcome to smart home" app

1. Double click to run the Chinese version of AI2, as shown in Figure 12-14, and log in with QQ;

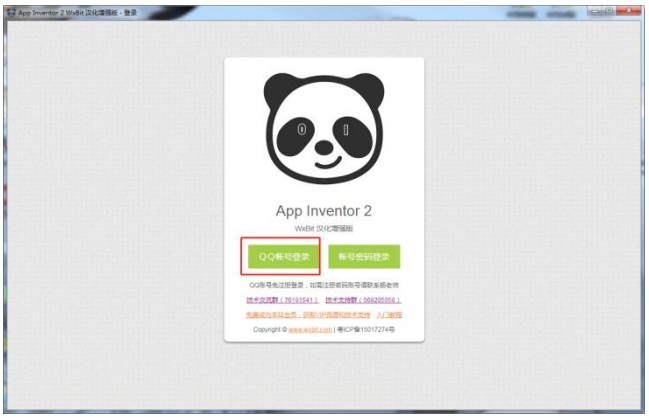


Figure 12-14

2. After that, the login interface is shown in figure 15-12;

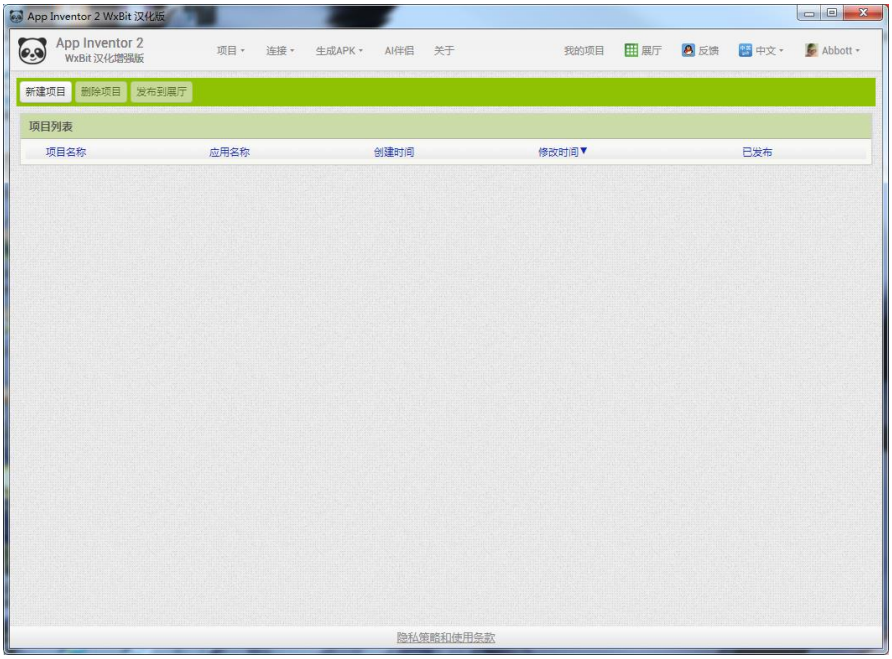


Figure 12-15

3. To create a new project, click "new project" to start making Android applications, as shown in Figure 12-16. In the pop-up window, fill in the project name as "smart home", as shown in Figure 12-17.

Figure 12-16

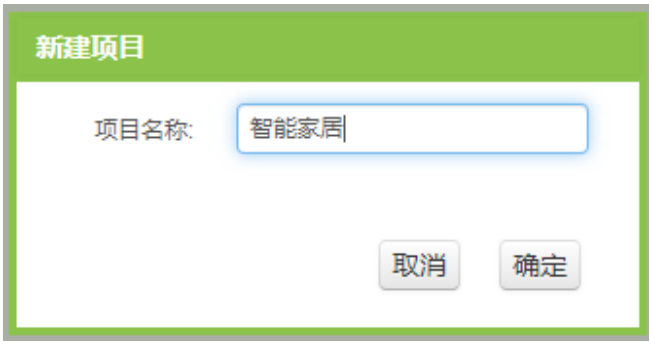


Figure 12-17

4. Click “confirm” to enter the component design page automatically, as shown in Figure 12-18.

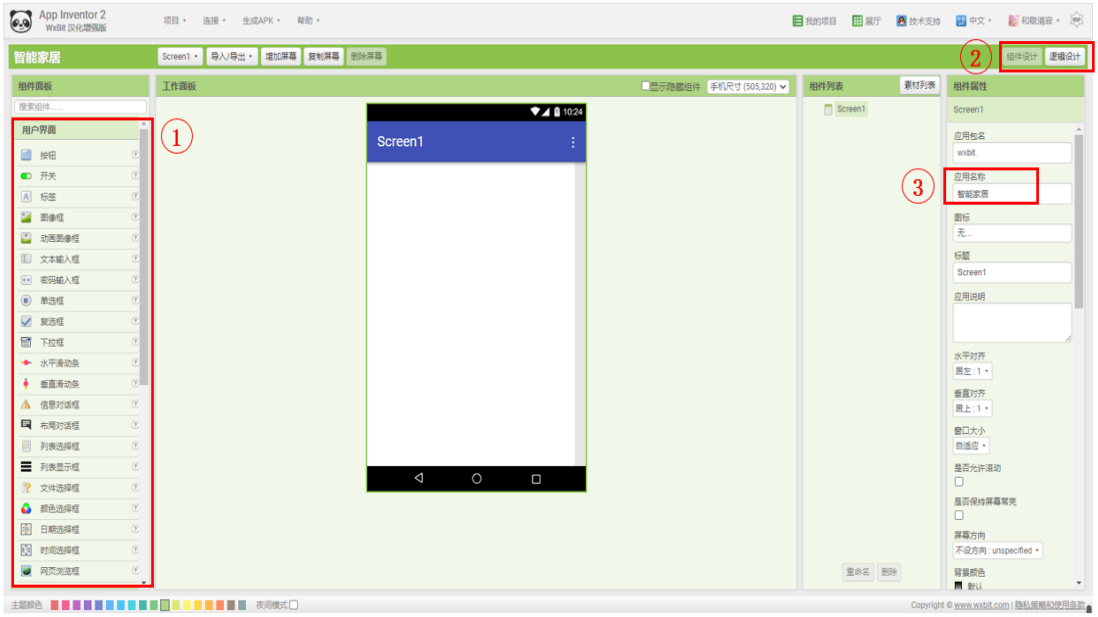


Figure 12-18

Identification 1: Component Panel: After selecting the required components, drag and drag the mouse to the middle mobile interface area, and then the component can be used in the project. Click the question mark on the right side of the component to view the introduction of the component. After familiar with the AI built-in components, you will

find that the components are not enough, so you can add other components by uploading "extension" to expand the AI function and make more rich applications.

Identification 2: There are two important functions in AI: component design and logic design.

In the component design view, select the appropriate interface for component design and application;

In the logical design view, design the event logic corresponding to the component. For example, click the button to update the display text of the label.

Identification 3: In the "component properties" area, different components will have different attributes. In the properties of "screen1" component, you can set the display name and application icon installed in the mobile phone. The specific purpose of the property can be understood through the attribute name. A few attributes that cannot be understood can be seen by connecting AI partners after setting.

5.Click "Screen1", and in the title bar of component properties, change the title name to "Smart Home" and enter to confirm. You will see that the text above the preview window has changed, as shown in Figure 12-19.

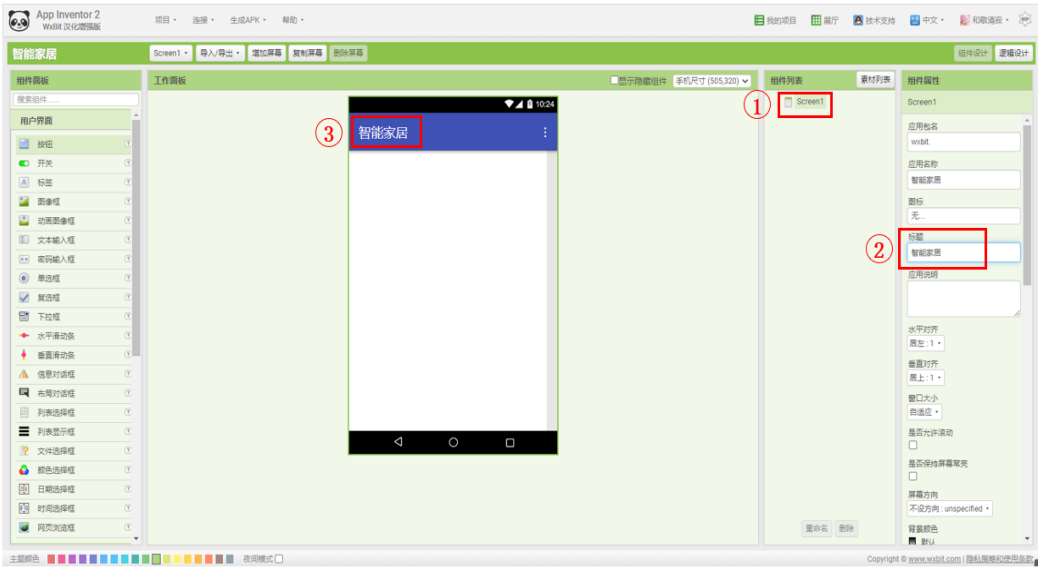


Figure 12-19

6.Drag the button on the user interface to the control work panel, and then click screen1 in the component list, and select the corresponding alignment method in the horizontal and vertical alignment in the component properties, and you can see the position of "button" in the app interface, as shown in Figure 12-20:

