keyestudio WiKi

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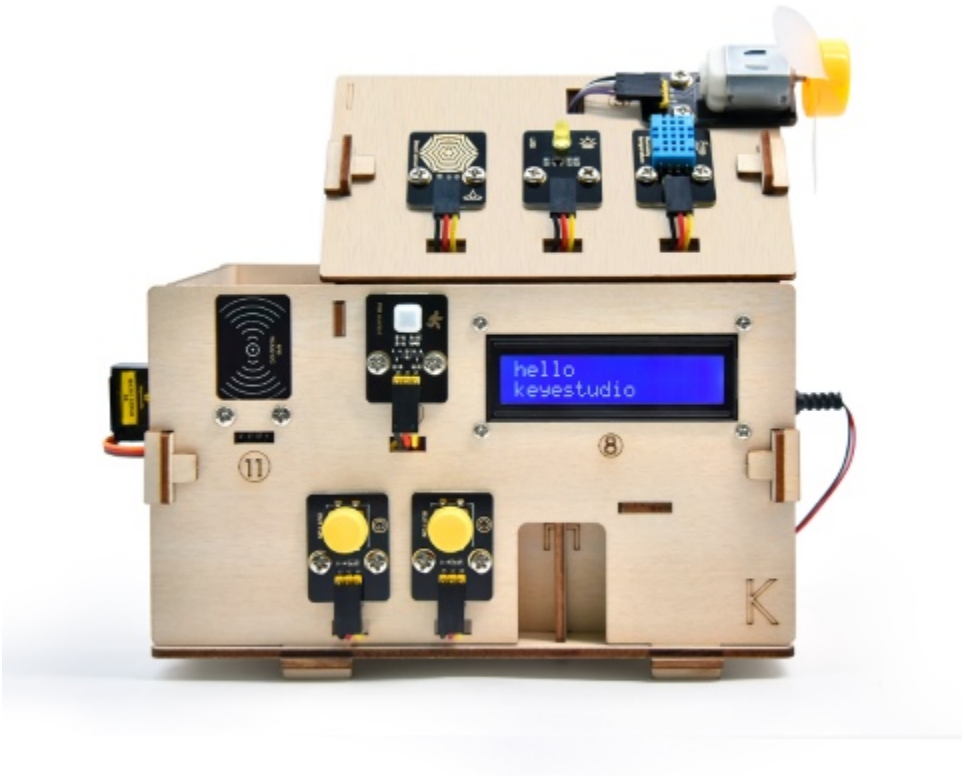
Dec 04, 2023

KEYESTUDIO IOT SMART HOME KIT FOR ESP32


hello
keyestudio
11
8
K

CHAPTER

ONE

DESCRIPTION

As the rapid development of the Internet grows, various intelligent devices are gradually integrated into our daily life. For example, we can use RFID to open the door. In addition, the kitchen is equipped with a gas detection alarm, which alerts people to the danger when dangerous gas and large smoke are detected. When it detects rain, it can automatically collect clothes and close windows. All kinds of electrical equipment can be controlled by mobile phone, control lights, fans, air conditioning and so on.

In this connection, we seek to launch this smart home product with ESP32 control, which has a host of sensors and modules as well as networking function, making the relevant knowledge of the Internet more accessible to you.

CHAPTER

TWO

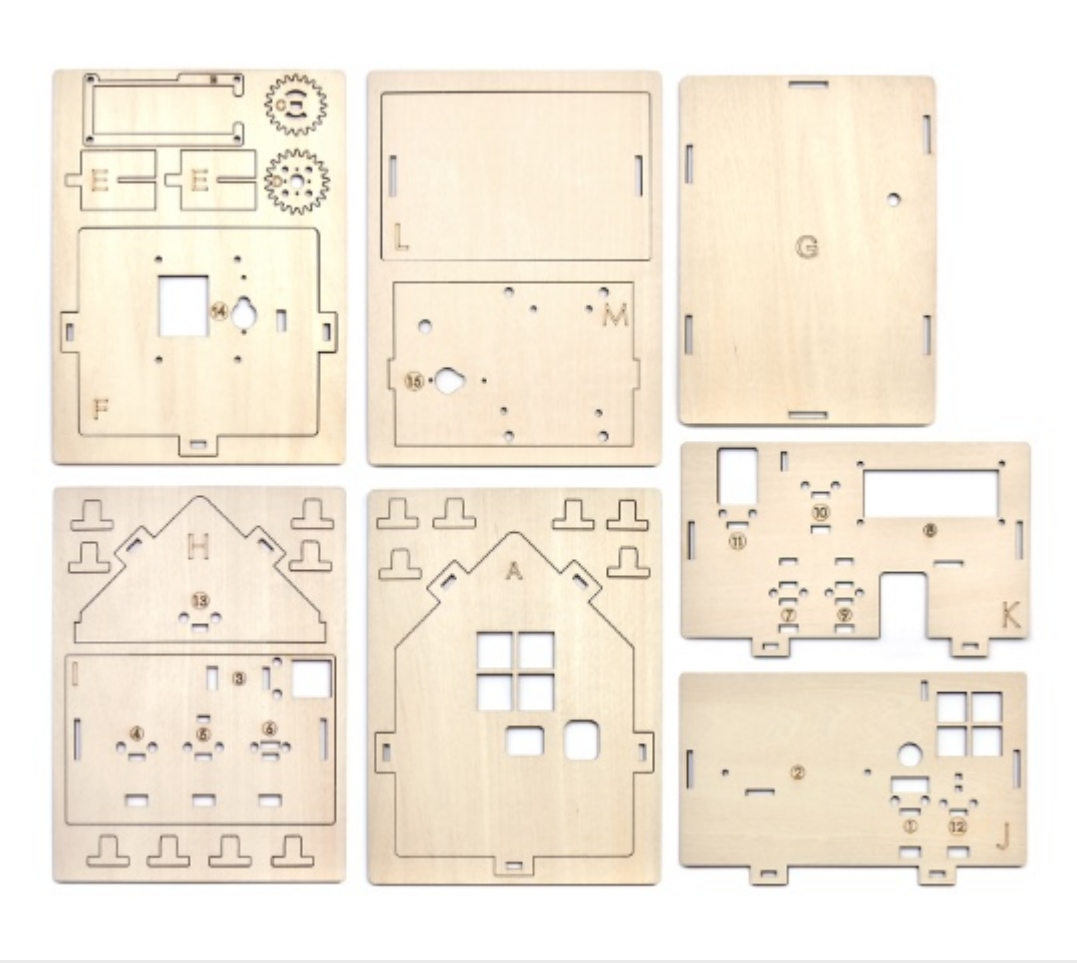
FEATURES

1. Elegant appearance
2. A host of sensor modules
3. Mobile phone APP network control
4. Morse password door
5. It can automatically close windows
6. RFID function
7. C language and MicroPython

CHAPTER

THREE

KIT LIST

#	Picture	Name
1		Wooden

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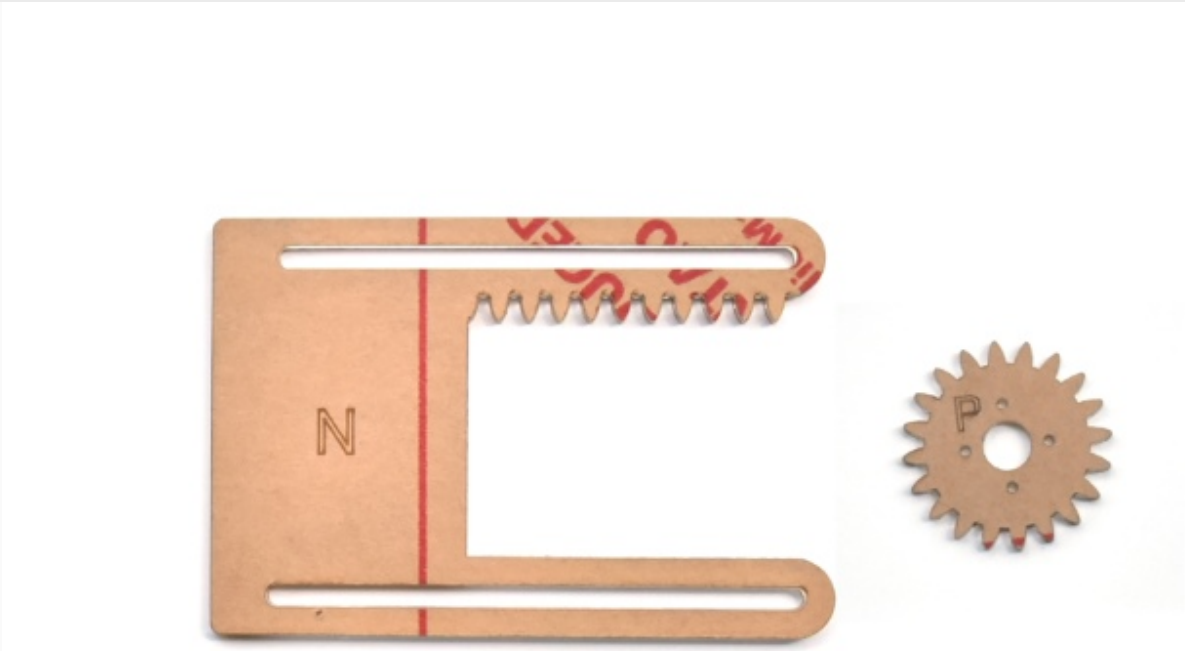
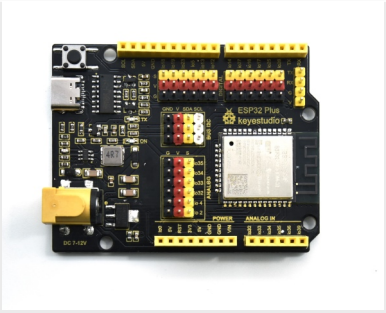
2		Acrylic
3		ESP32 E

Table 1 – continued from previous page

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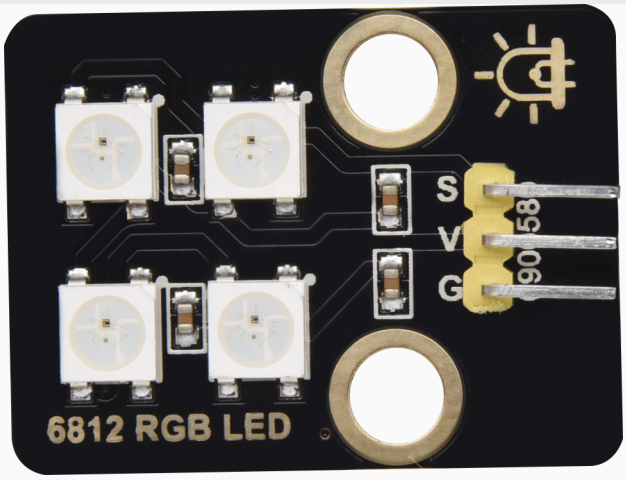
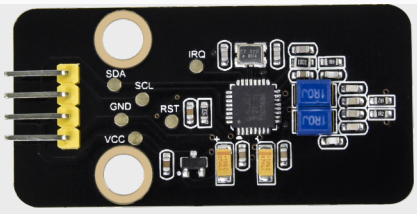
4		6812 RG
5		Analog
6		Button M
7		RFID M

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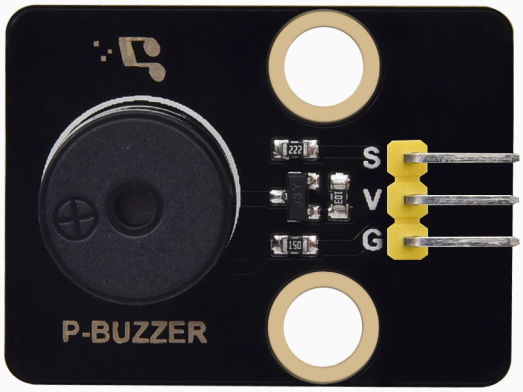
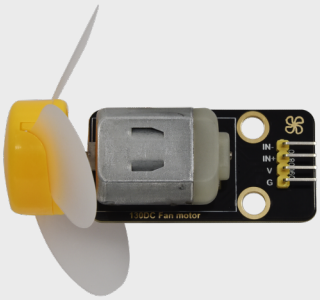
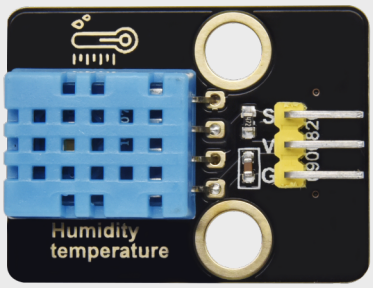
8		Passive
9		130 Mo
10		Steam S
11		XHT11

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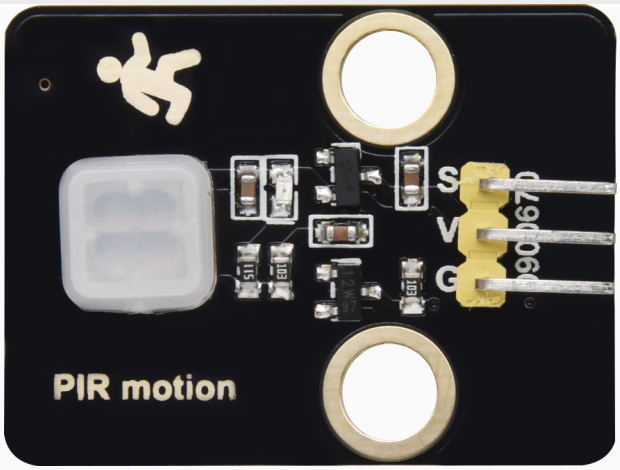
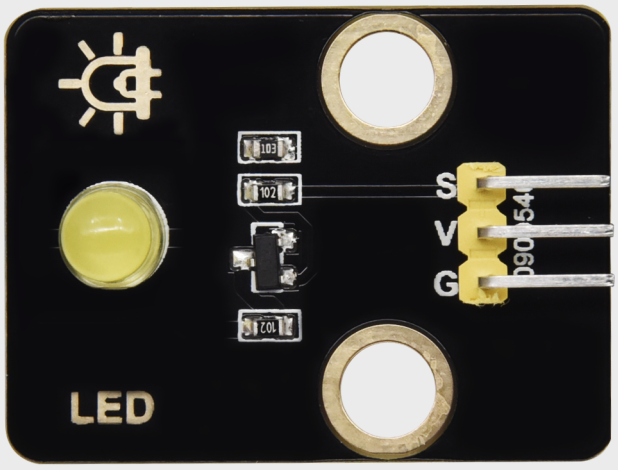
12		PIR Mo
13		Yellow

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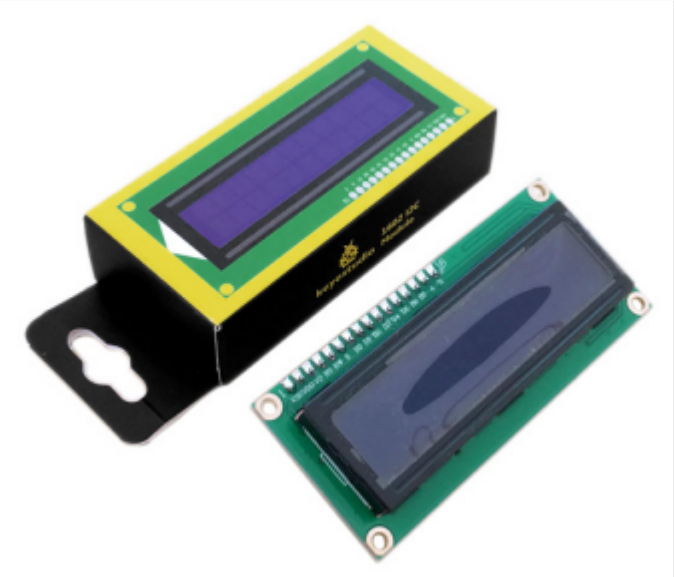
15		I2C1602
16		3P F-F

Table 1 – continued from previous page

#	Picture	Name
17		3P F-F 2
18		F-F 200
19		4P F-F 2
20		M1.4*6
21		M3 Nicl
22		M4*8M
23		M3*6M
24		M3*10M

Table 1 – continued from previous page

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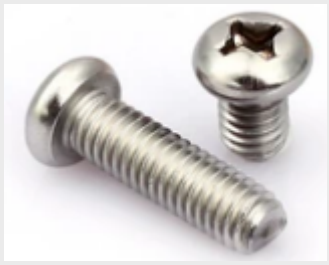
25		M2*12M
26		M4 Nicl
27		M3 Nicl
28		M2 Nicl

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#	Picture	Name
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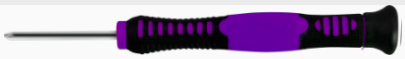
30		Cross W
31		3.0*40M
32		2.0*40M
33		M3*10M

Table 1 – continued from previous page

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35		6-Slot A

Table 1 – continued from previous page

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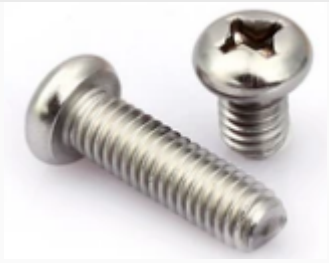
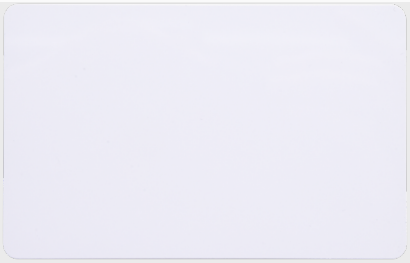
36		M3*12M
37		White C
38		ABS RF