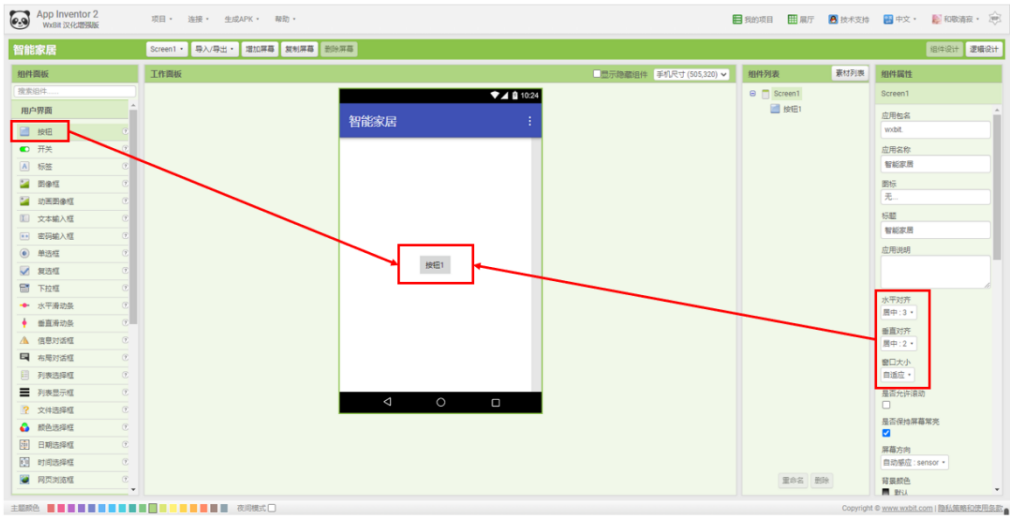


Figure 12-20

7.Click the button of the component list, modify the text in the component properties, “Welcome to the Smart Home Furnishing”. Set the size of the font size, then select the photos you need to import in the background bar, adjust the appropriate size in the width and height column, as shown in Figure 12-21:

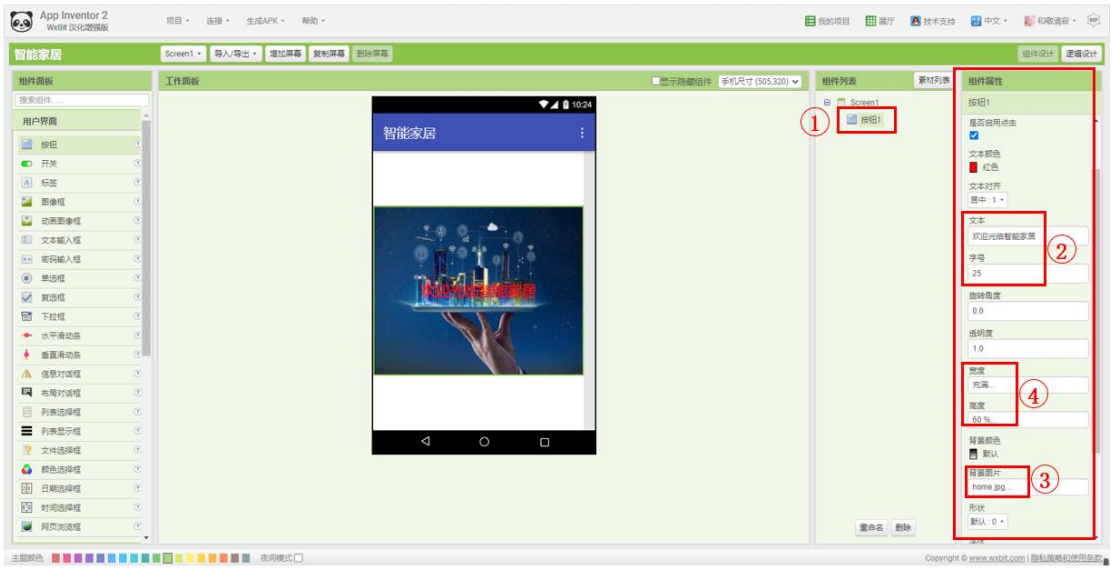


Figure 12-21

8.In the components panel on the left side of design view, click multimedia components to open the multimedia components list. Drag and drop an audio player component into the preview window. No matter where you put it in the preview window, it will appear in the “Non Visual Components” area at the bottom of the workspace. Non visual components are used to implement specific functions in the application, but they will not be displayed in the user interface. Then click audio player 1 to upload and download

the good components in the source file column of component properties “Welcome.Mp3”. The sound effect file is shown in Figure 12-22.

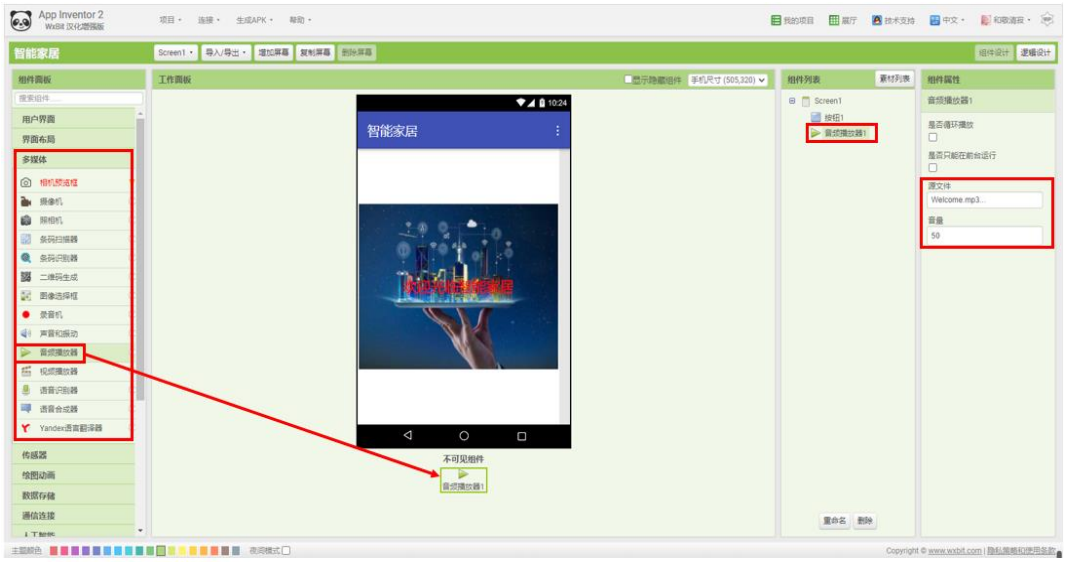


Figure 12-22

9.Click the logic design in the upper right corner to switch to the programming interface, then select its control program module from the buttons in the module and the sound player, drag it to the work panel for combination, and then click save project, as shown in Figure 12-23.

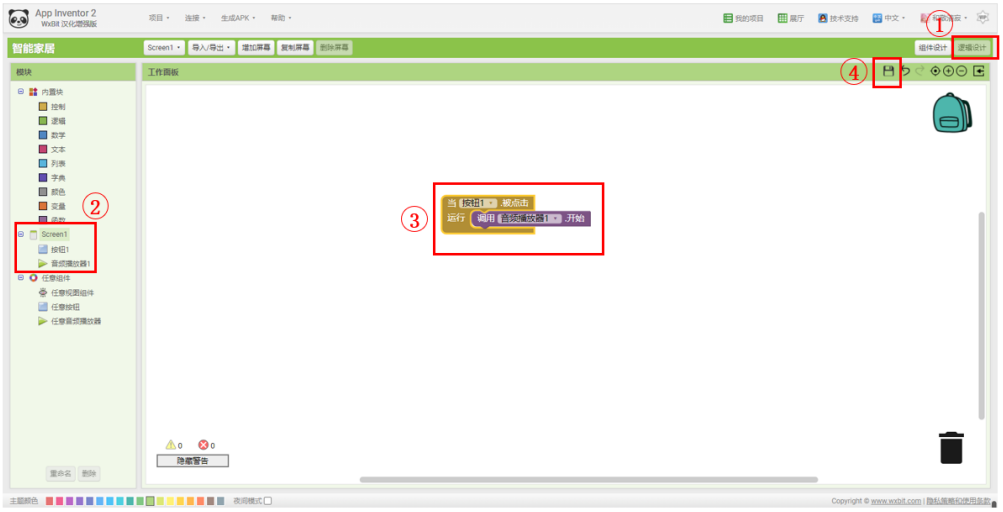


Figure 12-23

10.Click generate APK in the upper left corner, and the options of “display QR code” and “download to local” will appear, as shown in Figure 12-24. Click the display QR code to generate the APK file QR code, as shown in Figure 12-25, and then use the mobile phone AI partner to scan the map QR code to download and follow the smart home app; select download to this machine to download the generated APK file to the computer, as shown in Figure 12-26, that is to complete the app production.

Figure 12-24

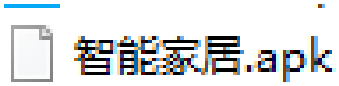


Figure 12-25 Figure 12-26

11.Open the smart home app on the mobile phone, and you can see the interface as shown in Figure 12-27. Click the pattern to hear the “Welcome” voice.

Figure 12- 27

5.Conclusion

In this lesson, we learned about the development environment and use of APP inventor, and made a simple app welcome to smart home through APP inventor 2, so as to master the basic production method of APP.

XIII Bluetooth Smart Light

Task Background

In the ordinary home, household appliances and equipment are generally controlled by manual switch, which is very troublesome in the use process, and sometimes there is the danger of electric shock. If you can directly use the mobile phone to realize the remote control of the electric light, it will be more safe and convenient. The task of this lesson is to make a mobile phone app to realize the remote control of lighting on and off.

Equipment Preparation

Arduino Ble-Uno main board, expansion board, battery box, LED module, mobile phone, connecting cable and data cable.

1.Learn about the Principle of Bluetooth Smart Light

The principle of the Bluetooth smart light produced in this course is to connect the mobile phone with Arduino Ble-Uno via Bluetooth, and then use the mobile phone app to remotely send wireless signals to the Ble-Uno main board, and then the main board controls the LED light on and off.

2. Bluetooth Smart Light App Production

2.1 Bluetooth Plug in Extension Import

Due to the lack of some functions in the Bluetooth connection process of ble-nano, the components in the communication connection part of AI2 need to be imported and extended.

1.Click “Extend” in the component panel, and then click “Import Extension”, as shown in Figure 13-1.

Figure 13-1

Figure 13-2

2.Click “select file” in the pop-up window, as shown in Figure 13-2; then find the file to store “edu.mit.appinventor.ble.BluetoothLE.aix”. Select the file and open it, then click “import” and import Bluetooth plug-in successfully.

2.2 Design of APP Interface Components

Last class, we have completed the production of smart home app home page, we can continue to complete the function realization of this class on the basis of it.

1. Click add screen and confirm the screen name is screen2. You can see that a blank page of screen2 has been added to the work panel, as shown in Figure 13-1.

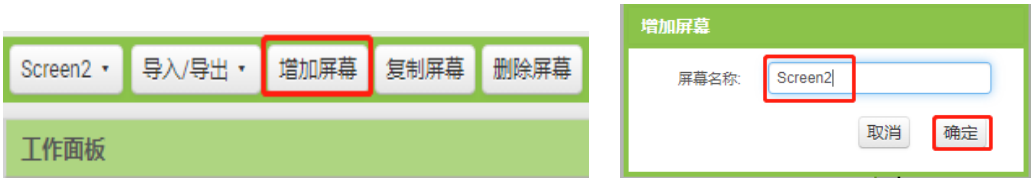


Figure 13-3

2.Find the required components from the components panel, drag them to the work panel in turn, as shown in Figure 13-4, and then modify the corresponding parameters.

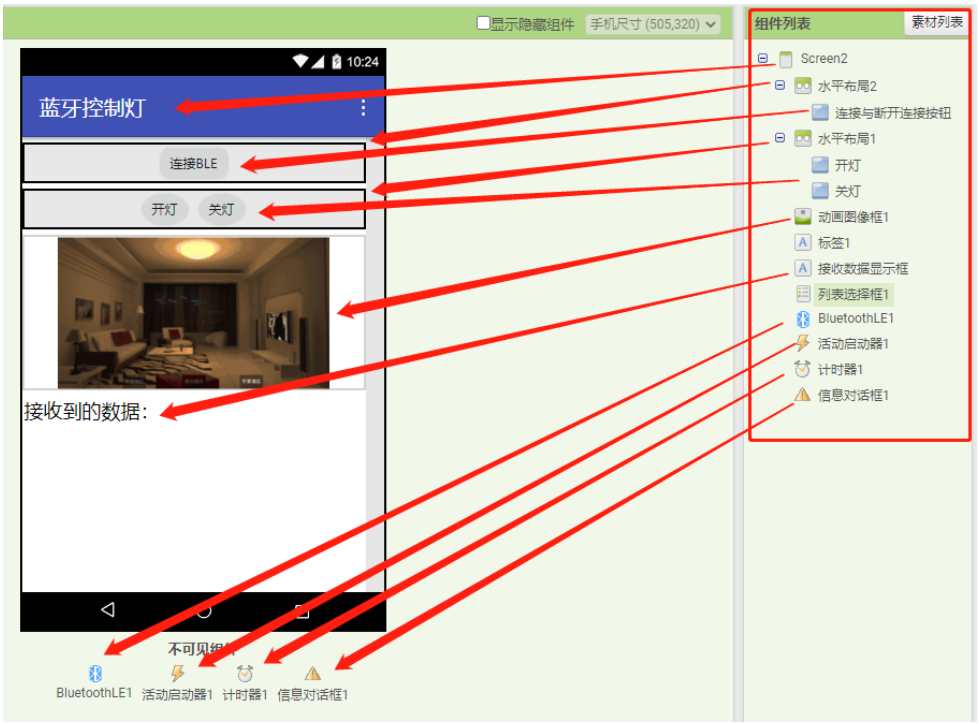


Figure 13-4

2.3 App interface Logic Design

1. First, switch the screen, select the screen 1 to enter the logic design interface of screen 1, and input the following program:

Figure 13-5

1. Bluetooth Logic Design. Select screen 2 to enter the logic design page of screen 2. When designing Bluetooth, you first need to know the UUID of the device. Therefore, you need to get the UUID of the device through the general Bluetooth test app, and first verify whether the BLE is recognized normally https://github.com/emakefun/emakefun-Ble-uno/tree/master/TestApp. Download the APK and test that the communication with BLE-UNO board is normal. Verify that the equipment is normal, install a BLE test tool, open the test app, and the interface is shown in figure 13-6. Find the corresponding Bluetooth name (Ble-Nano) and click to connect. After connecting, as shown in figure 13-7, four options will appear to test

different functions. We will see the service of the device UUID:0000ffe0-0000-1000-8000-00805f9b34fb.

Figure 16-6

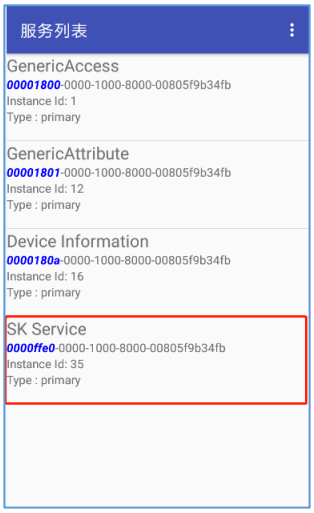


Figure 13-7

2. Select SK service to enter, and you will see the characteristic value UUID (characteristic)_uuid): 0000ffe1-0000-1000-8000-00805f9b34fb, as shown in figure 13-8.

Figure 13-8

Since the address is required for communication with bluno, two global text variables are initialized first, as shown in figure 13-9.

1）ble_ service_uuid is the address of Bluetooth service, changed to: 0000ffe0-0000-1000-8000-00805f9b34fb

2）ble_ characteristic_ uuid is the communication address of the device, which is changed to: 0000ffe1-0000-1000-8000-00805f9b34fb

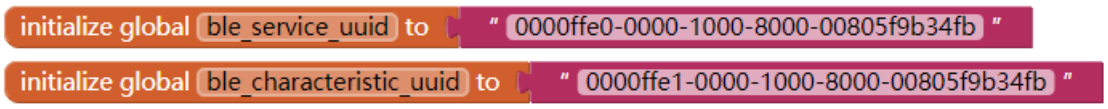


Figure 13-9

3. Next, turn on Bluetooth to get permission for the program and scan the surrounding Bluetooth device:

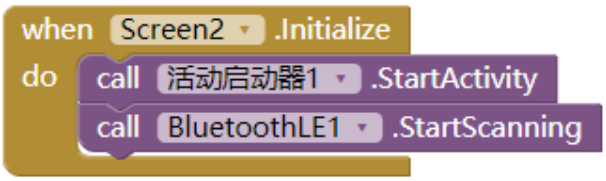


Figure 13-10

4. Scan after Bluetooth is turned on

●If the button is displayed as “connect BLE” when the button is pressed, it indicates that the current Bluetooth is disconnected, then stop scanning around;

●If the button displays “disconnect BLE” when you click it, it indicates that the current Bluetooth is connected, then disconnect the current connected Bluetooth.

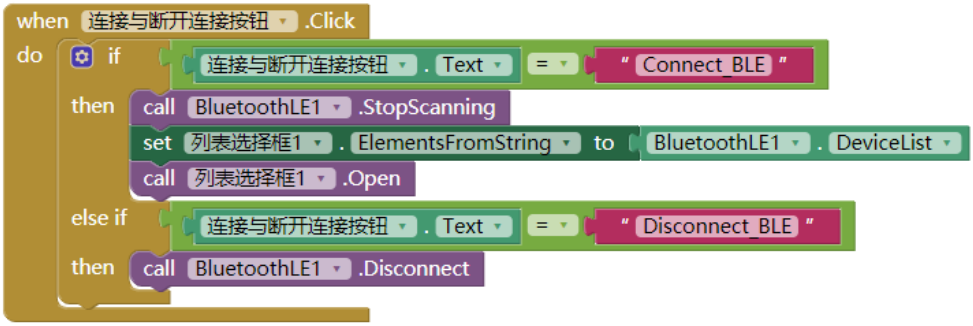


Figure 13-11

5. Data Getting:

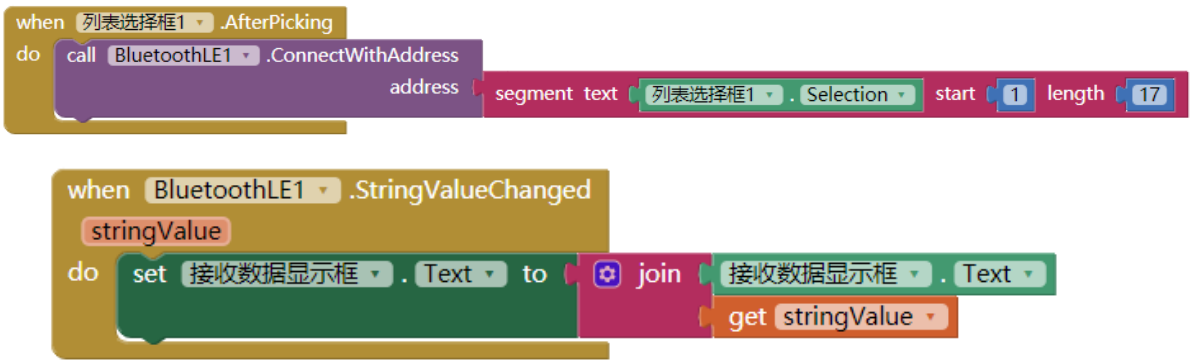


Figure 13-12

6. Set Timer Action:

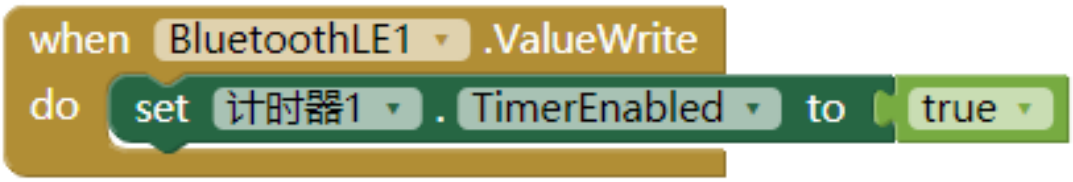


Figure 13-13

Figure 13-14

7.Define the Data Sending Process:

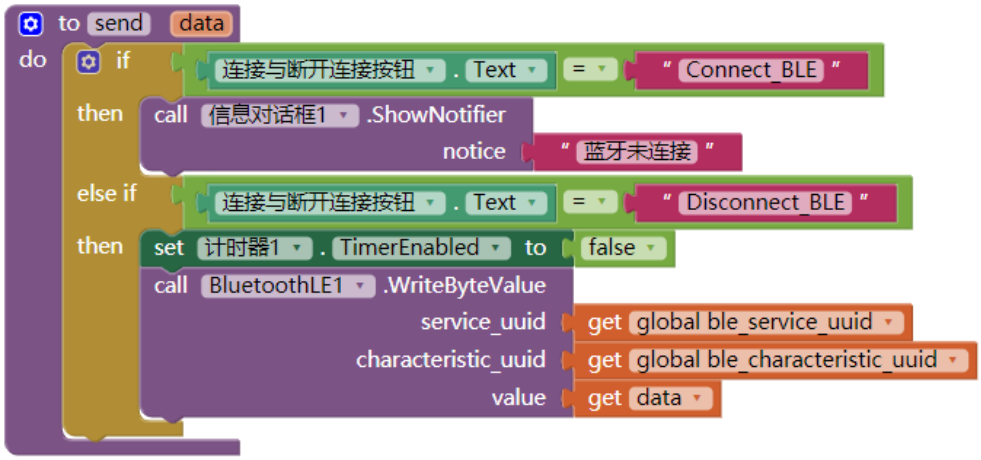


Figure 13-15

8 .Switch On and Off Button Settings

Figure 13-16

9.Connect BLE Button Settings

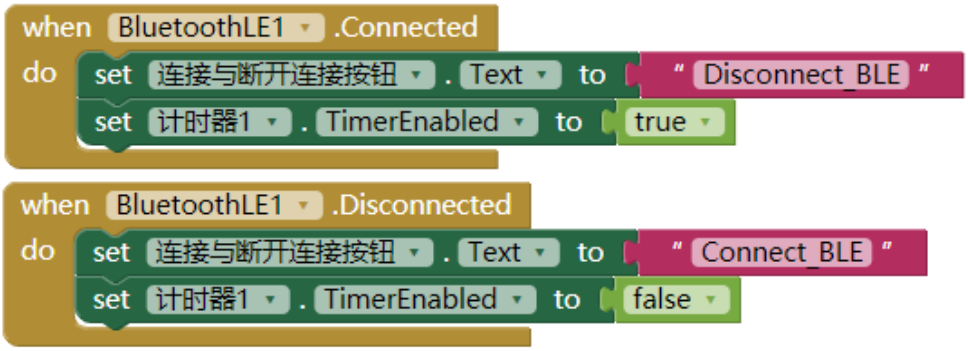


Figure 13-17

10. After the design of app is completed, download it with AI2 partner mobile phone, open it after installation, and the interface is shown in Figure 13-18.

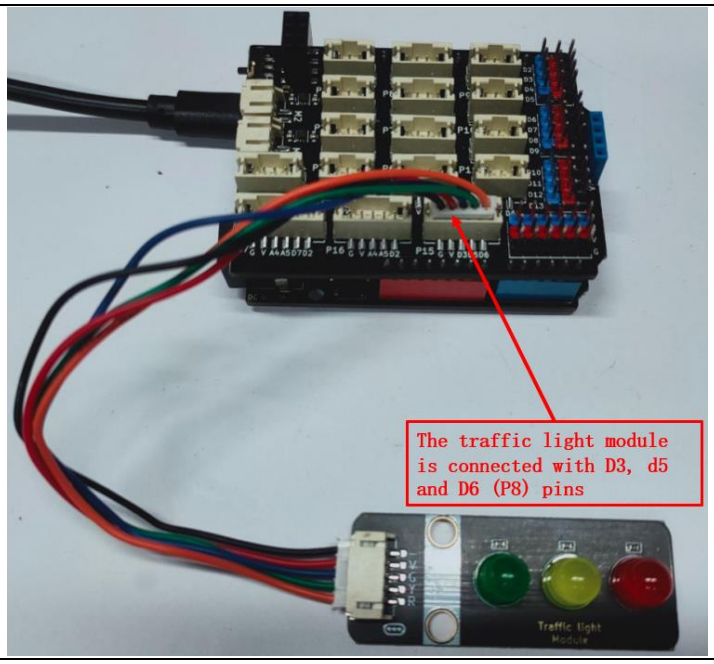
Figure 13-18

3. Programming of Arduino Ble-Uno main board

3.1 Hardware Connection:

Connect the traffic light module to the D3, D5, D6 (P15) pins of Arduino BLE-UNO main board, and the green LED corresponds to the D3 pin, so the green light is controlled in the example program.

Actuator	**Main Control Board**
Traffic Light Module	D3、D5、D6（P15）

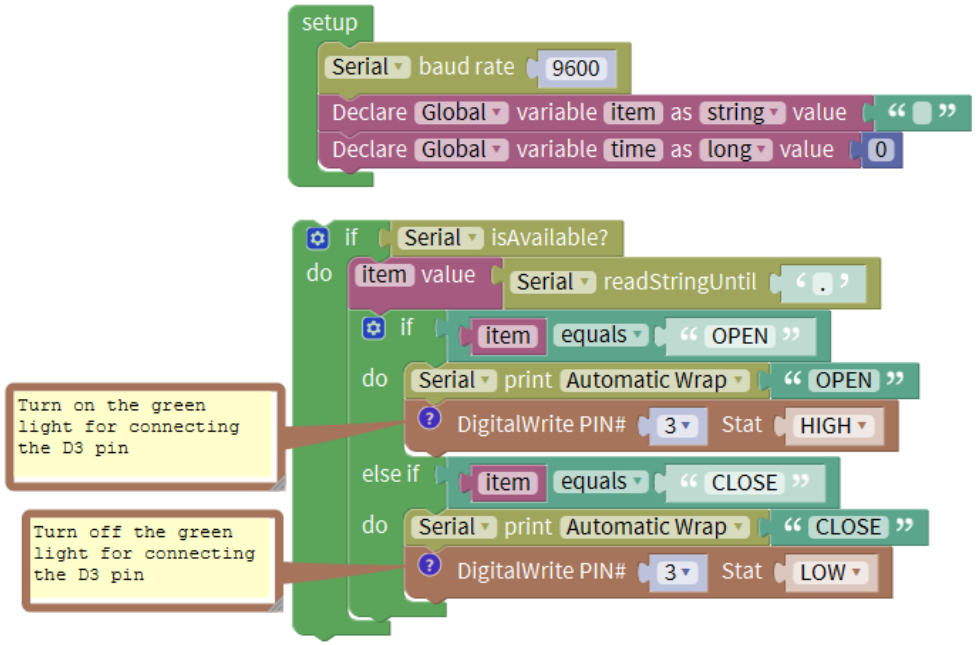


3.2 Program Example:

Arduino IDE Program

```
String item;
volatile long time;
void setup(){
  Serial.begin(9600);
  item = "";
  time = 0;
  pinMode(3, OUTPUT);
}

void loop(){
  if (Serial.available() > 0) {
    item = Serial.readStringUntil('.');
    if (String(item).equals(String("OPEN"))) {
      Serial.println("OPEN");
      // Turn on the green light for connecting the D3 pin
      digitalWrite(3,HIGH);
    } else if (String(item).equals(String("CLOSE"))) {
      Serial.println("CLOSE");
      // Turn off the green light for connecting the D3 pin
      digitalWrite(3,LOW);
    }
  }
}
```

Mixly Program



MagicBlock Program

Warning:

When downloading the program, you need to disconnect the power supply from BLE-Nano and power it on again. If the app is in the open state, you need to click exit in the upper right corner and then connect again, otherwise you cannot operate BLE-Nano normally.

4. Conclusion

In this lesson, we learn how to make Bluetooth intelligent control light, further consolidate the production of app, master the programming principle and production of Bluetooth light, and realize the function of APP Bluetooth remote control LED light on and off.

XIV Bluetooth intelligent fan

Task Background:

Although the fan used in people's daily life can adjust the speed and wind force properly, it can't be controlled remotely and needs manual operation to start or shut down. The task of this lesson is to make a Bluetooth intelligent fan, and design a mobile app for remote control of the fan. Through Bluetooth connection, remote control of the fan can be realized, so that people can experience the convenience of smart home again.

Equipment Preparation:

Arduino ble uno mainboard, expansion board, battery box, DC motor fan module, connecting cable, USB data cable.