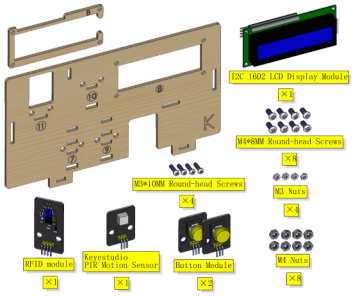
CHAPTER

FOUR

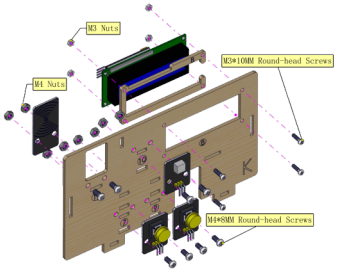
HOW TO INSTALL THE SMART HOME

Step 1

Components Required



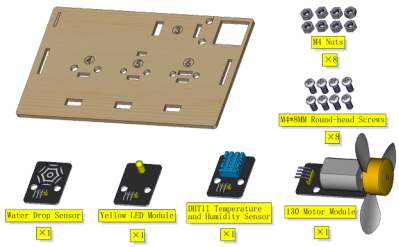
Installation Diagram

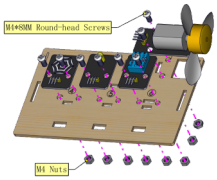


Prototype

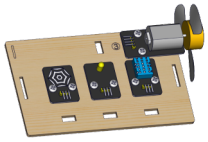
Step 2

Components Required

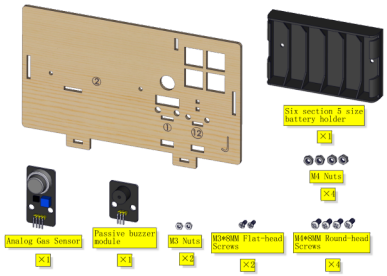




Installation Diagram



Prototype
Step 3



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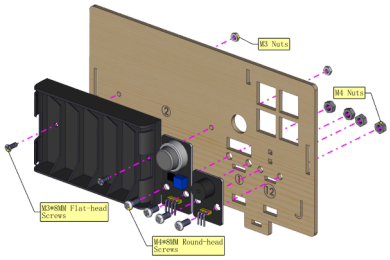
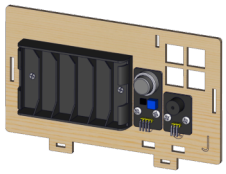
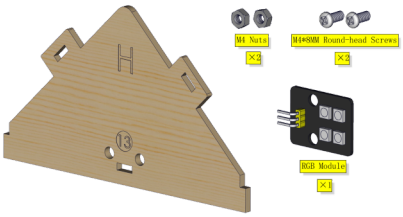


Installation



Prototype
Step 4



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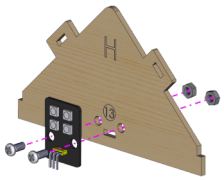
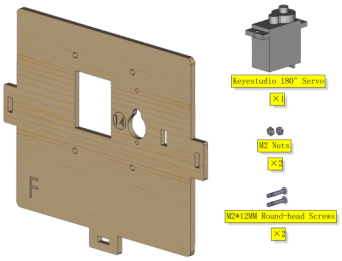


Installation Diagram

Prototype
Step 5



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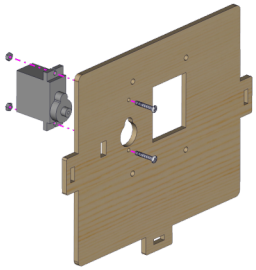
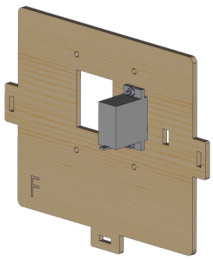
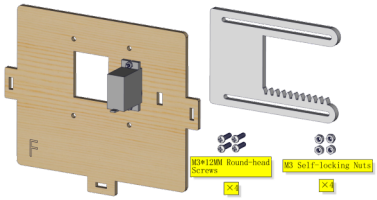


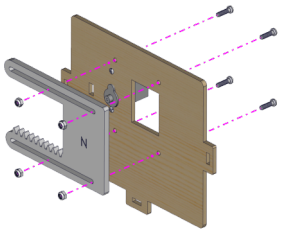
Step 1



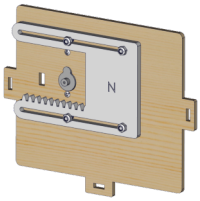
Prototype
Step 6



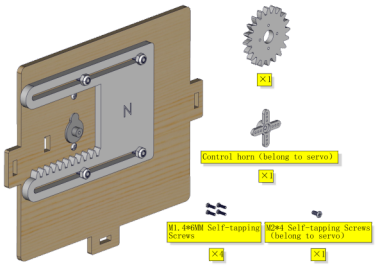
Components Required



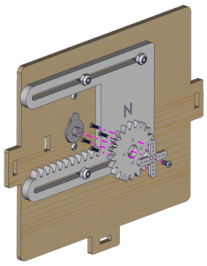
Installation(Don't tighten the self-locking nuts)



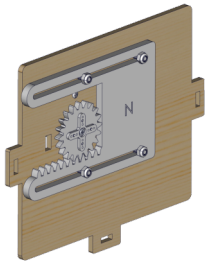
Prototype
Step 7



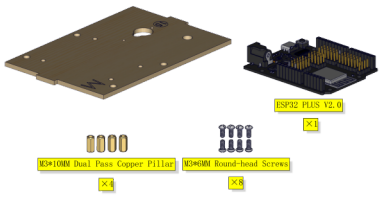
Components Required
Adjust the angle of the servo adjust servo of the window to 0 degree before installation



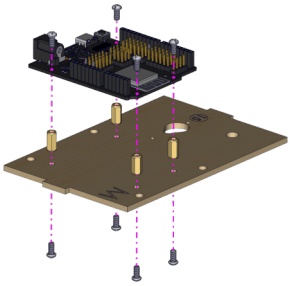
Installation (As shown in the picture)



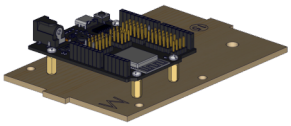
Prototype
Step 8



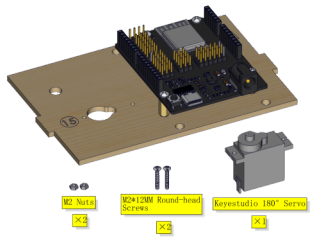
Components Required



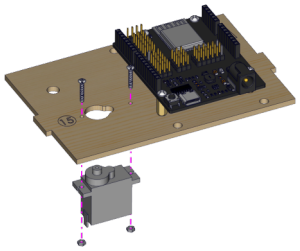
Installation Diagram



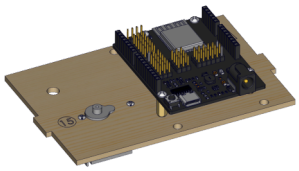
Prototype
Step 9



Components Required

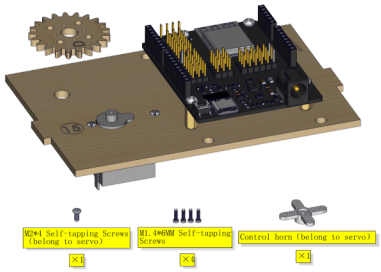


Installation Diagram



Prototype

Step 10



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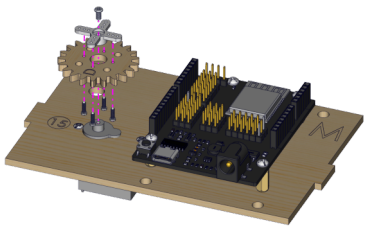

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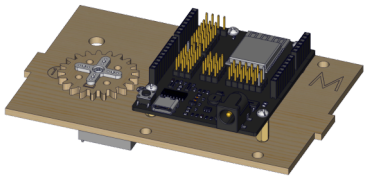
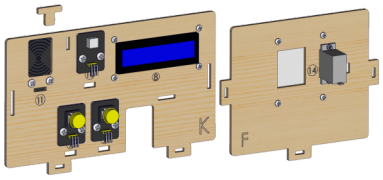
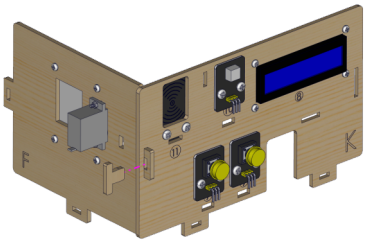


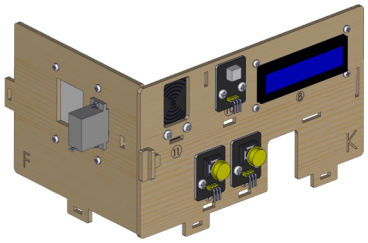
Prototype
Step 11



Components Required



Installation Diagram



Prototype
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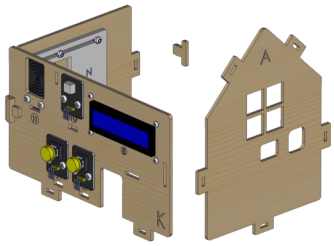
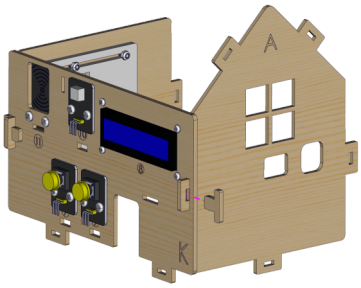


Components Required



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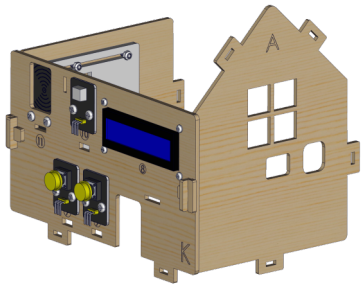
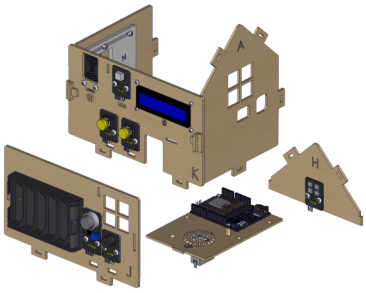
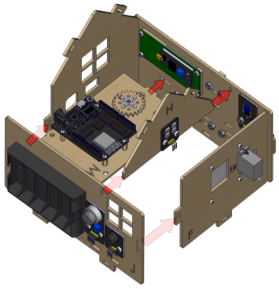


Prototype
Step 13

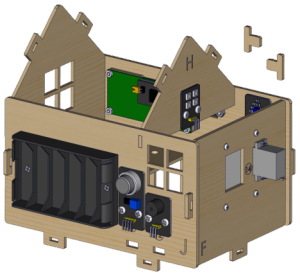


Components Required

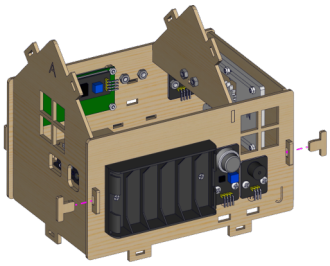


Installation Diagram

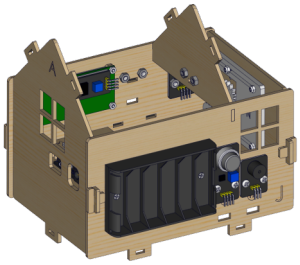
Prototype
Step 14



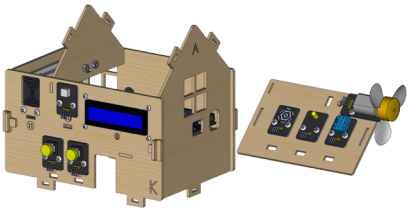
Components Required



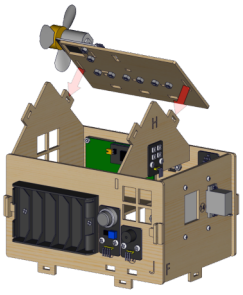
Installation Diagram



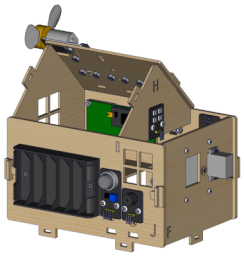
Prototype
Step 15



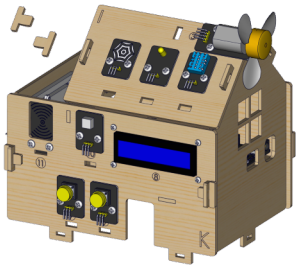
Components Required



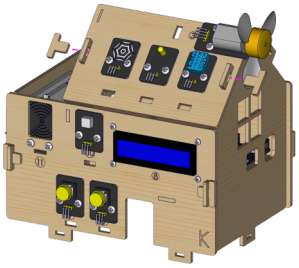
Installation Diagram



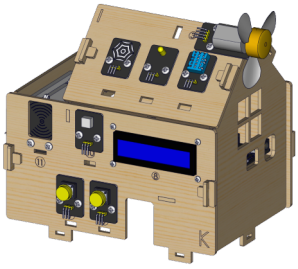
Prototype
Step 16



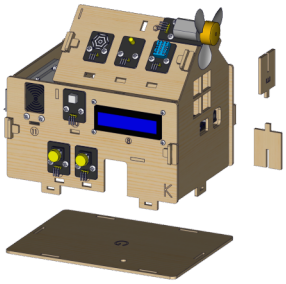
Components Required



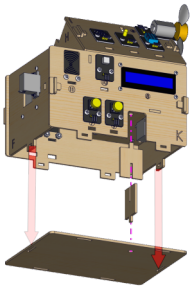
Installation Diagram



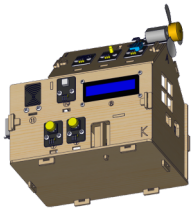
Prototype
Step 17



Components Required



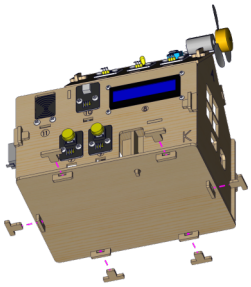
Installation Diagram



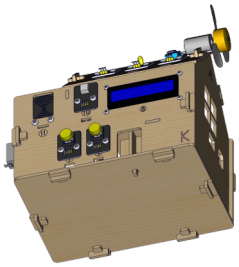
Prototype

Step 18

Components Required

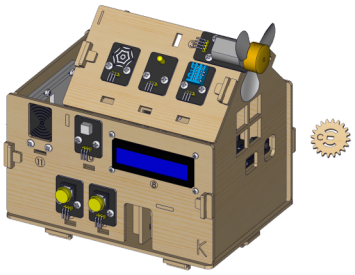


Installation Diagram

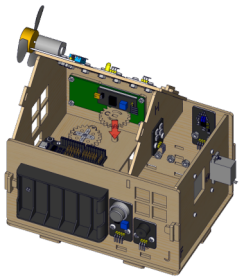


Prototype

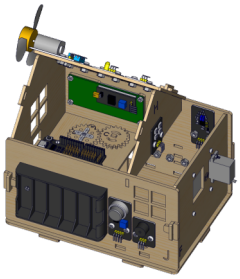
Step 19



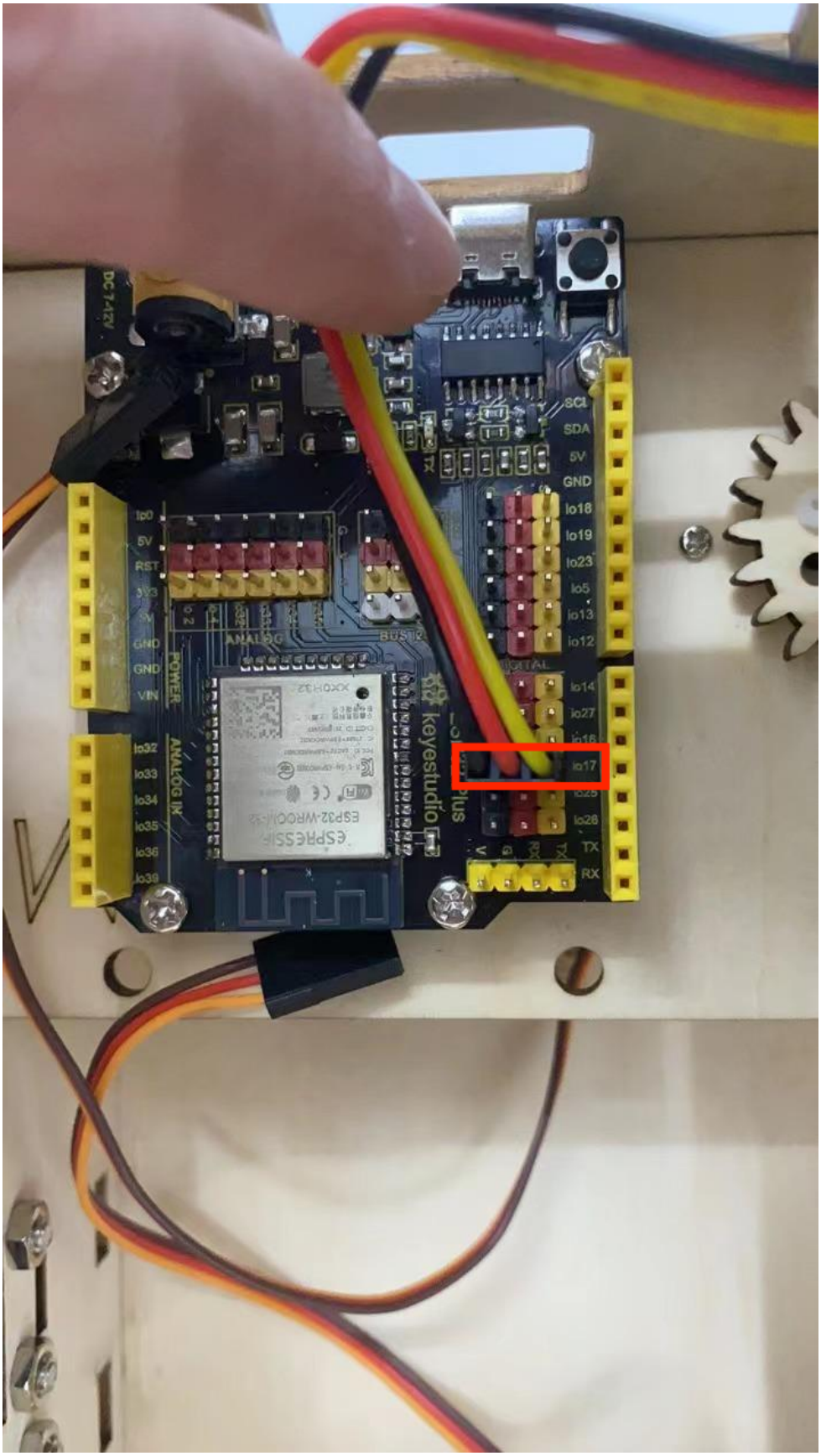
Components Required



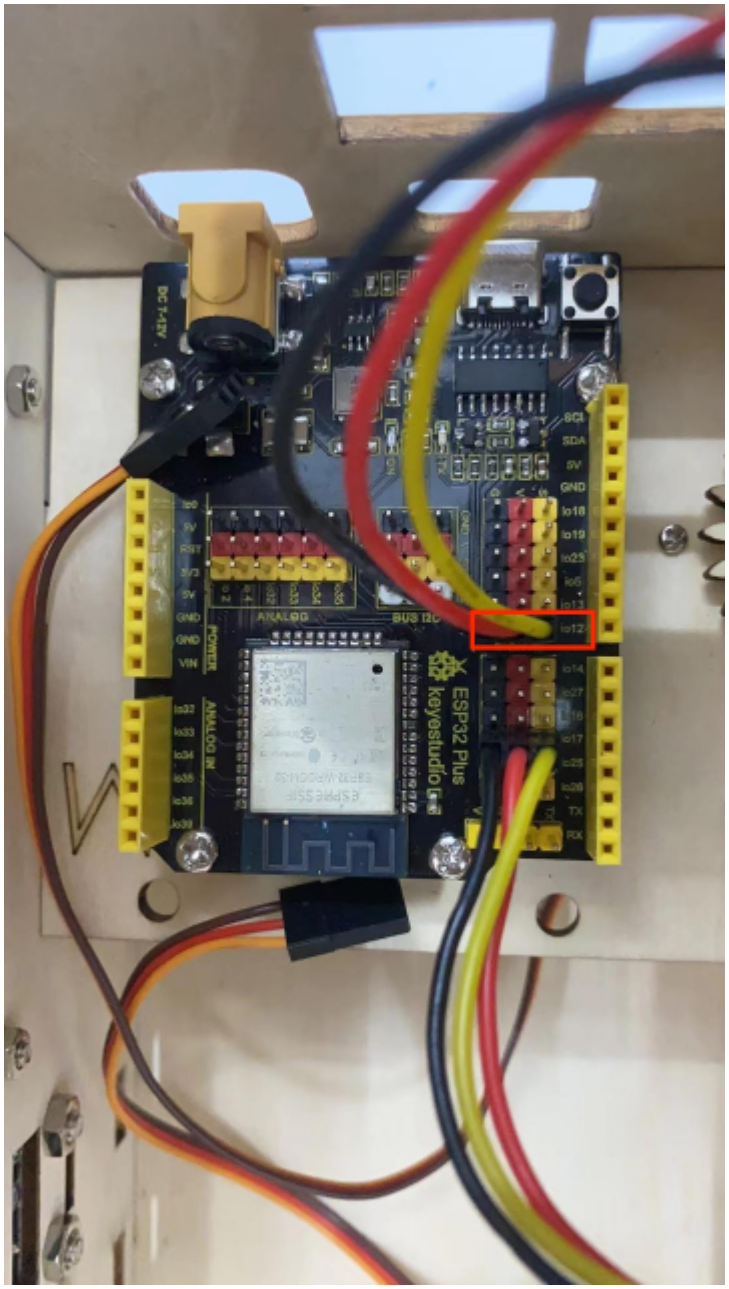
Installation Diagram

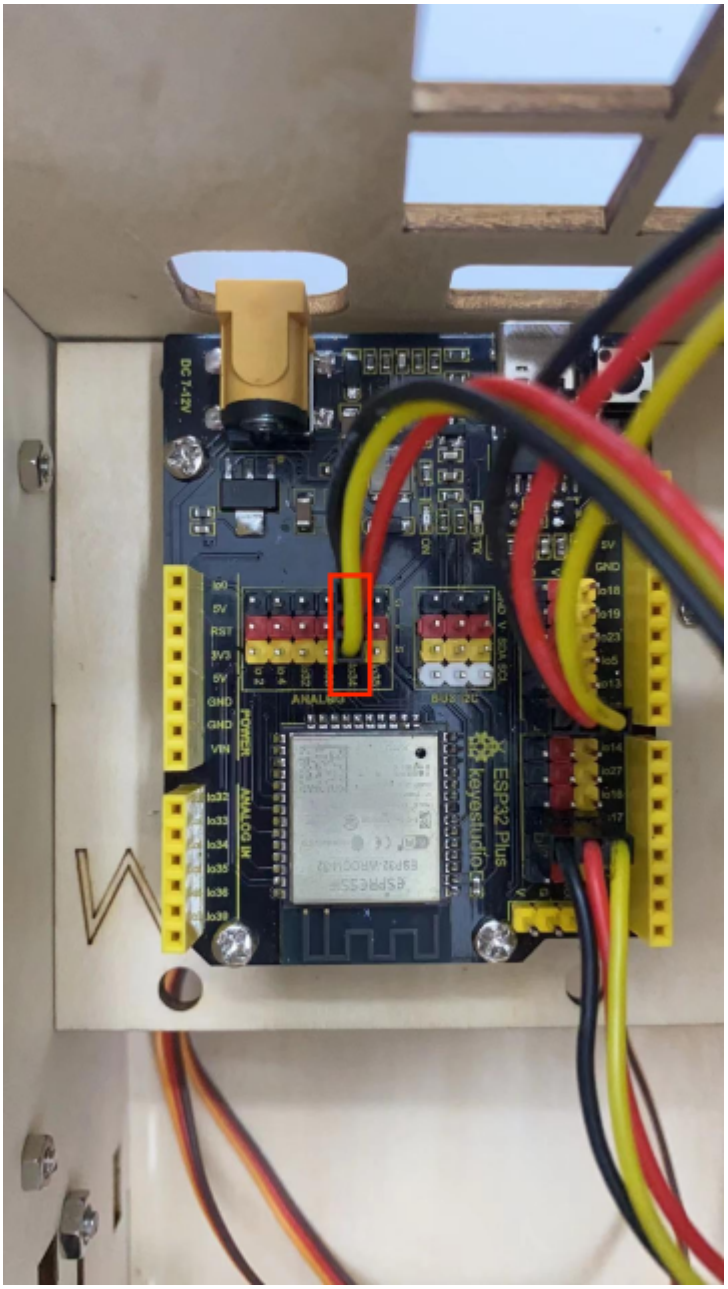


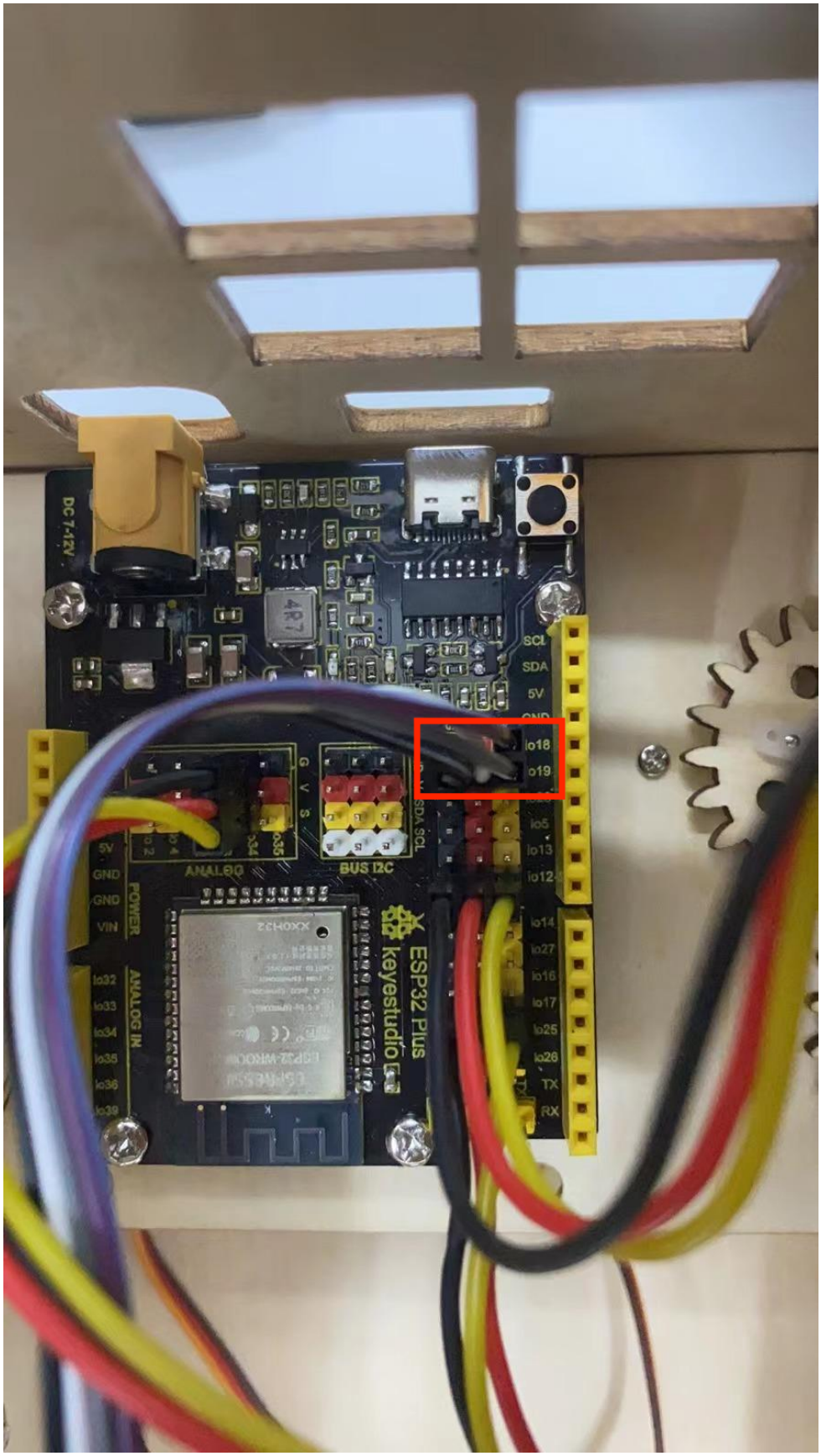
Prototype
Wiring Part



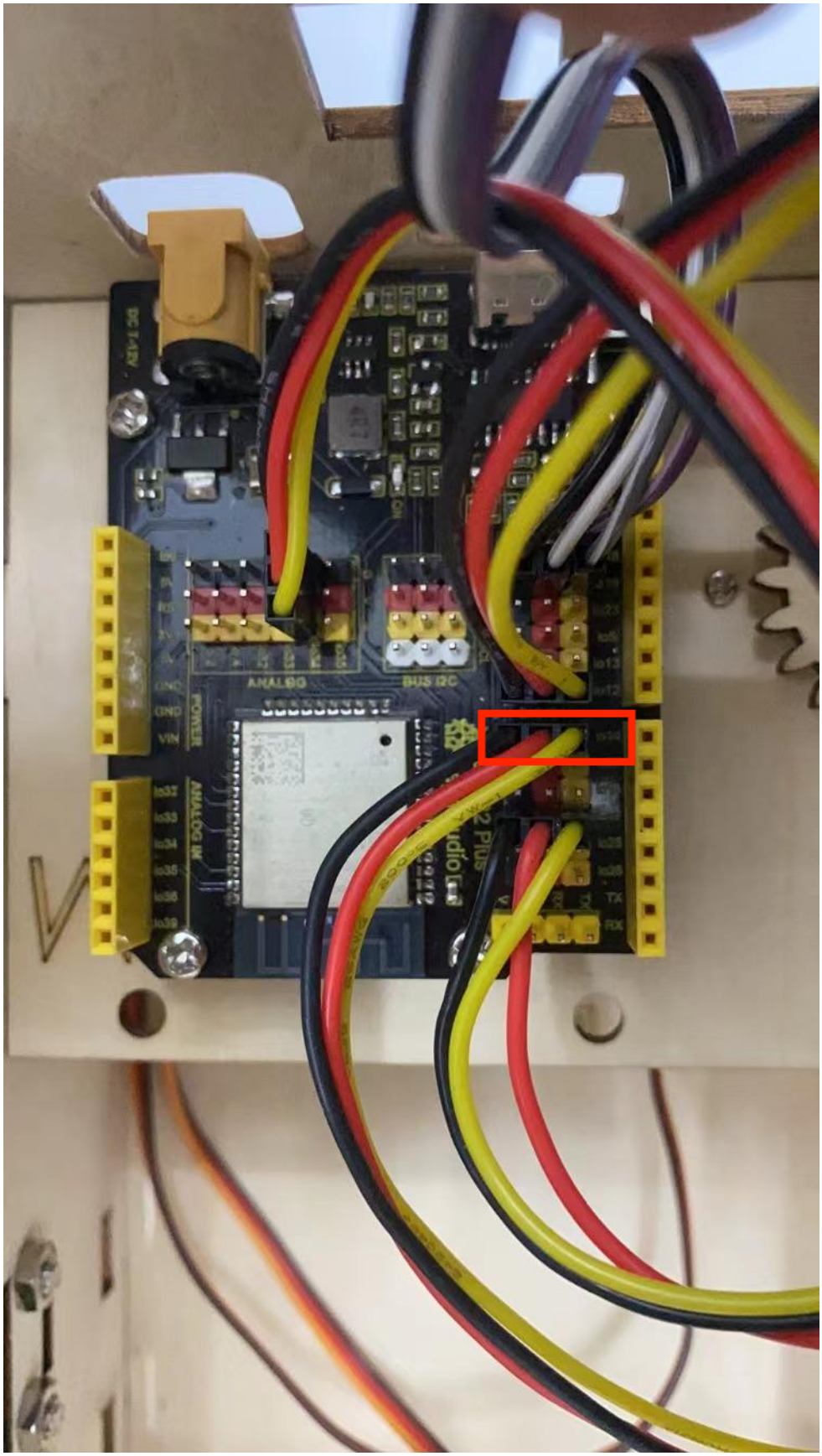
temperature and humidity to io17

yellow led module to io12 

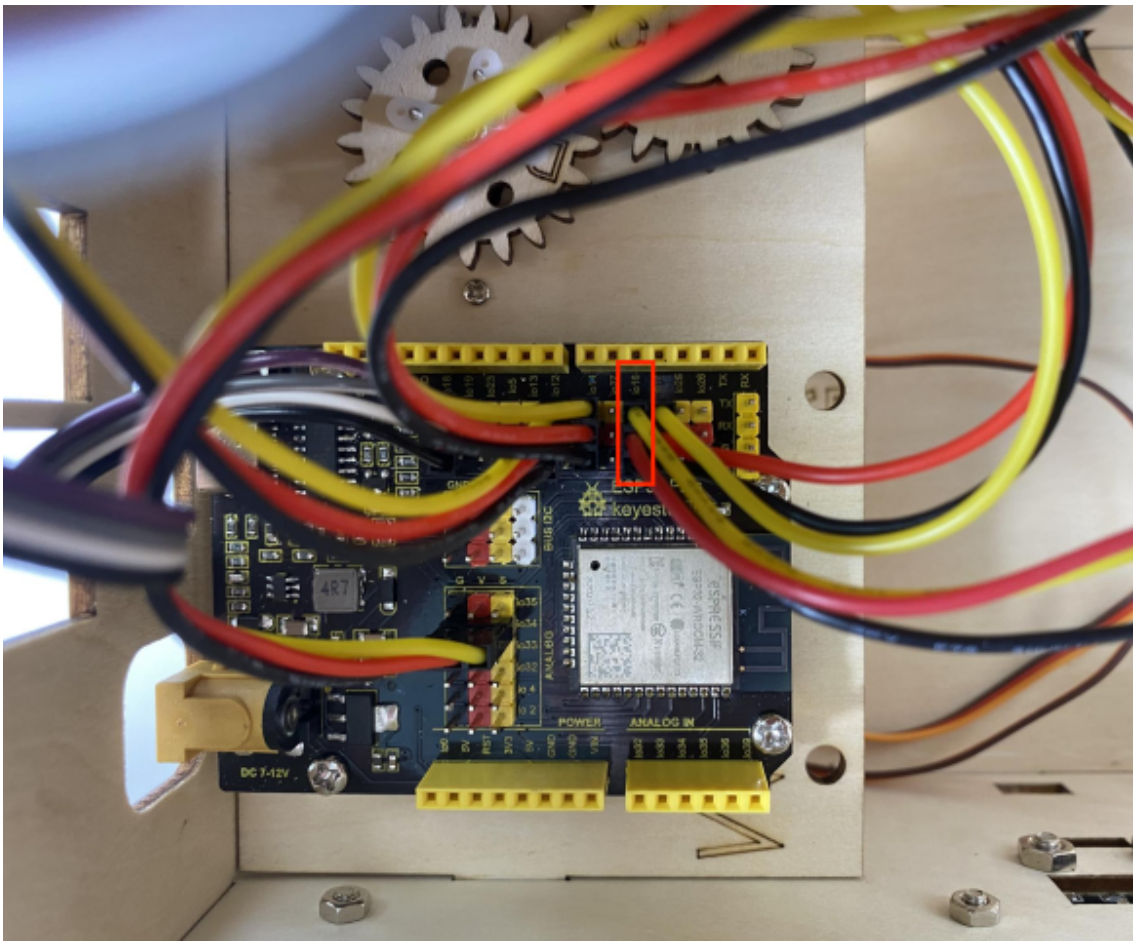
steam sensor to the io34 

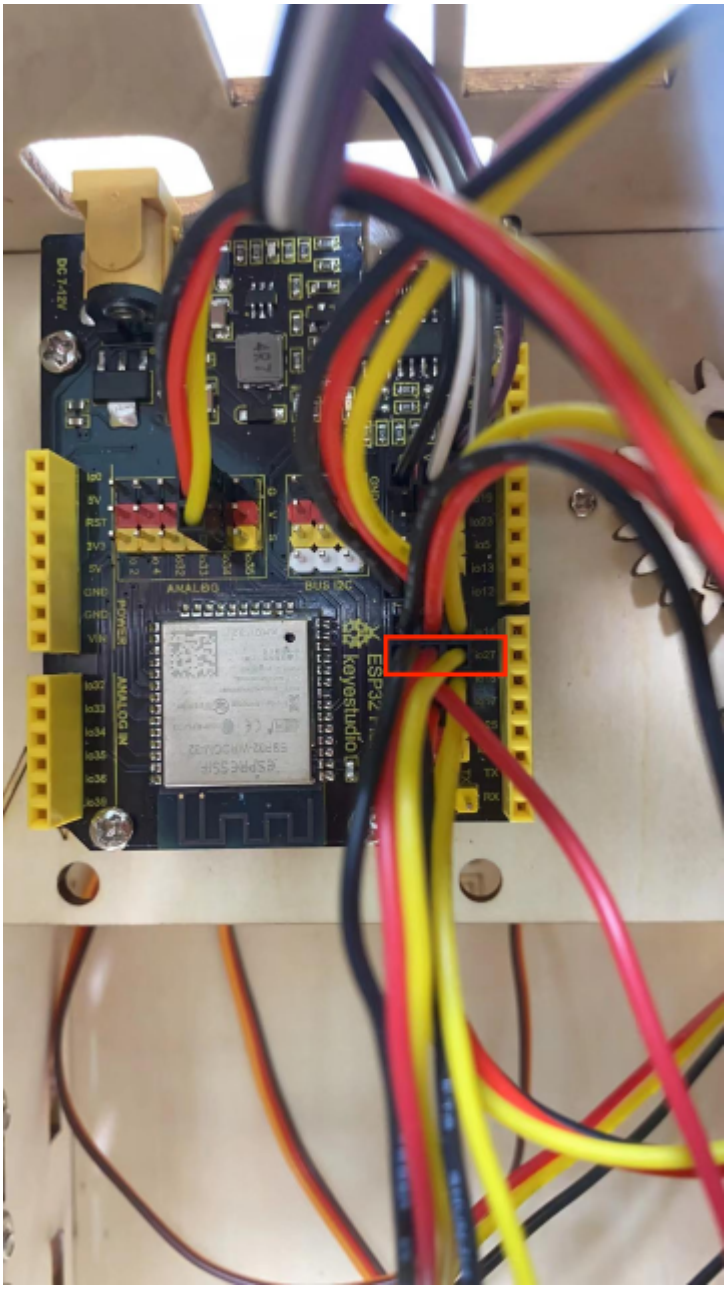


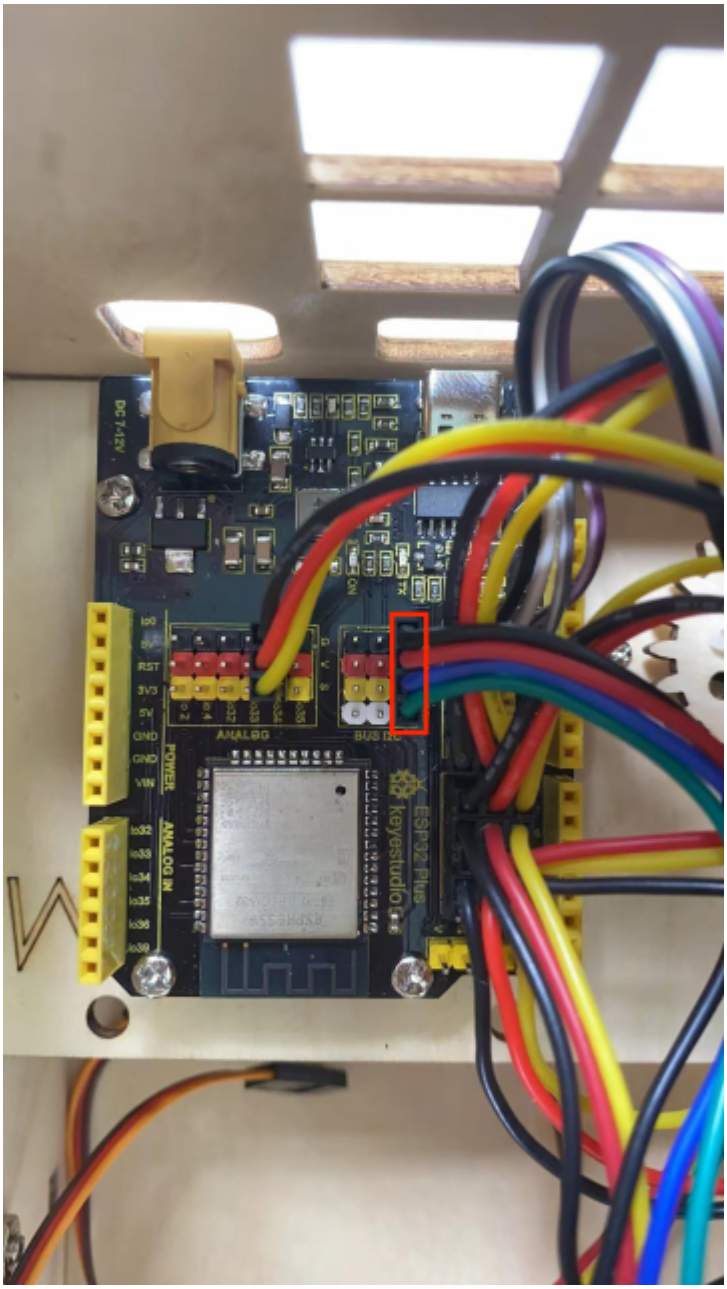
fan (IN- to io18IN+ to io19)