1.Learn about the principle of Bluetooth intelligent fan

The principle of the Bluetooth intelligent fan produced in this lesson is to use the smart home mobile phone app to connect with the Arduino BLE-UNO main board through Bluetooth, and then remotely control the startup and shutdown of the fan through the app.

2.Bluetooth intelligent fan app production

2.1 Interface Design

1)The operation of control fan is the same as the control LED lamp designed in the last lesson. We can continue to add buttons and other components to control fan start and close on the basis of the previous lesson, and write corresponding programs. We can also add a "Bluetooth Fan" interface separately.

2) If you add a Bluetooth fan control interface, we can select the copy page on the Srceen2 page, modify the name of the new screen as Screen3 in the pop-up window, then rename the relevant components, and rename the name or other parameters you want, as shown in Figure 14-1:

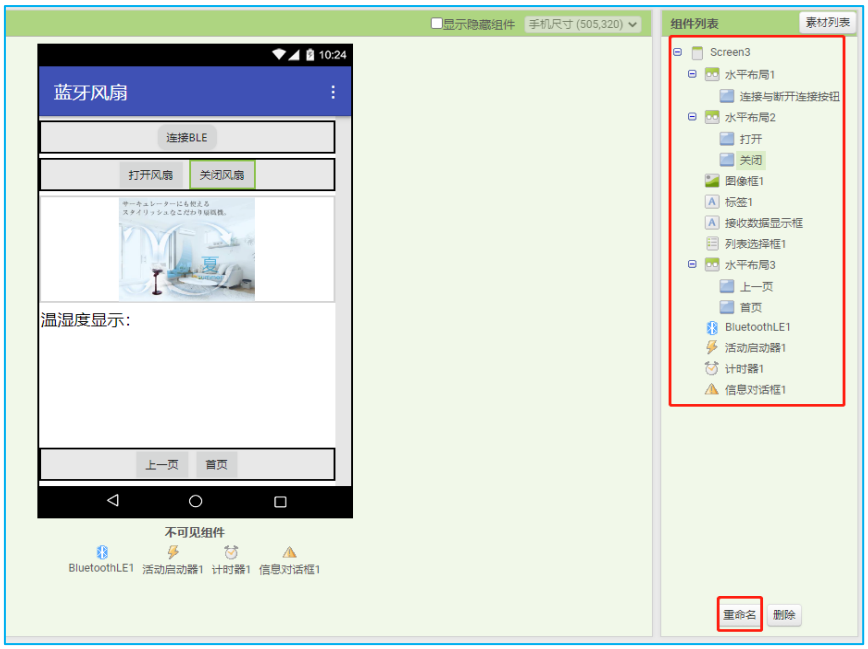


Figure 14-1

3)Because more one interface is added, we must have corresponding key operation to switch multiple interfaces on app. Therefore, we add components of “previous page” and “next page” or “home page” in Screen2 interface and Screen3 interface, as shown in Figure 14-2.

Figure 14-2

2.2 Program Logic Design

1）If you need to switch multiple interfaces, you need to write the corresponding program on the corresponding page, as shown in figure 14-3：

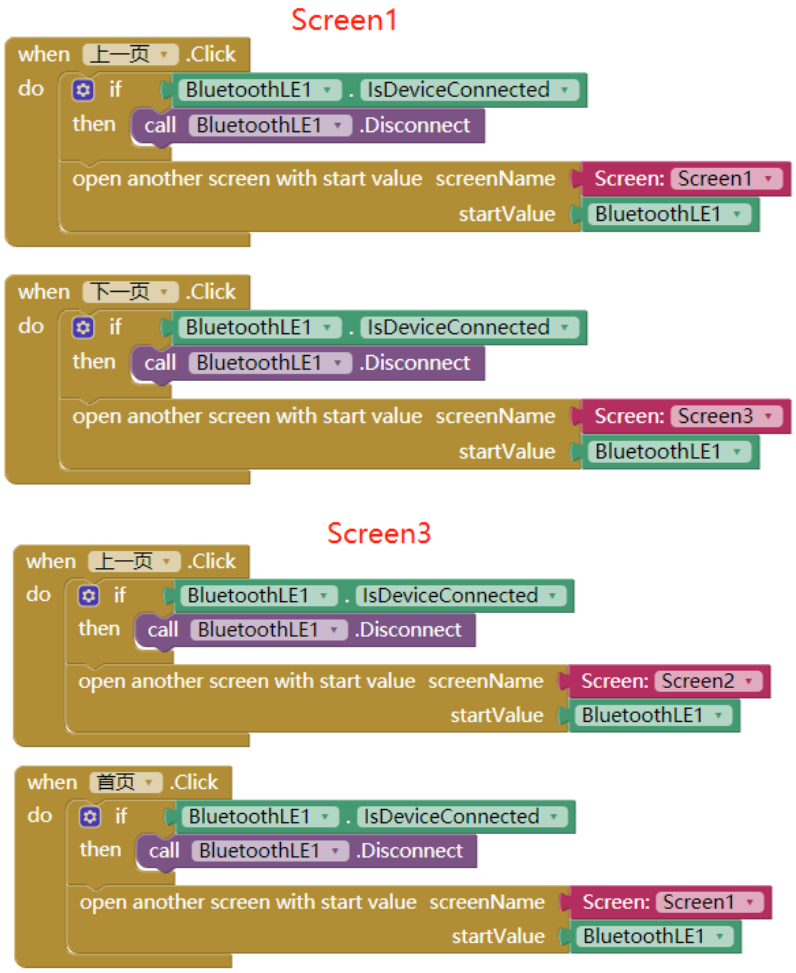


Figure 14-3

2）When copying an interface, we copy not only the components of the interface, but also the programs of the interface. In this way, we can modify the corresponding programs according to our newly added interface components.

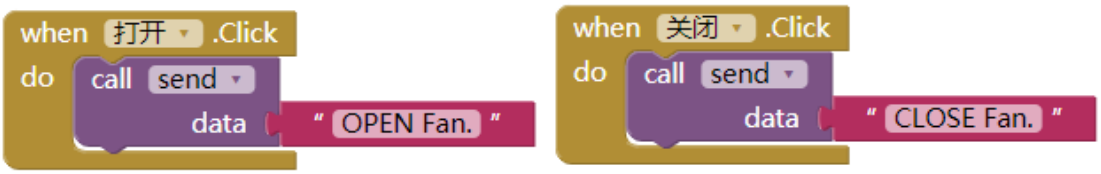


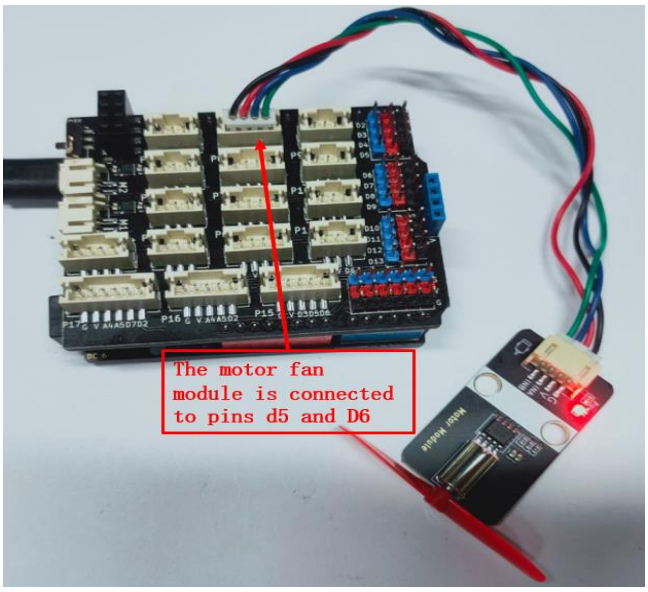
Figure 14-4

3. Programming of Arduino BLe-Uno main board

3.1 Hardware Connection:

Connect the DC motor fan module to pins D5 and D6 (P8).