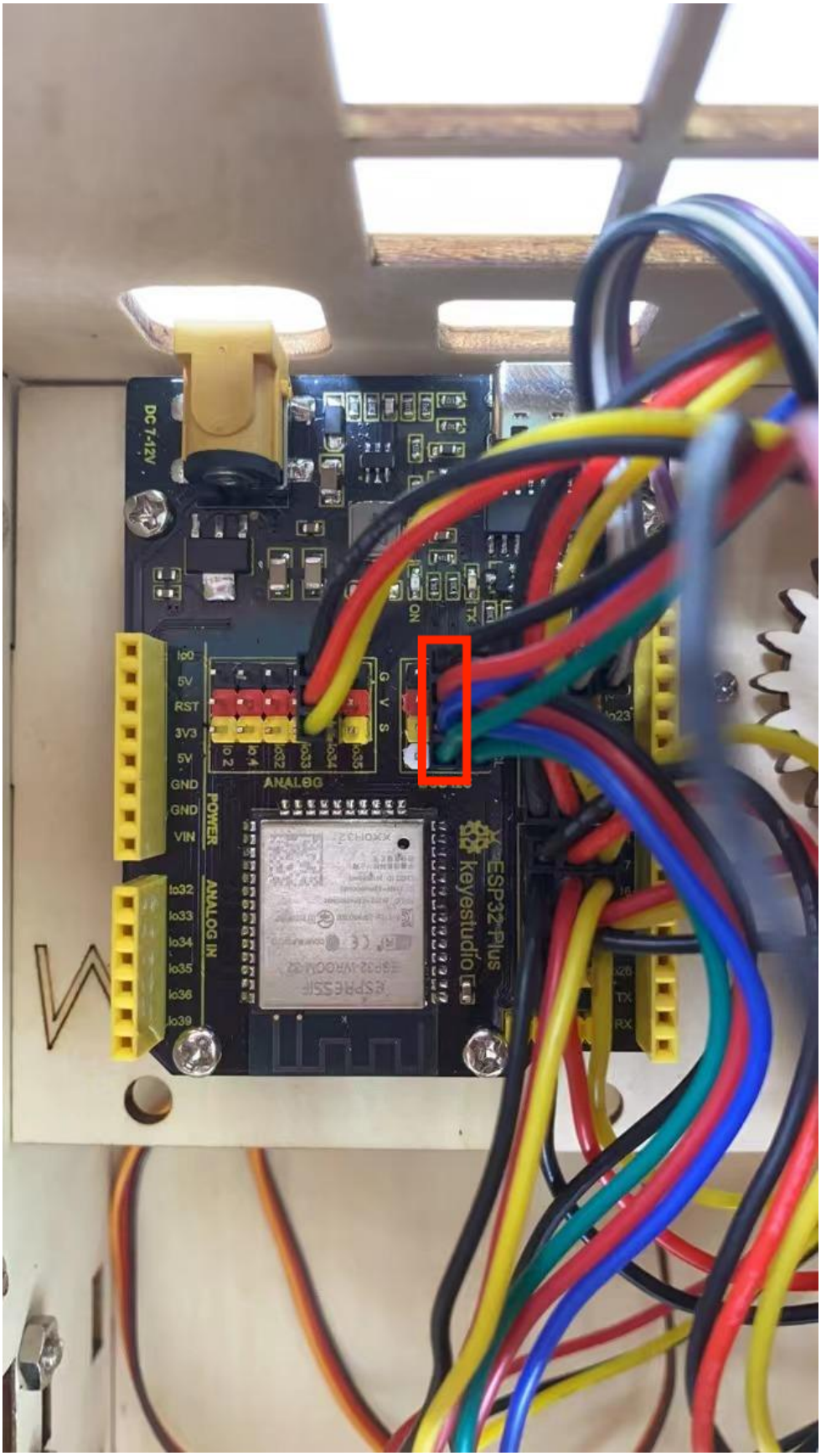


PIR motion sensor to the io14

left button module to the io16 

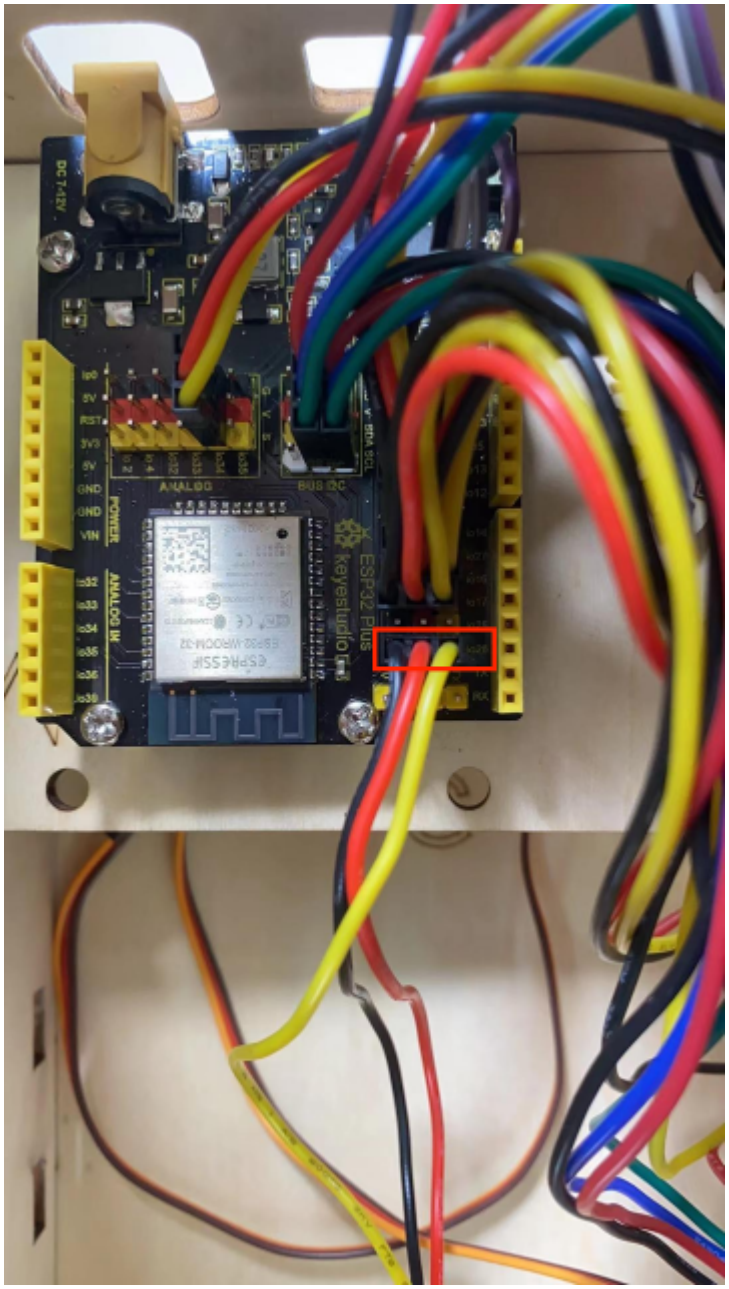
right button module to the io27 

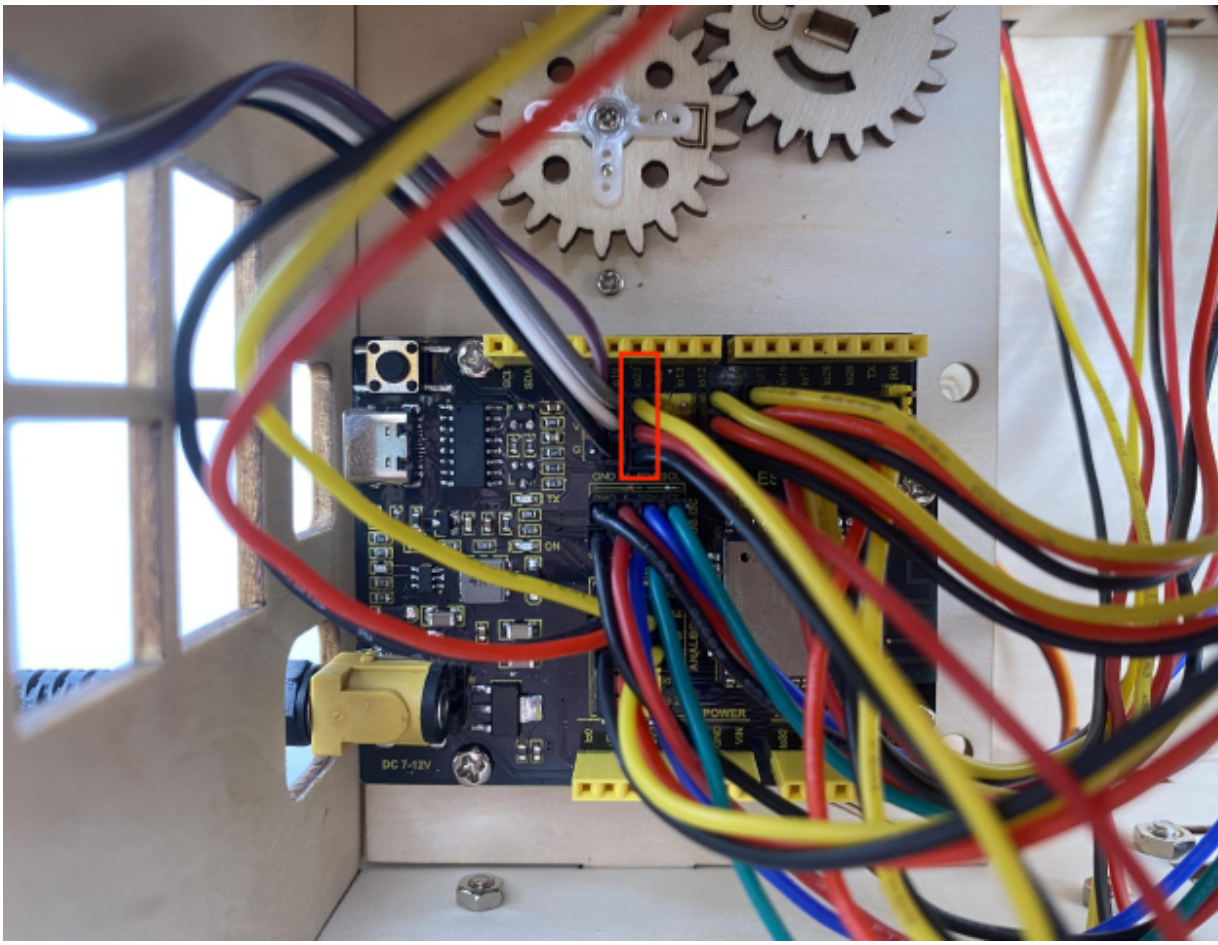
RFID module to the IIC 

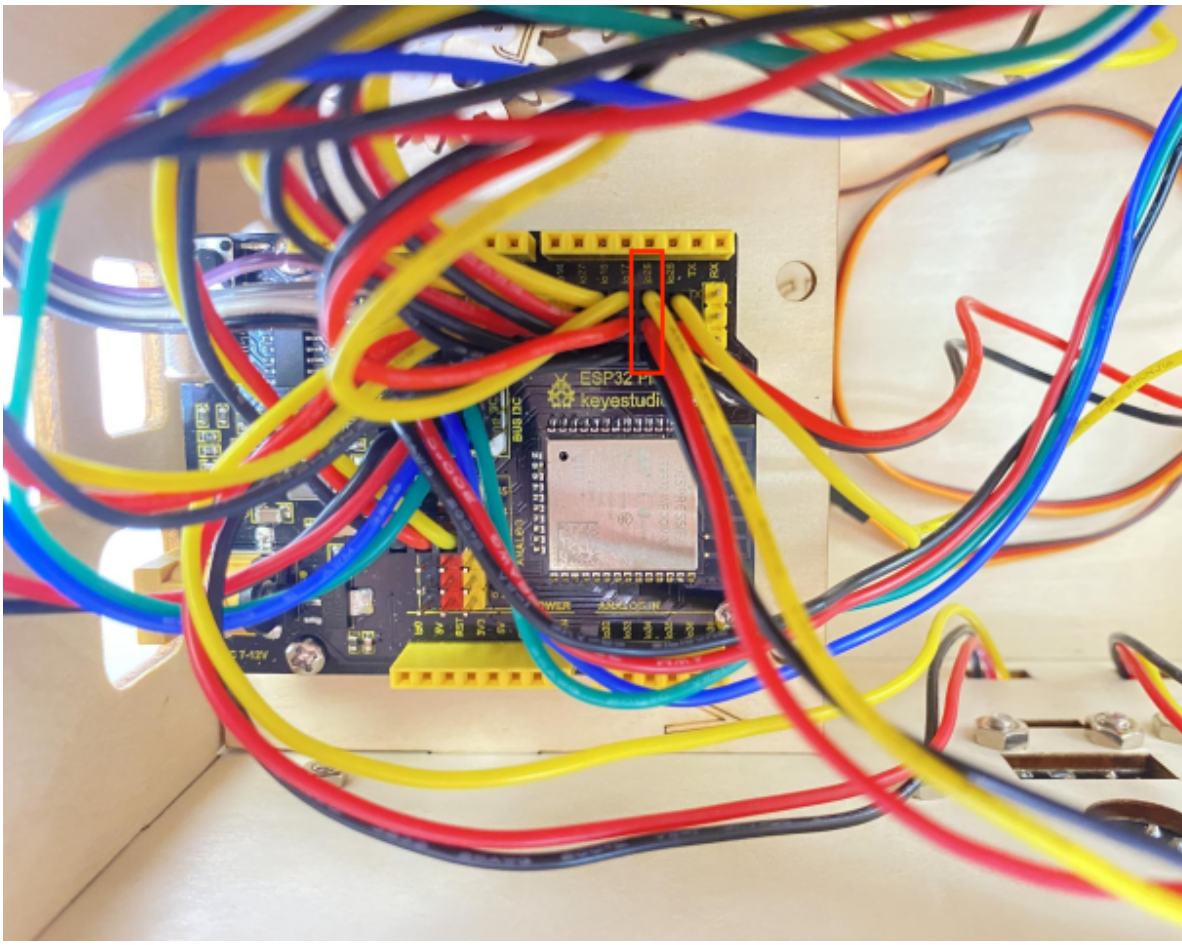


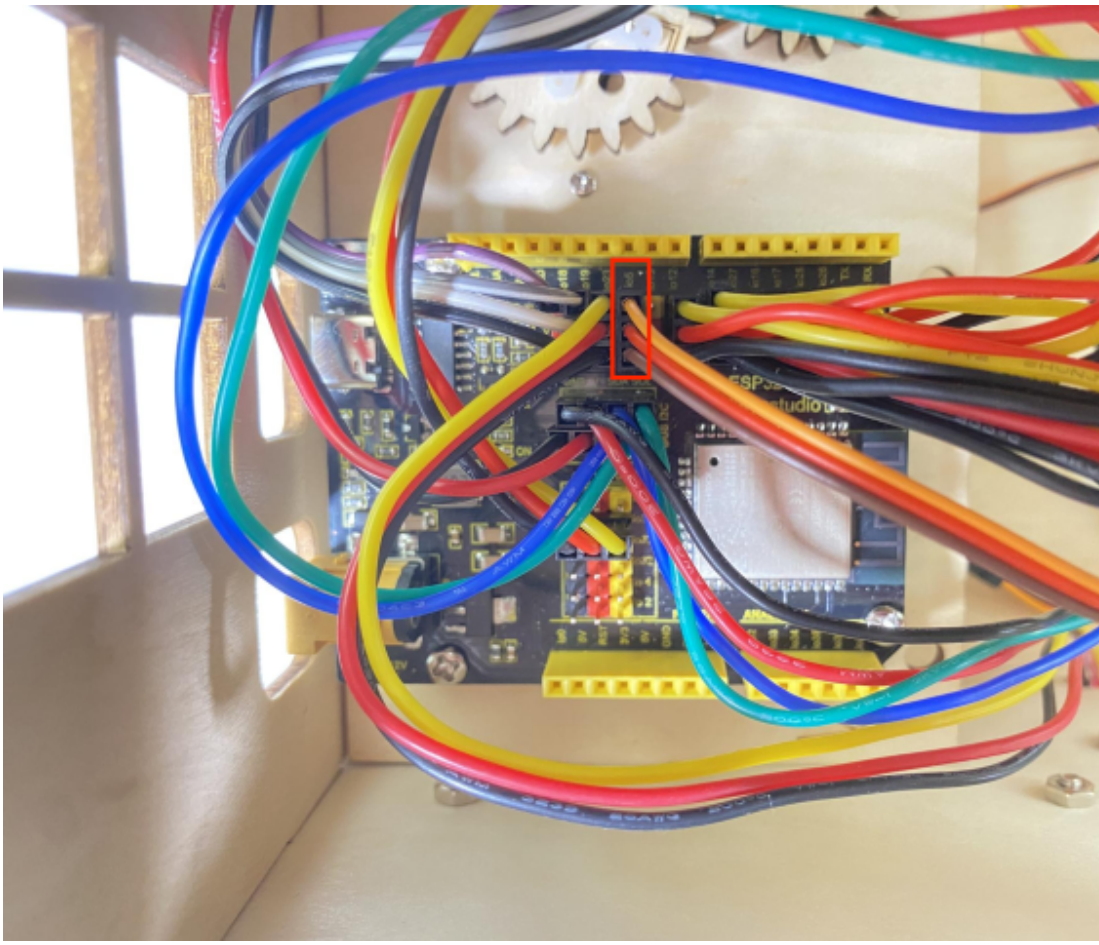
LCD1602 display to the IIC

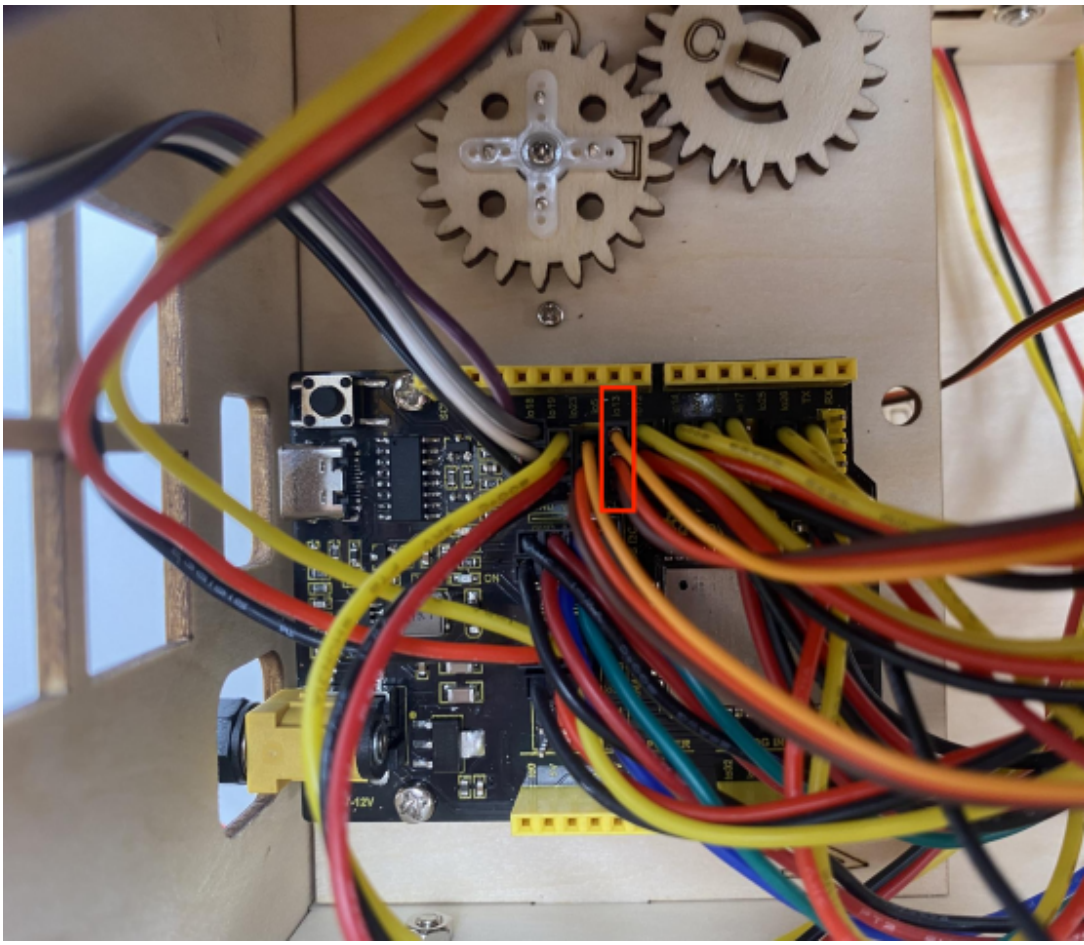
6812RGB LED to the io26

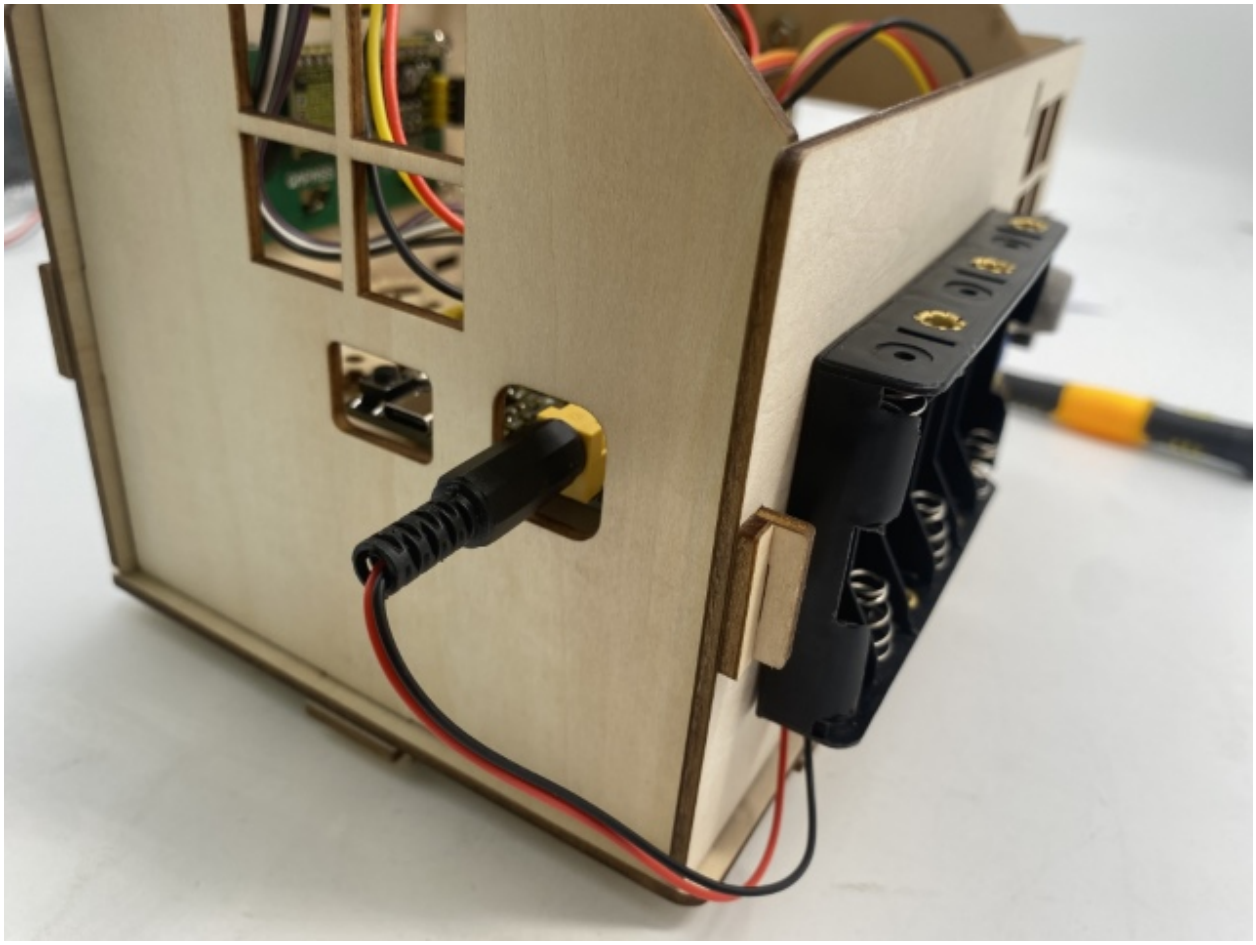


gas sensor to the io23 

buzzer sensor to the io25 

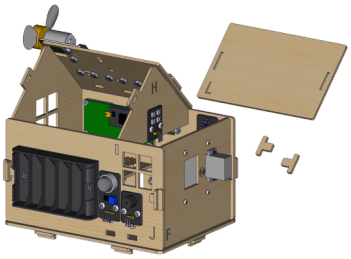