Actuator	Main Control Board
DC Motor Fan Module	D5、D6（P8）



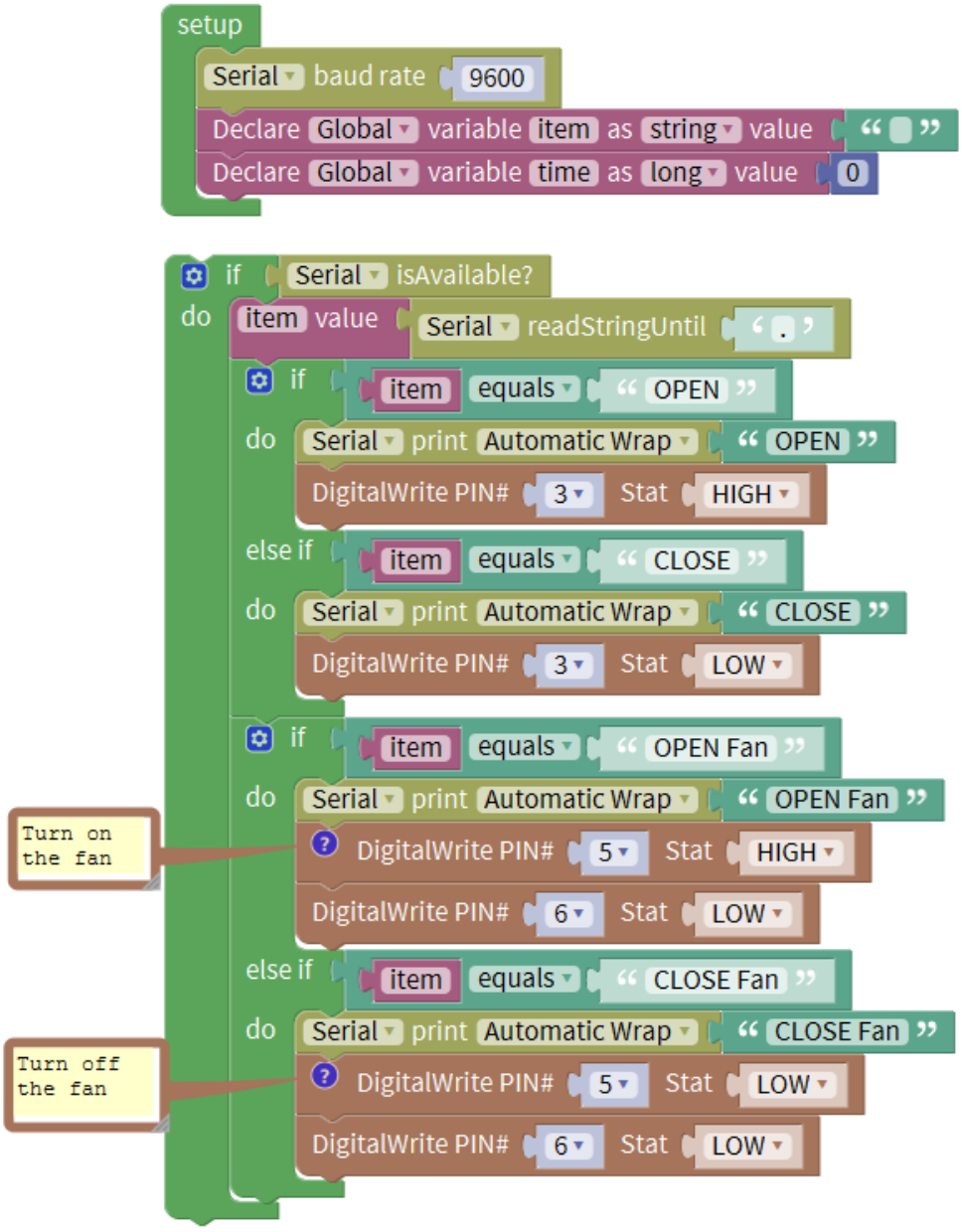
3.2 Program Sample:

Arduino IDE

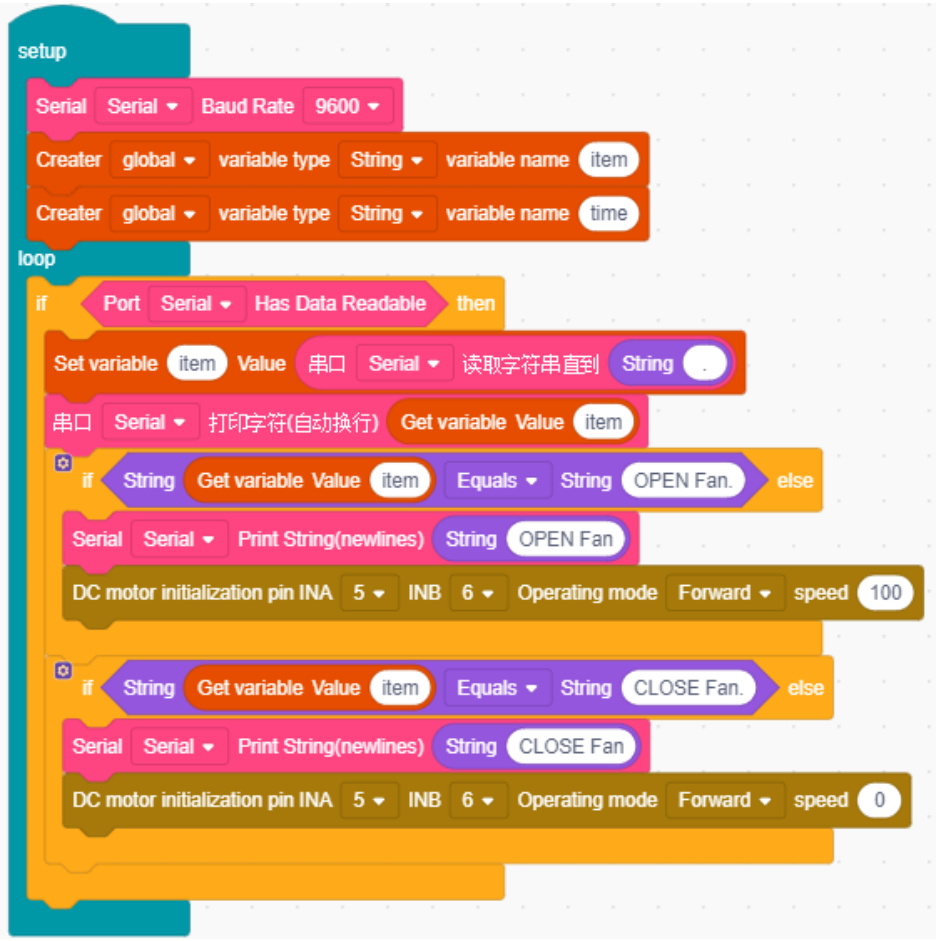
```
String item;
volatile long time;
void setup(){
  Serial.begin(9600);
  item = "";
  time = 0;
  pinMode(3, OUTPUT);
  pinMode(5, OUTPUT);
  pinMode(6, OUTPUT);
}
void loop(){
  if (Serial.available() > 0) {
    item = Serial.readStringUntil('.');
    if (String(item).equals(String("OPEN"))) {
      Serial.println("OPEN");
      digitalWrite(3,HIGH);
    } else if (String(item).equals(String("CLOSE"))) {
      Serial.println("CLOSE");
      digitalWrite(3,LOW);
    }
    if (String(item).equals(String("OPEN Fan"))) {
      Serial.println("OPEN Fan");
      // Turn on the fan
```

```
        digitalWrite(5,HIGH);
        digitalWrite(6,LOW);
    } else if (String(item).equals(String("CLOSE Fan"))) {
        Serial.println("CLOSE Fan");
        // Turn off the fan
        digitalWrite(5,LOW);
        digitalWrite(6,LOW);
    }
  }
}
```

Mixly Program



MagicBlock Program



4. Conclusion

In this lesson, we learn to make Bluetooth smart fans, master the production of Bluetooth smart fan app, be familiar with the design of Bluetooth app and Bluetooth control programming, and realize the remote control of the fan on and off through Bluetooth.

XV Bluetooth Smart Windows and Doors

Task Background

With the continuous development of economy, people are eager to improve the quality of life, ordinary doors and windows can not meet the needs of people's life. The emergence of intelligent doors and windows can meet the needs of people to improve the quality of life to a greater extent. The task of this lesson is to make a mobile app which controls the door and window, and realize the opening and closing of the remote control door and window of mobile app.

Equipment Preparation:

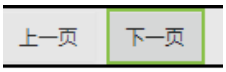
Arduino Ble-Uno main board, expansion board, battery box, steering gear, connecting wire, USB data cable, etc

1. Learn about Bluetooth Smart Doors and Windows

Intelligent doors and windows generally refer to the doors and windows installed with advanced anti-theft, anti robbery and alarm system technology. The intelligent door and window control system consists of wireless remote controller, intelligent master controller, door and window controller, door and window driver, etc. Bluetooth smart doors and windows are connected with mobile phones through Bluetooth to realize the keyless opening and closing of mobile app.

2.Bluetooth Intelligent Windows APP production

2.1 Interface Design

Using the method of copying the screen, we can add more functional interfaces to control the windows and doors in the Bluetooth fan app project we did last lesson. Click “Copy Screen” on the Screen3 interface, change the screen name to Screen4, and then add or modify the component content and parameters of the interface in the component design, as shown in Figure 15-1. Change the screen 3 home button 

to next page.

Figure 15-1

2.2 Component Design

When we copy the screen, in addition to copying the contents of the components to the new screen, the corresponding programs will also be copied. If there are more additions or name changes, we need to add or modify the programs of the corresponding components.

1）Modify the program on the next page of Screen3 to display Screen4:

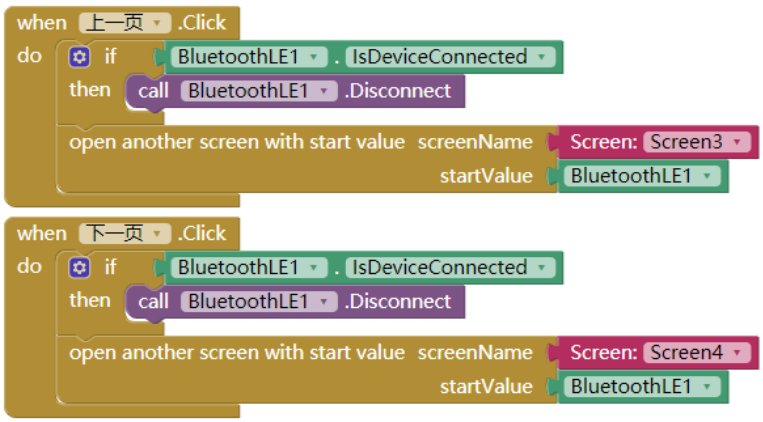


Figure 15-2

2）Add programs to open and close the doors and windows:

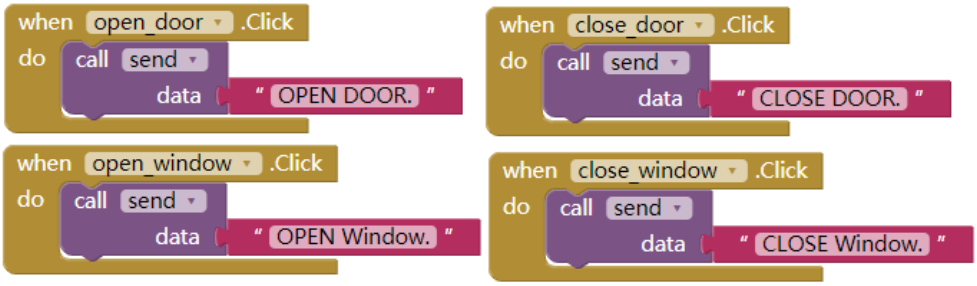


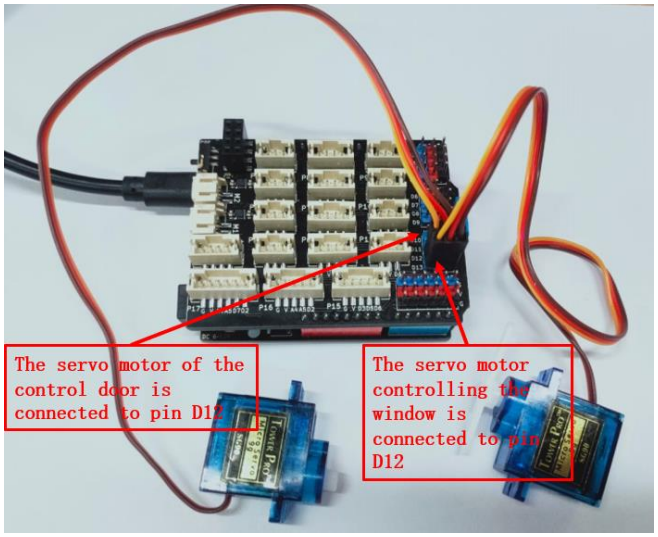
Figure 15-3

3.Programming of Arduino Ble-Uno main board

3.1 Hardware Connection:

Connect the steering gear of the control door to pin D12 and the steering gear of the window to pin D13.

Actuator	Main Control Board
Steering Gear for Control Door	D12
Steering Gear of Control Window	D13



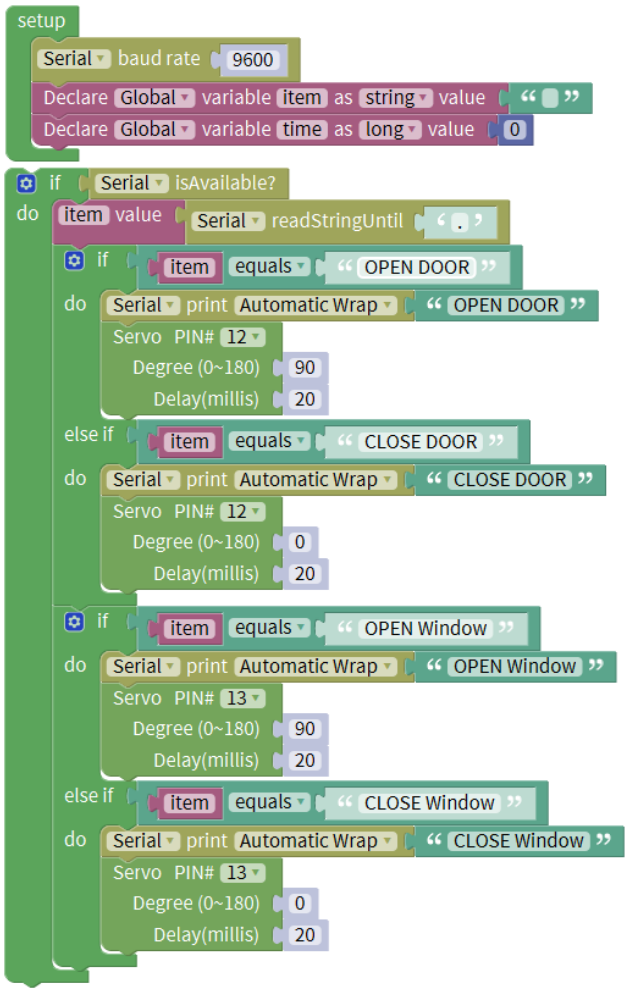
3.2 Program Sample:

Arduino IDE Program

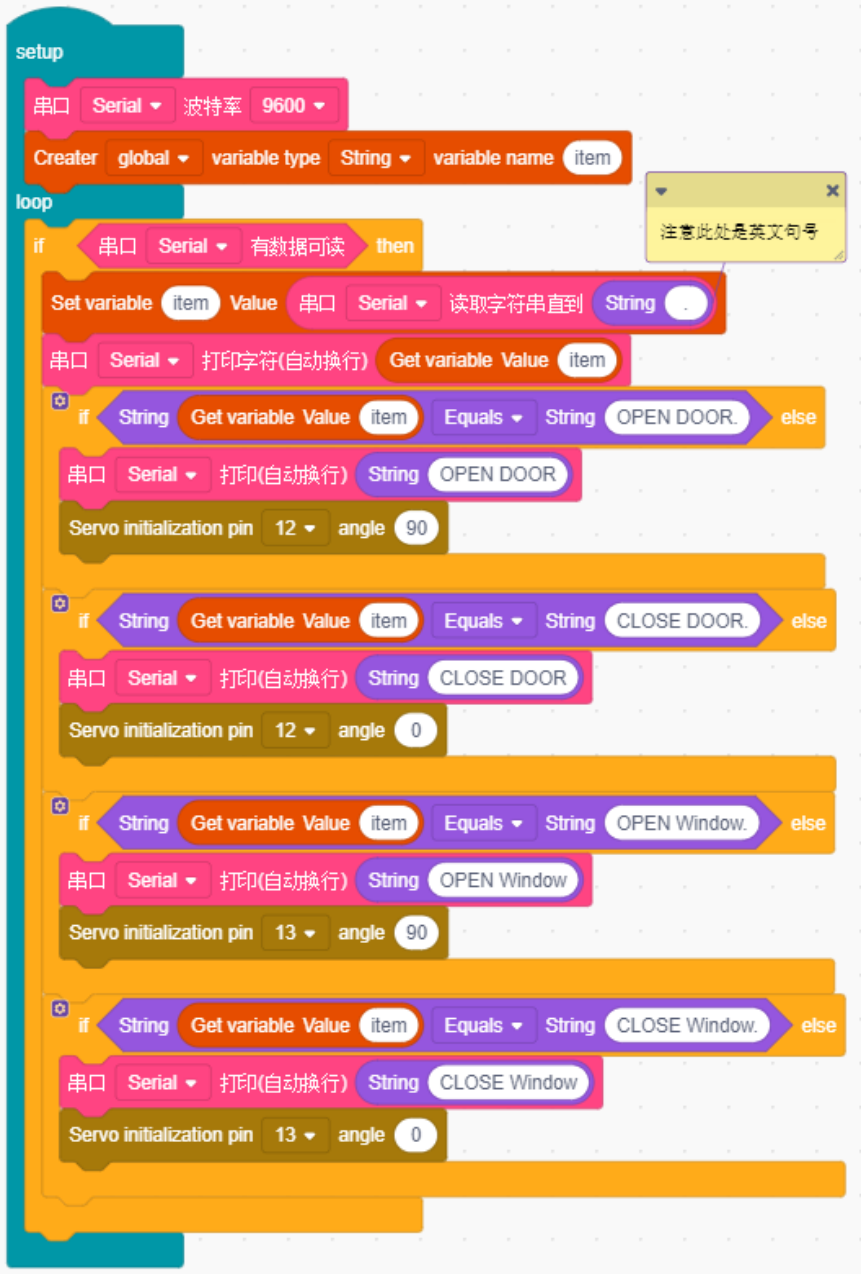
```
#include <Servo.h>
String item;
volatile long time;
Servo servo_12;
Servo servo_13;
void setup(){
  Serial.begin(9600);
  item = "";
  time = 0;
  servo_12.attach(12);
  servo_13.attach(13);
}
void loop(){
  if (Serial.available() > 0) {
    item = Serial.readStringUntil('.');
    if (String(item).equals(String("OPEN DOOR"))) {
      Serial.println("OPEN DOOR");
      servo_12.write(90);
```

```
        delay(20);
      } else if (String(item).equals(String("CLOSE DOOR"))) {
        Serial.println("CLOSE DOOR");
        servo_12.write(0);
        delay(20);
      }
      if (String(item).equals(String("OPEN Window"))) {
        Serial.println("OPEN Window");
        servo_13.write(90);
        delay(20);
      } else if (String(item).equals(String("CLOSE Window"))) {
        Serial.println("CLOSE Window");
        servo_13.write(0);
        delay(20);
      }
    }
}
```

Mixly Program



MagicBlock Program



4.Conclusion

In this lesson, we learn to make Bluetooth intelligent control doors and windows, further consolidate the production of app, master the programming principle and production of Bluetooth intelligent doors and windows, and realize the opening and closing of APP Bluetooth remote control doors and windows.

XVI Smart Home Monitoring System

Task Background:

With the rapid development of intelligent analysis technology, network technology and the improvement of people's living standards, people began to pay more attention to the safety of the home environment, so the intelligent real-time monitoring system came into being. In this lesson, we will learn how to use mobile app to check the indoor temperature, humidity, light intensity and other related parameters in real time to reflect the safety of the home.

Equipment Preparation:

Arduino ble uno mainboard, expansion board, battery box, temperature and humidity sensor, photosensitive sensor, sound sensor, connecting cable, USB data cable, etc.

1.Smart Home Monitoring System

Smart home monitoring system is a network system which is used for local and remote understanding of specific areas, keeping videos for future reference, and playing the role of deterrence, supervision, forensics and management. This is the remote monitoring function of smart home. Smart home monitoring system also has real-time monitoring function. Through distributed TV, monitor and touch screen, it can monitor the real-time situation of key areas such as the surrounding area, the door, each room, indoor channel, garage, etc.