servo controlling windows to io5 

servo controlling doors to the io13 

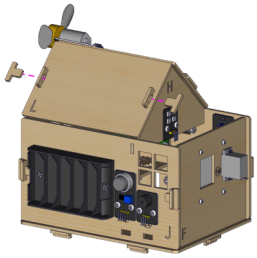


power wiring

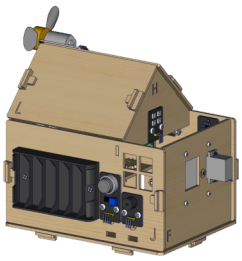
Step 20



Components Required



Installation Diagram



Prototype

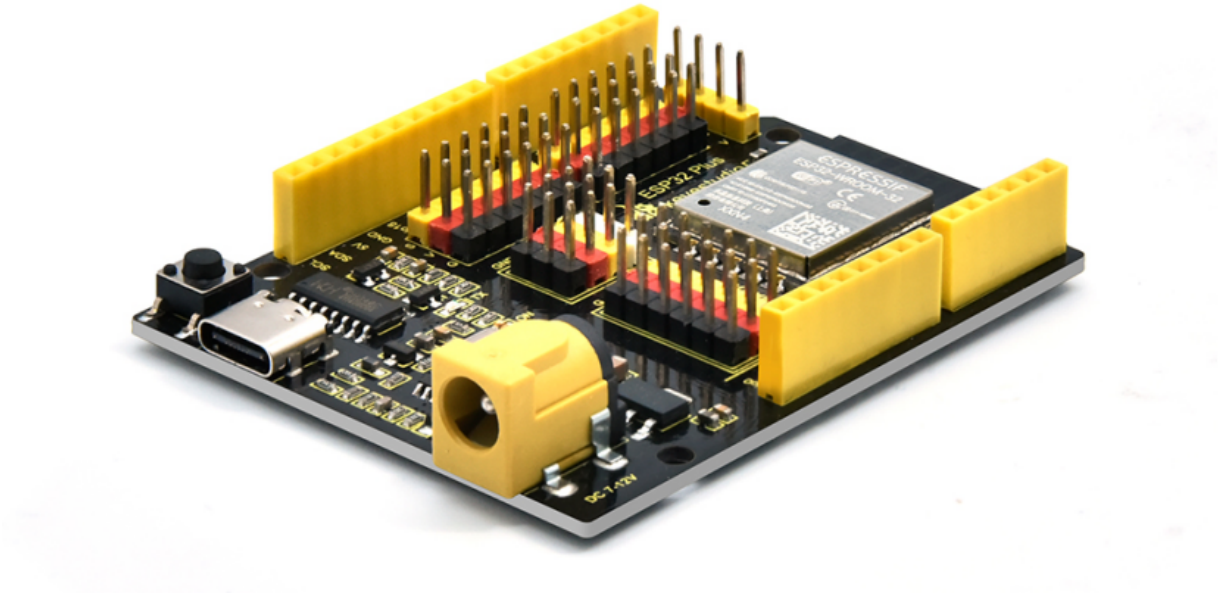
CHAPTER

FIVE

ARDUINO TUTORIAL

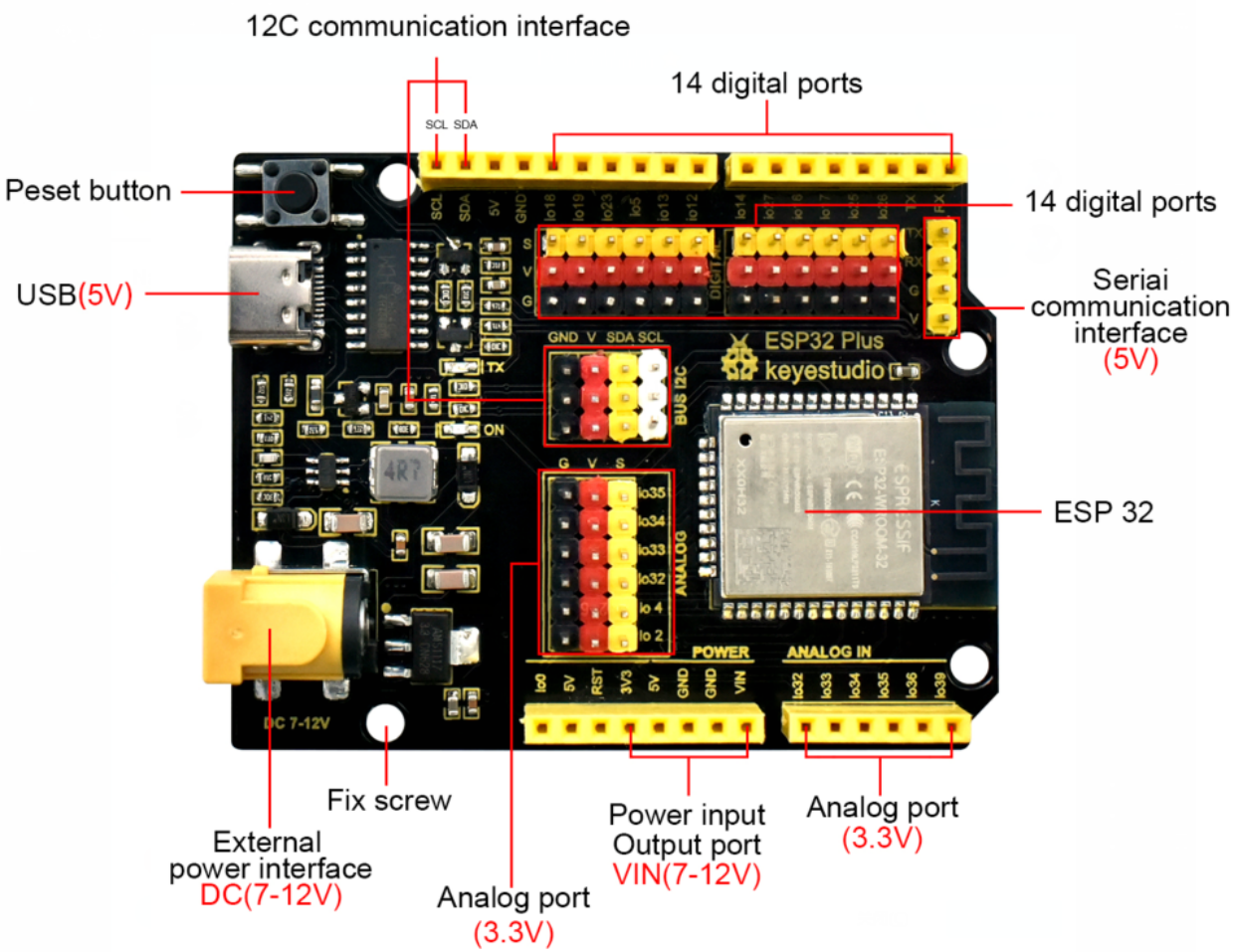
5.1 Getting started with Arduino

5.1.1 1. ESP32 PLUS Development board



ESP32PLUS is a universal WIFI plus Bluetooth development board based on ESP32, integrated with ESP32-WOROOM-32 module and compatible with Arduino.