The smart home monitoring system produced in this lesson is realized by using temperature and humidity sensor, photosensitive sensor, sound sensor and other modules as well as mobile phone app. The principle is that the sensor senses the surrounding environmental conditions, and then uploads them to Arduino BLE-UNO main board. Then the main board transmits the data to the mobile phone app through Bluetooth for display, and people can open the mobile phone app to view.

2. APP Page Design

2.1 Interface Design

Made in the previous course of the APP, click “copy screen” to add a new screen, Screen5, and then modify and add the required component content, as shown in figure 16-1.

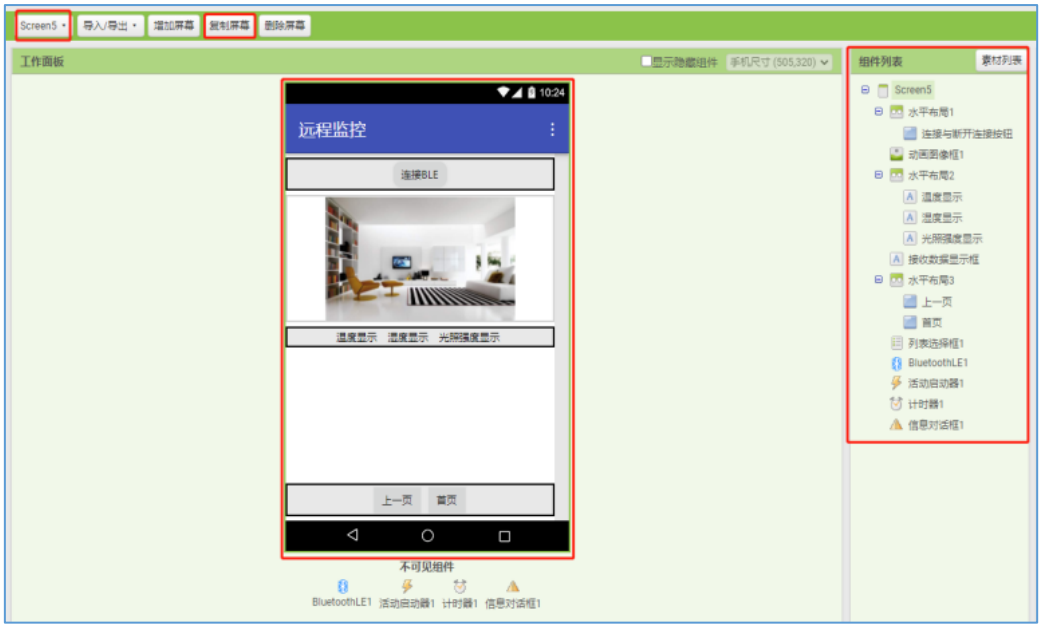


Figure 16-1

2.2 Logic Design

While copying the screen, the corresponding program modules will be copied, and then the corresponding programs can be modified or added according to the set components. In order to display the data sensed by the sensor on the app, the following program needs to be added:

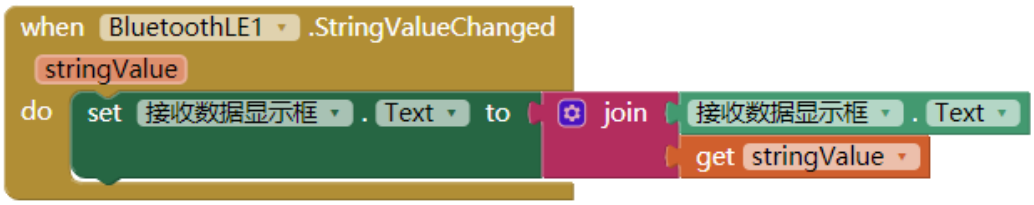


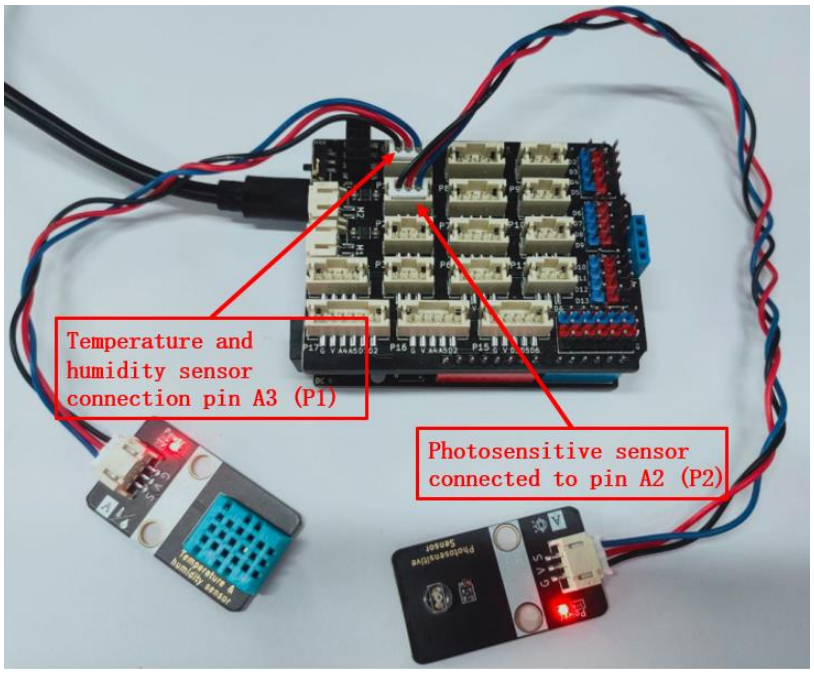
Figure 16-2

3.Programming of Arduino BLE-NANO main board

3.1 Hardware Connection:

Connect the temperature and humidity sensor to A0 (P4) pin and the photosensitive sensor to A1 (P3) pin.

Sensors and Actuators	Main Board
Temperature and Humidity Sensor	A0（P4）
Photosensitive Sensor	A1（P3）

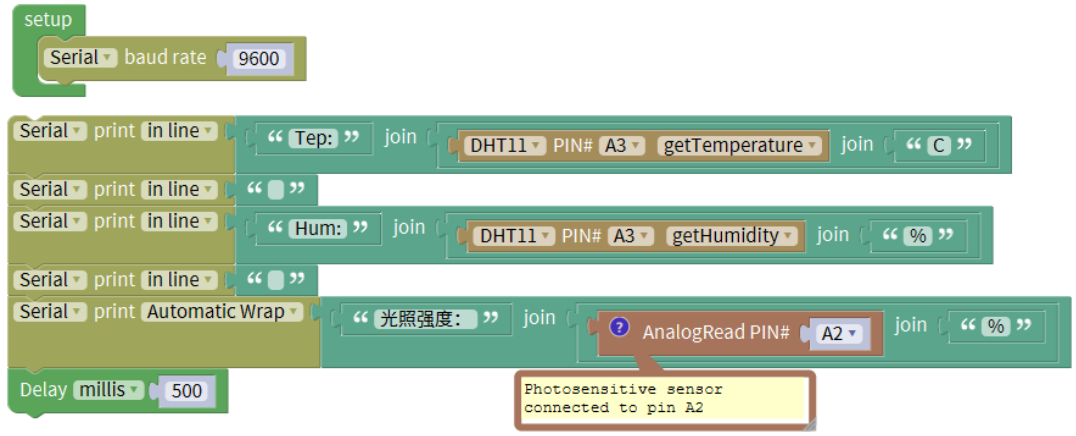


3.2 Program Sample

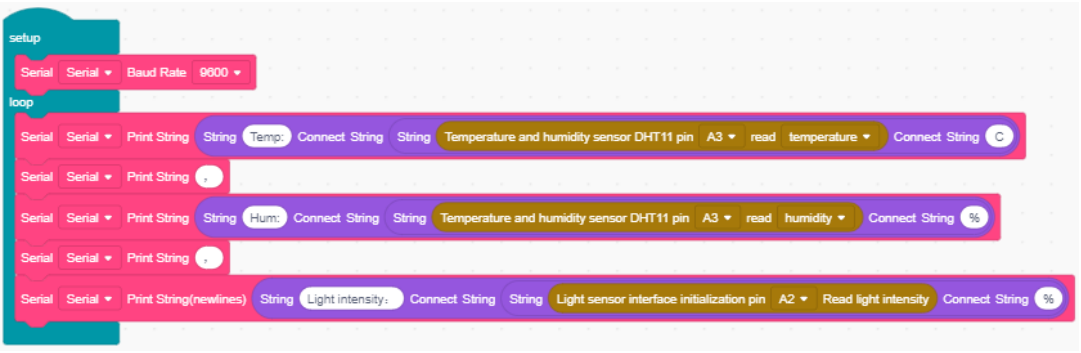
Arduino IDE Program

```
#include <DHT.h>
DHT dhtA3(A3, 11);
void setup(){
   Serial.begin(9600);
    dhtA3.begin();
}
void loop(){
   Serial.print(String("Tep:") + String(String(dhtA3.readTemperature()) + String("C")));
   Serial.print(" ");
   Serial.print(String("Hum:") + String(String(dhtA3.readHumidity()) + String("%")));
   Serial.print(" ");
   // Photosensitive sensor connected to pin A2
   Serial.println(String("Light intensity:") + String(String(analogRead(A2)) + String("%")));
   delay(500);
}
```

Mixly Program



MagicBlock Program



4.Conclusion

In this lesson, we learned how to make smart home monitoring system app, which uses serial port to print out sensor induced data and send it to mobile app for display through Bluetooth.