It has a hall sensor, high-speed SDIO/SPI, UART, I2S as well as I2C. Furthermore, equipped with freeRTOS operating system, which is quite suitable for the Internet of things and smart home.

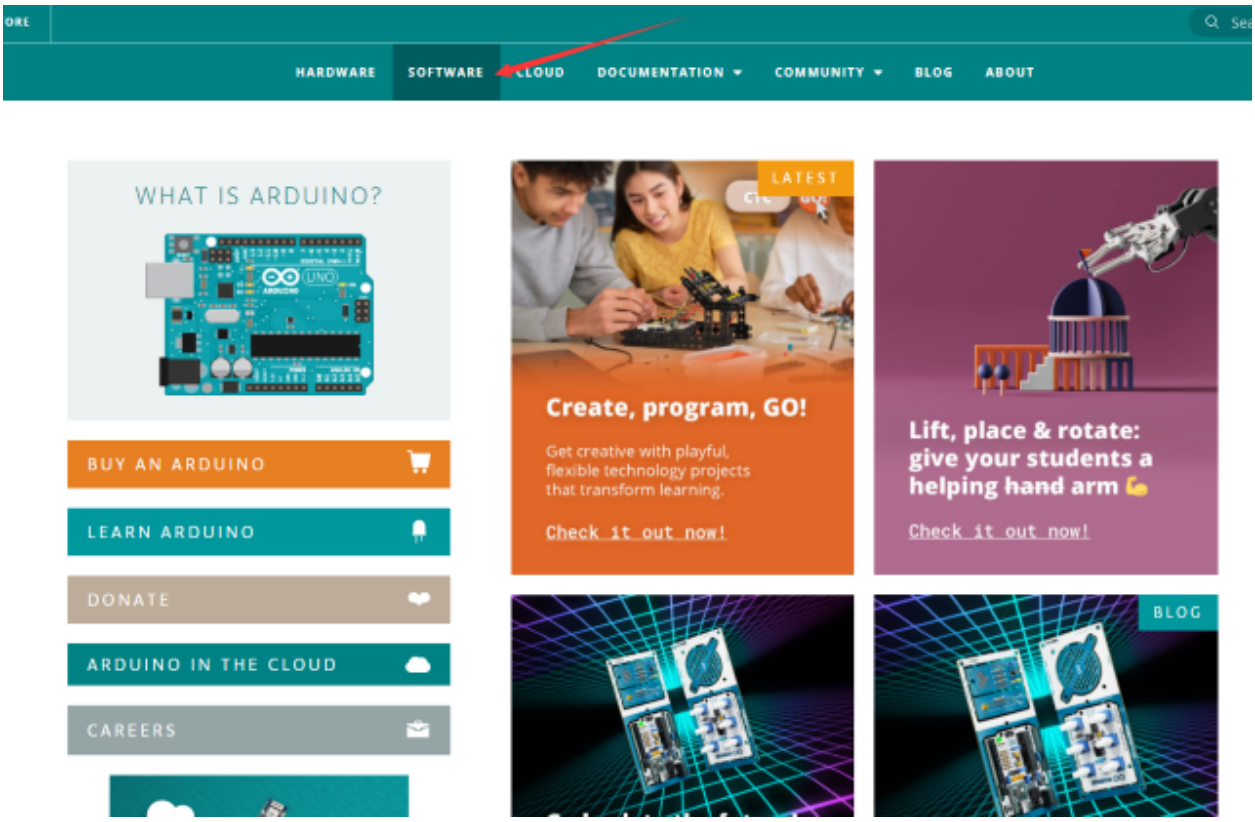


5.1.2 2. Windows System

2.1 Installing Arduino IDE

When you get control board, you need to download Arduino IDE and driver firstly.

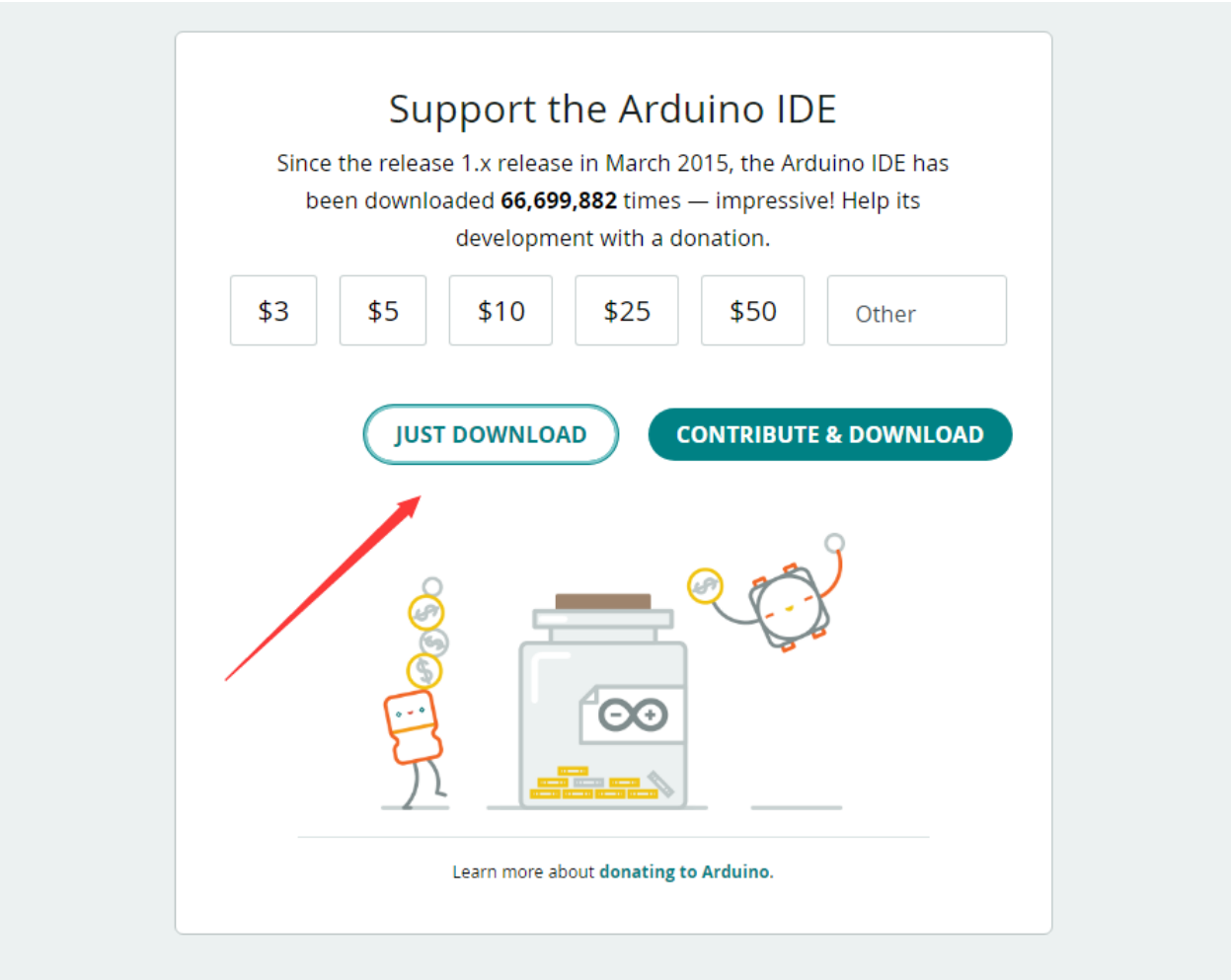
You could download Arduino IDE from the official website:https://www.arduino.cc/, click the **SOFTWARE** on the browse bar to enter download page, as shown below:



There are various versions of IDE for Arduino. Just download a version compatible with your system. Here we will show you how to download and install the windows version of Arduino IDE.

You can choose between the Installer (.exe) and the Zip packages. We suggest you use the first one that installs directly everything you need to use the Arduino Software (IDE), including the drivers. With the Zip package you need to install

the drivers manually. The Zip file is also useful if you want to create a portable installation.



You just need to click JUST DOWNLOAD.

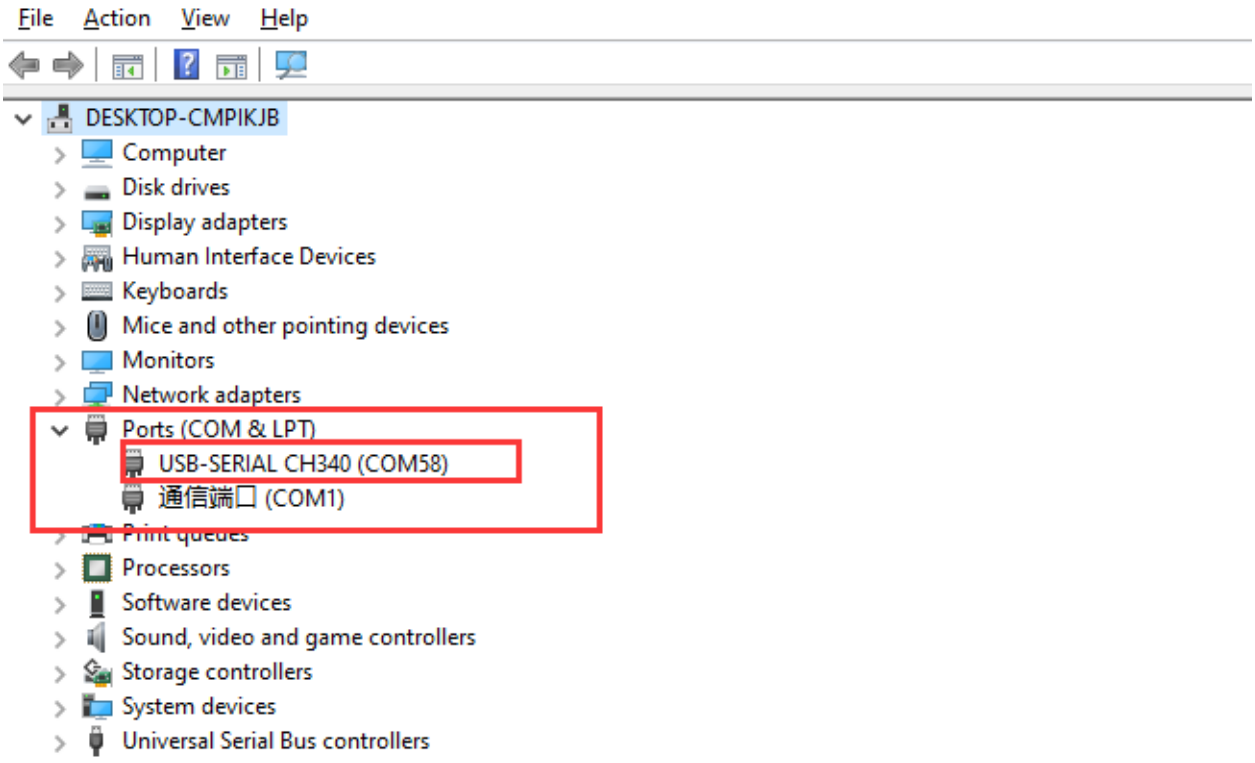
2.2 Install a driver

If you have installed the CH340 driver, just skip it.

Connect the main control board to your computer with a USB cable, and the driver will be installed automatically on MacOS and Windows10 system. If the driver installation process fails, you need to install the driver manually.

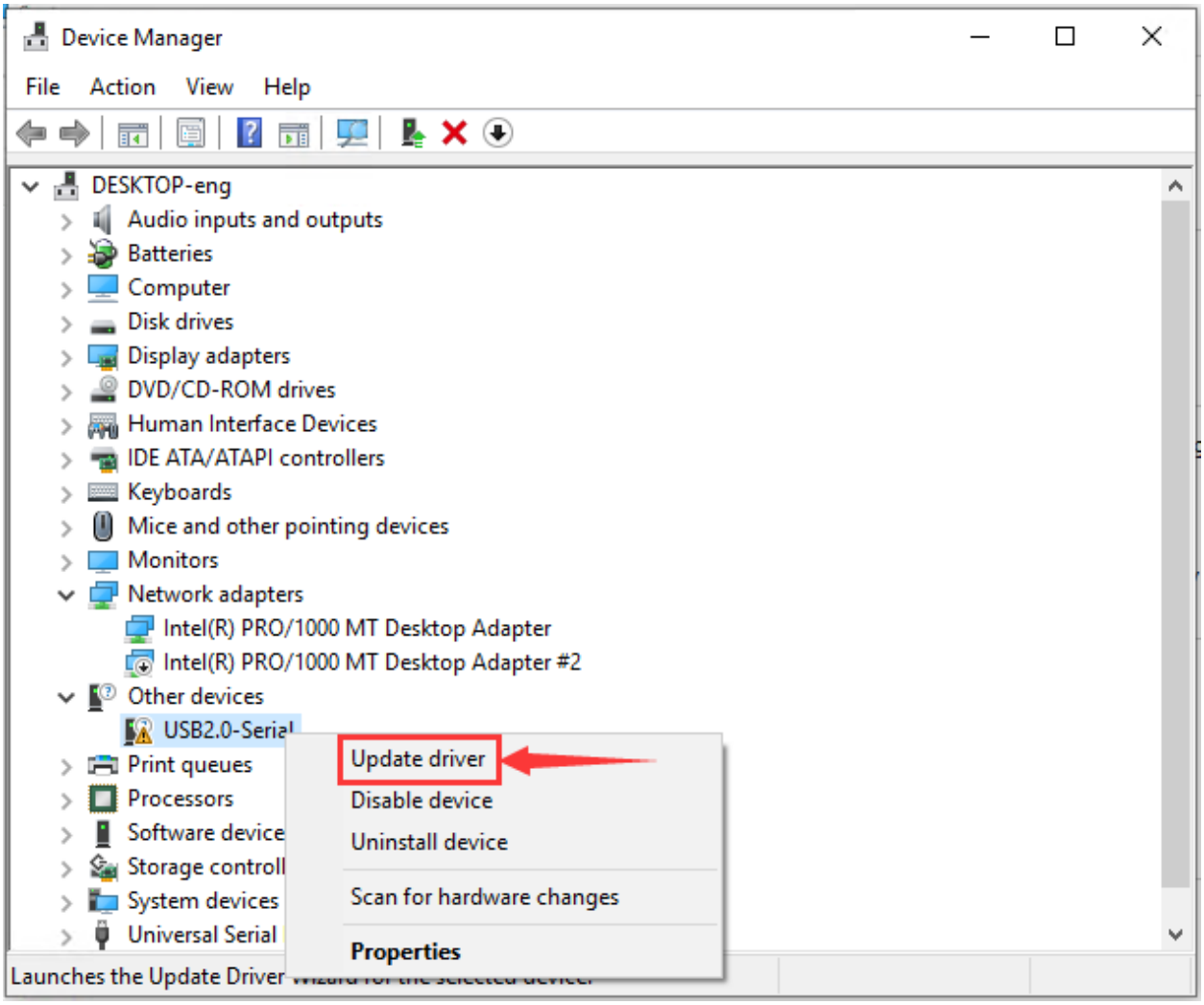
(1) Check whether the computer automatically installs the driver:

Right click Computer—— Click Properties——Click Device Manager, the following picture shows the successful installation:

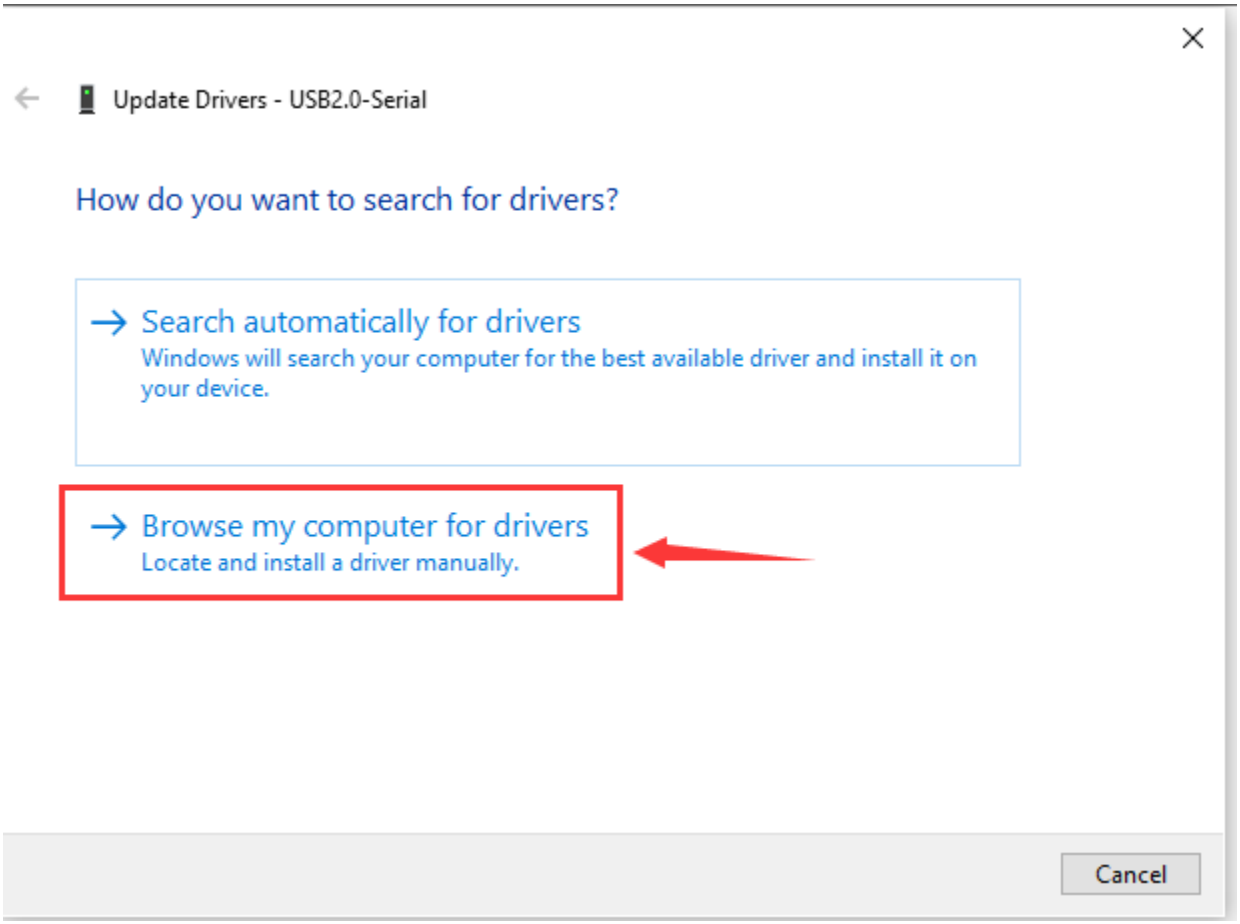


(2) Manual installation:

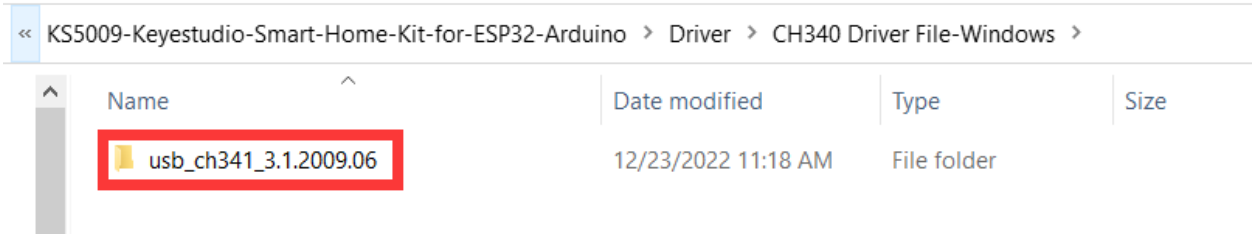
Right-click "**USB2.0-Serial**" and click "**Update drive…**"



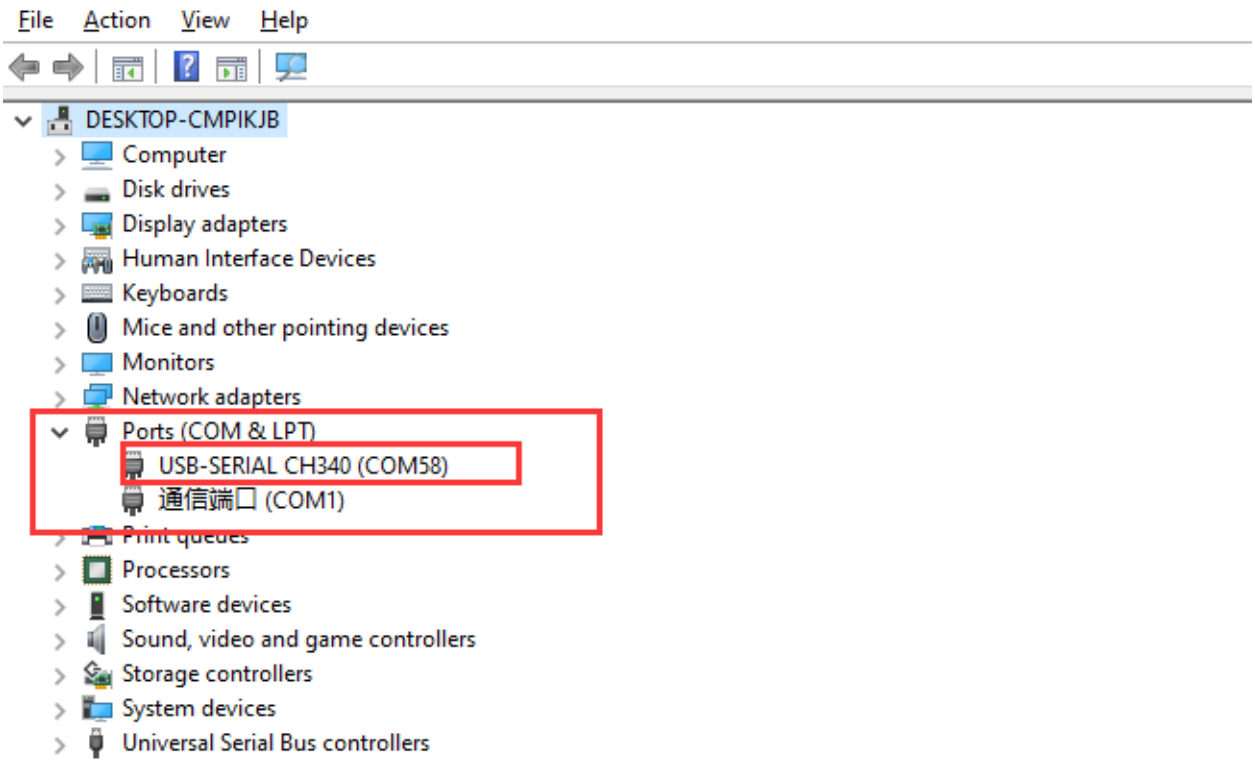
Click "**Browse my computer for driver software**"



Click"**Browse…**"and select the"**usb_ch341_3.1.2009.06 folder**".

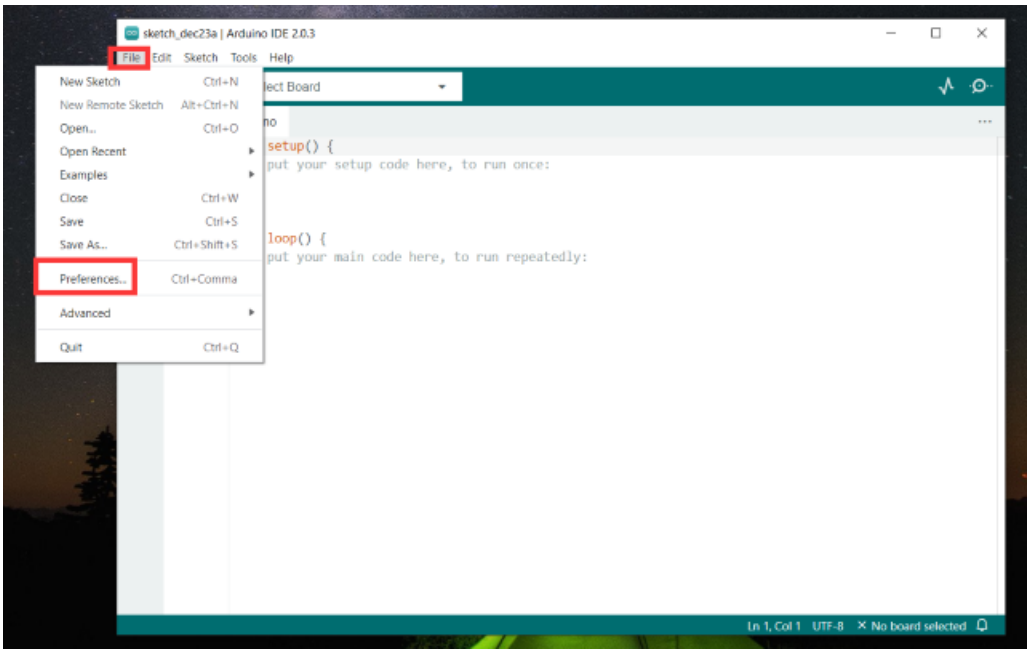


Check the serial port connection status again, as shown in the following figure, the driver is successfully installed.



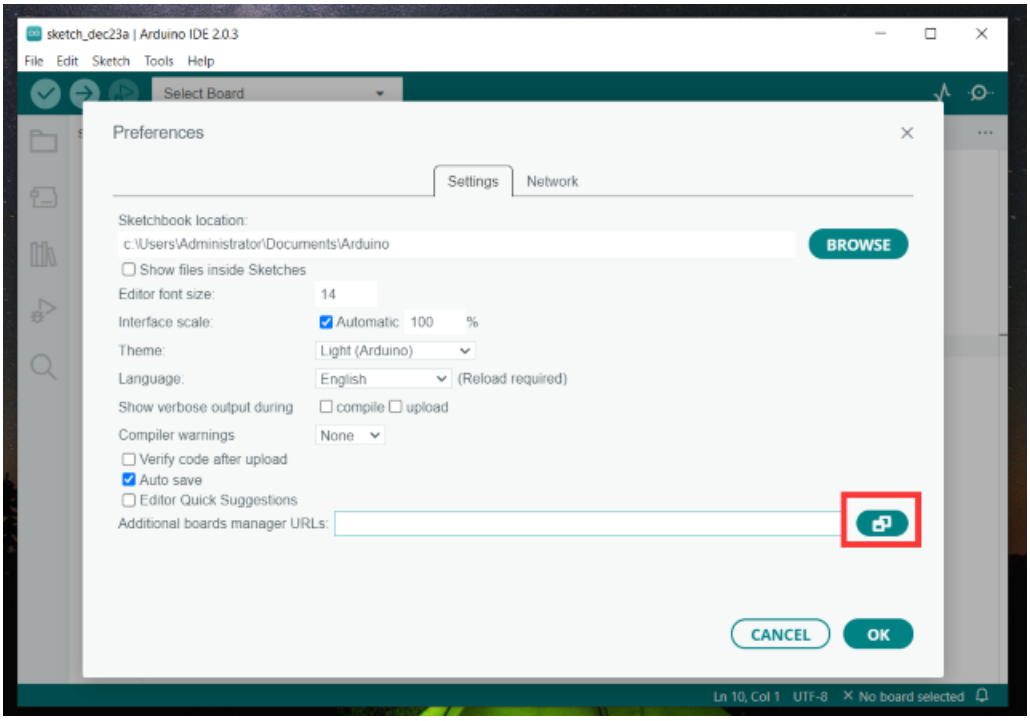
2.3 Add the ESP32 Environment

1Open the arduino IDEclick File > Preferencesas shown below:

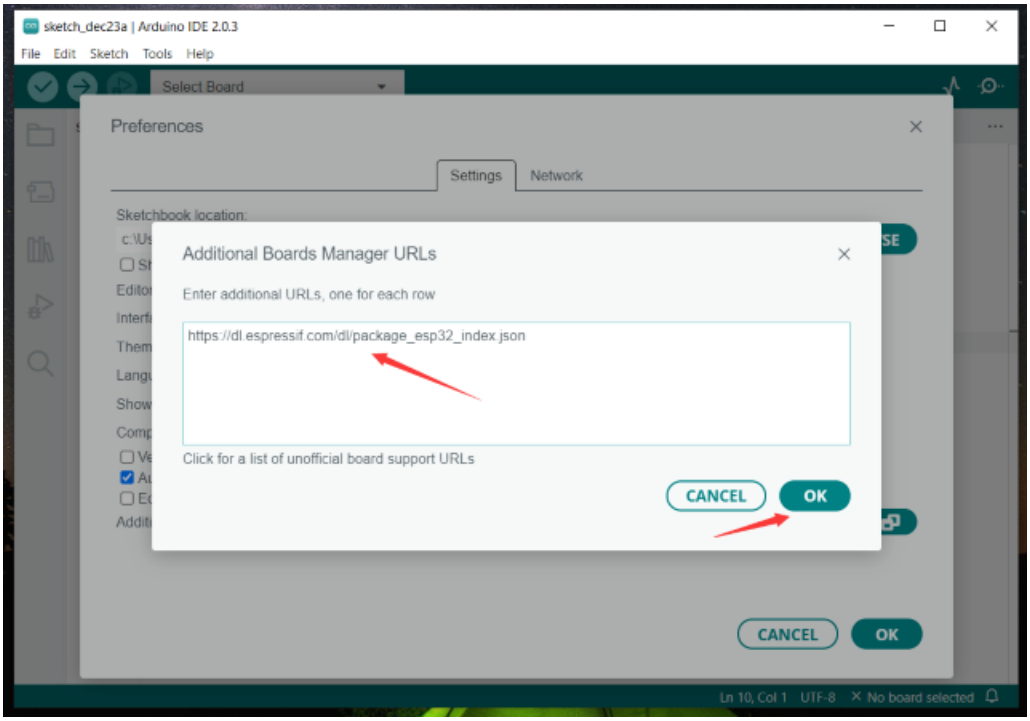


2Copy the linkhttps://dl.espressif.com/dl/package_esp32_index.json

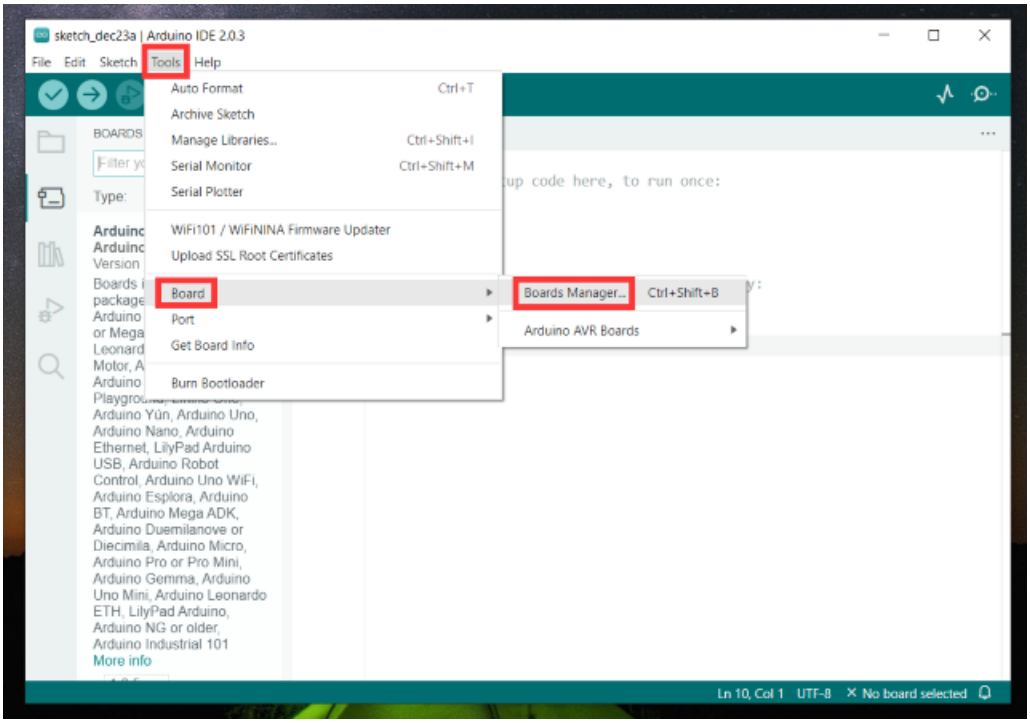
3Open the button marked below:



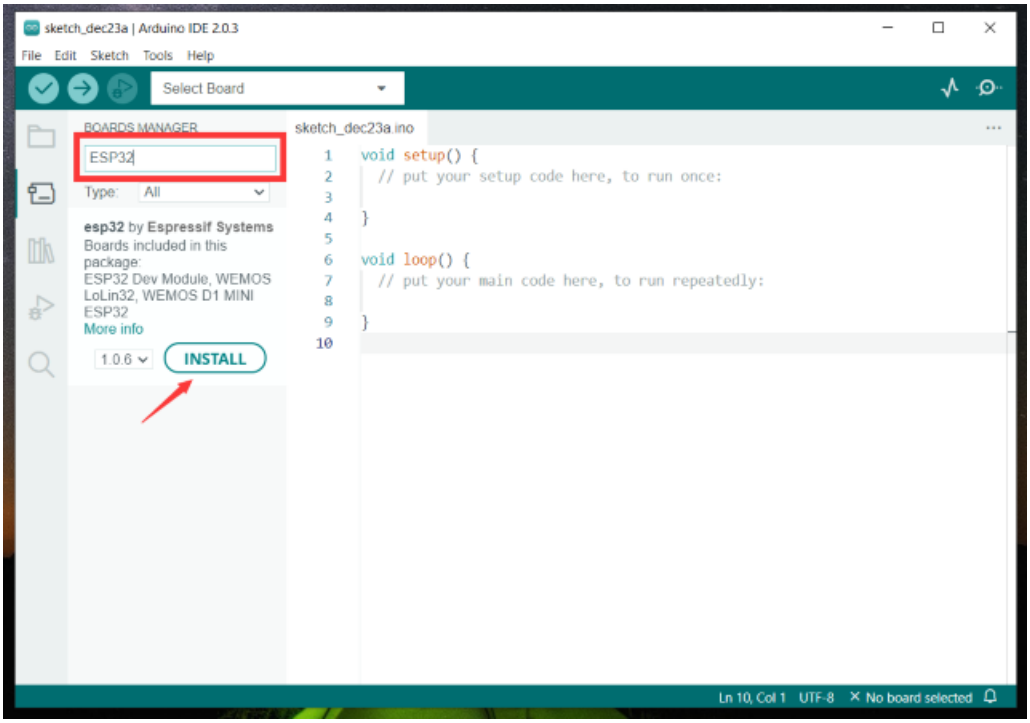
(4) Paste it inside and click OK, as shown below



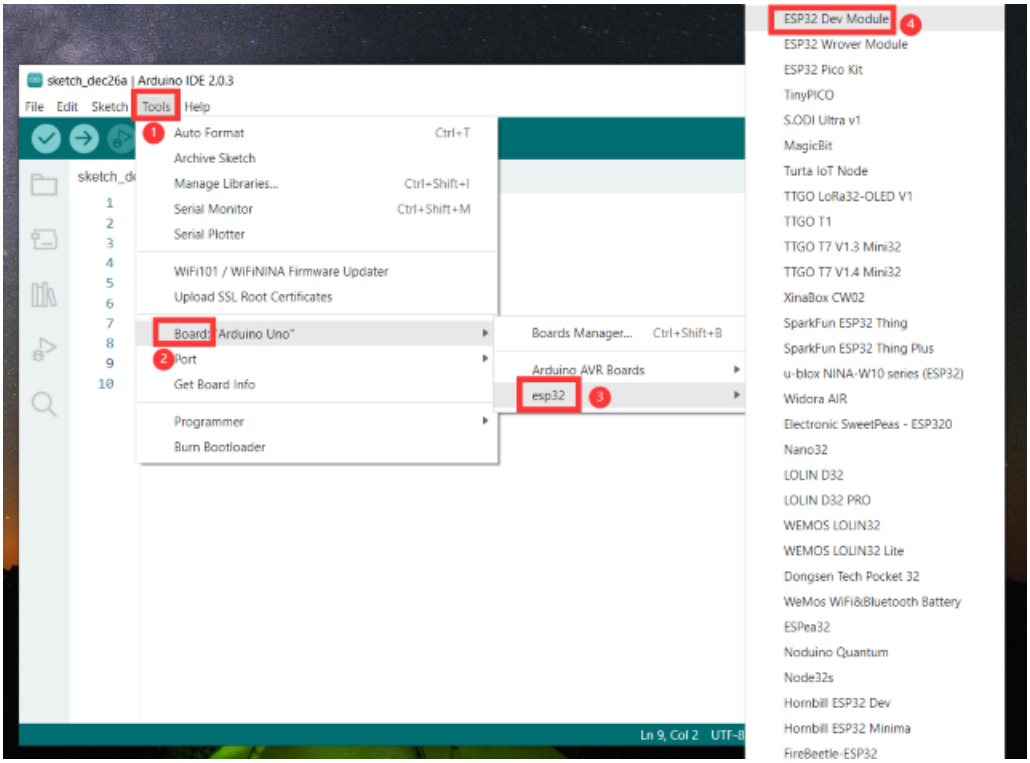
(5) Click Tools > Board > Boards Manager



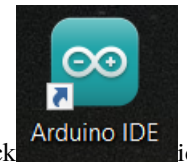
(6) Find the ESP32 from the pop up Boards Manager and then click install.



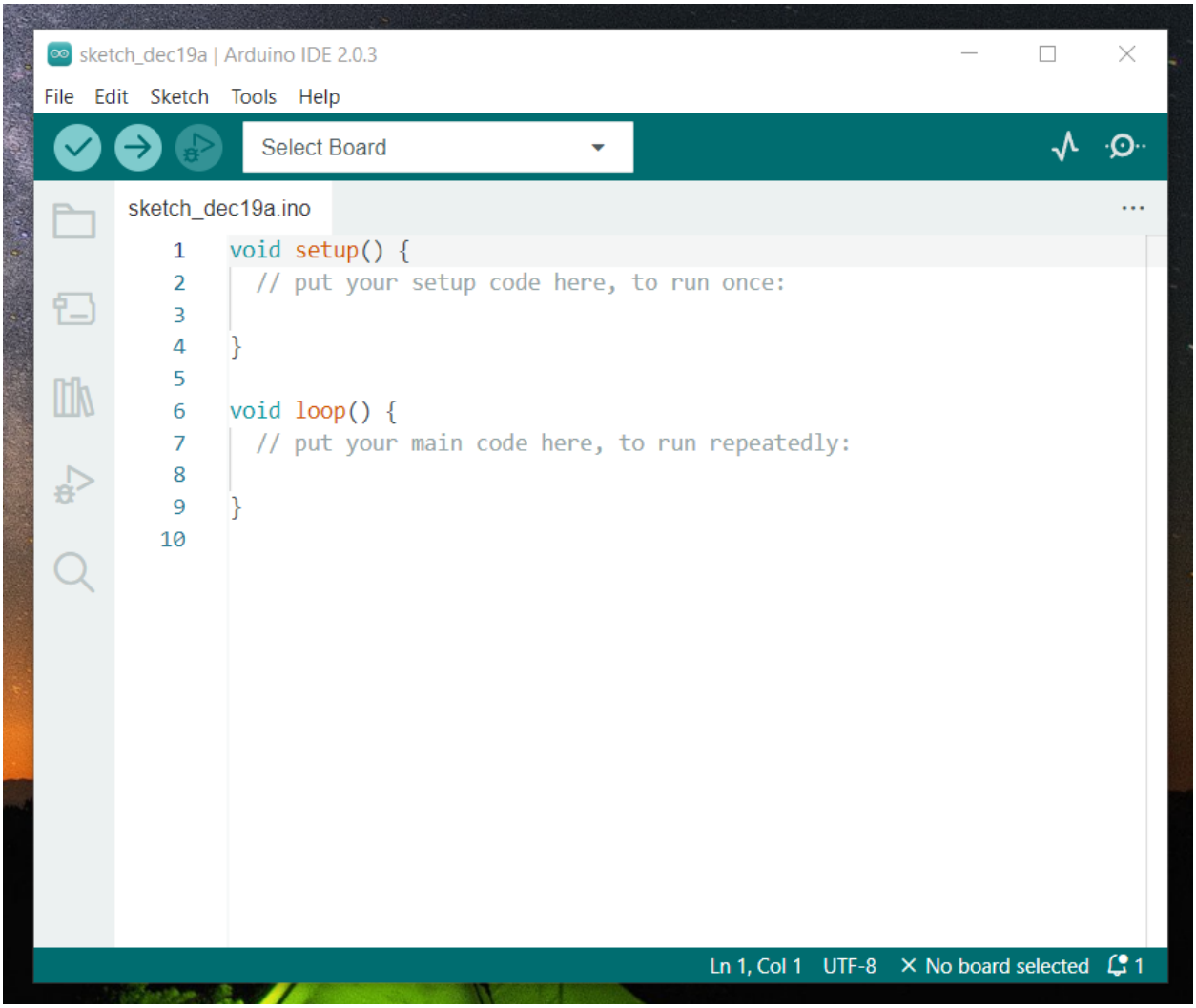
(7) Click Tools > Board >esp32 to choose the ESP32 Dev Module.



2.4 Arduino IDE Setting

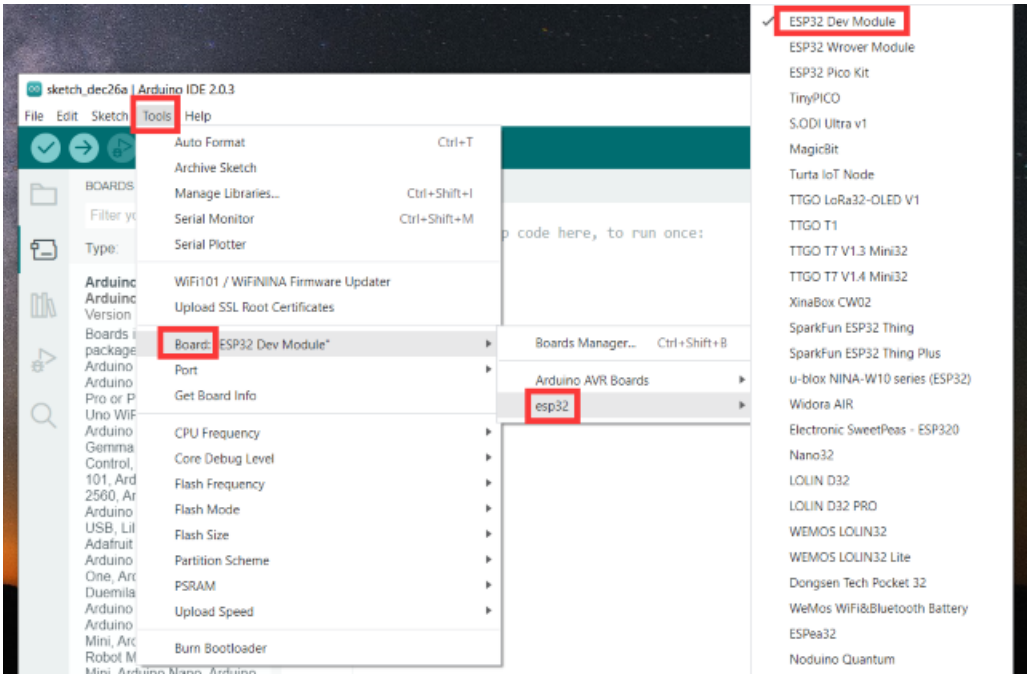
Click 

iconopen Arduino IDE.

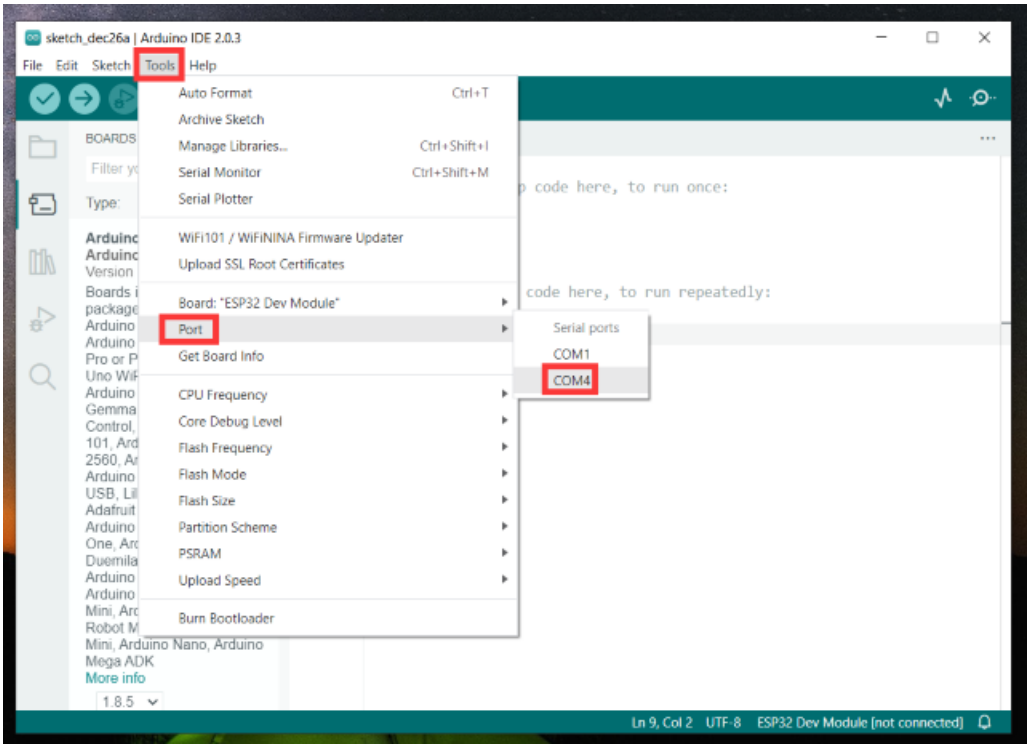


To avoid the errors when uploading the program to the board, you need to select the correct Arduino board that matches the board connected to your computer.

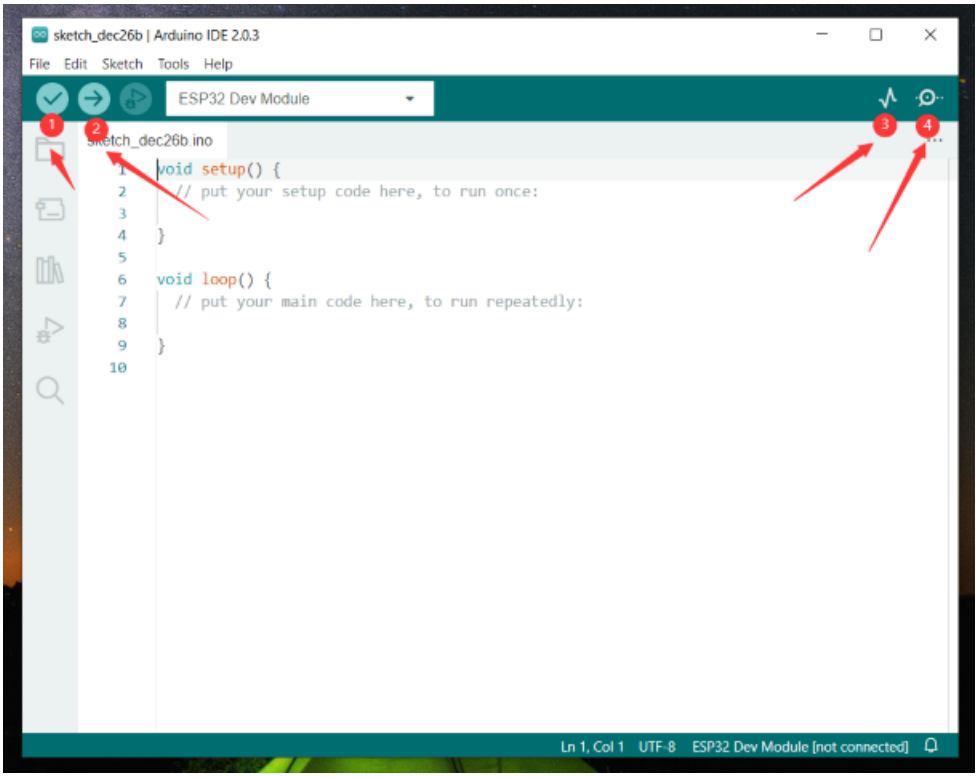
Then come back to the Arduino software, you should click Tools→Board, select the board. (as shown below)



Then select the correct COM port (you can see the corresponding COM port after the driver is successfully installed)



Before uploading the program to the board, let's demonstrate the function of each symbol in the Arduino IDE toolbar.



1- Used to verify whether there is any compiling mistakes or not.

2- Used to upload the sketch to your ESP32 board.

3- Used to send the serial data received from board to the serial plottle.

4- Used to send the serial data received from board to the serial monitor.

5.1.3 3.Mac System

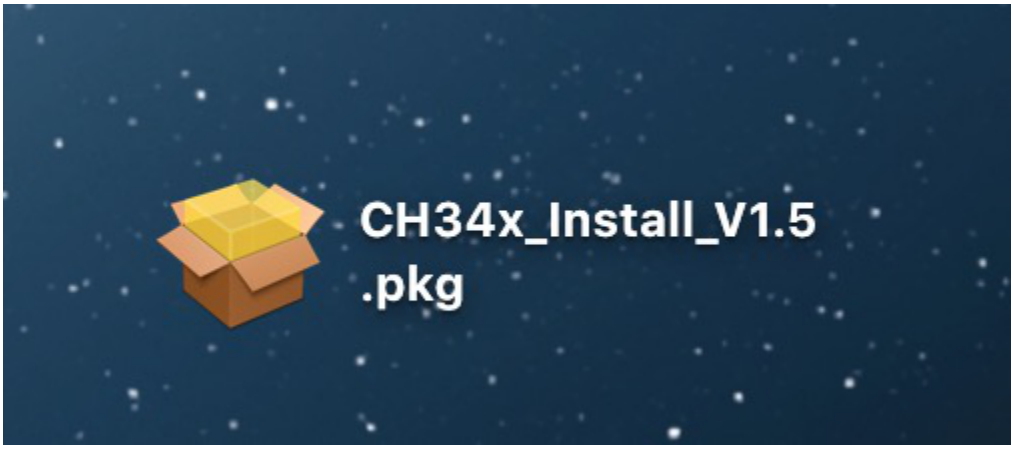
3.1 Download Arduino IDE

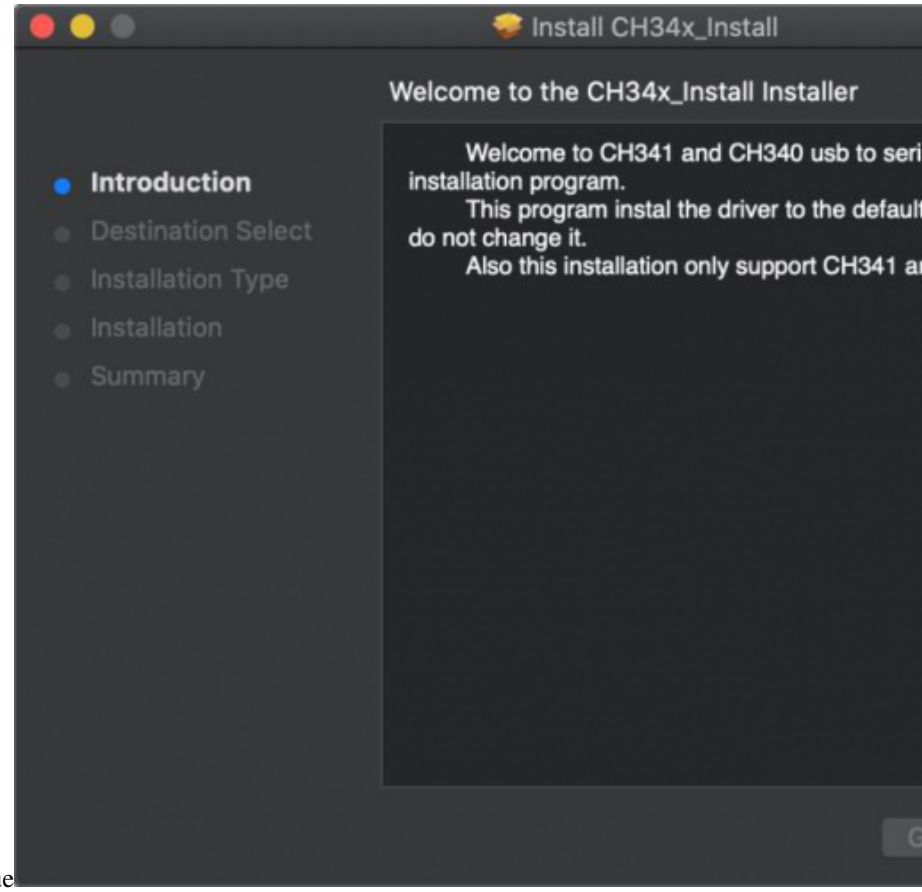
3.2 Download the CH340 driver

CH340 chip driver for MAC

3.3 How to install the CH340 driver

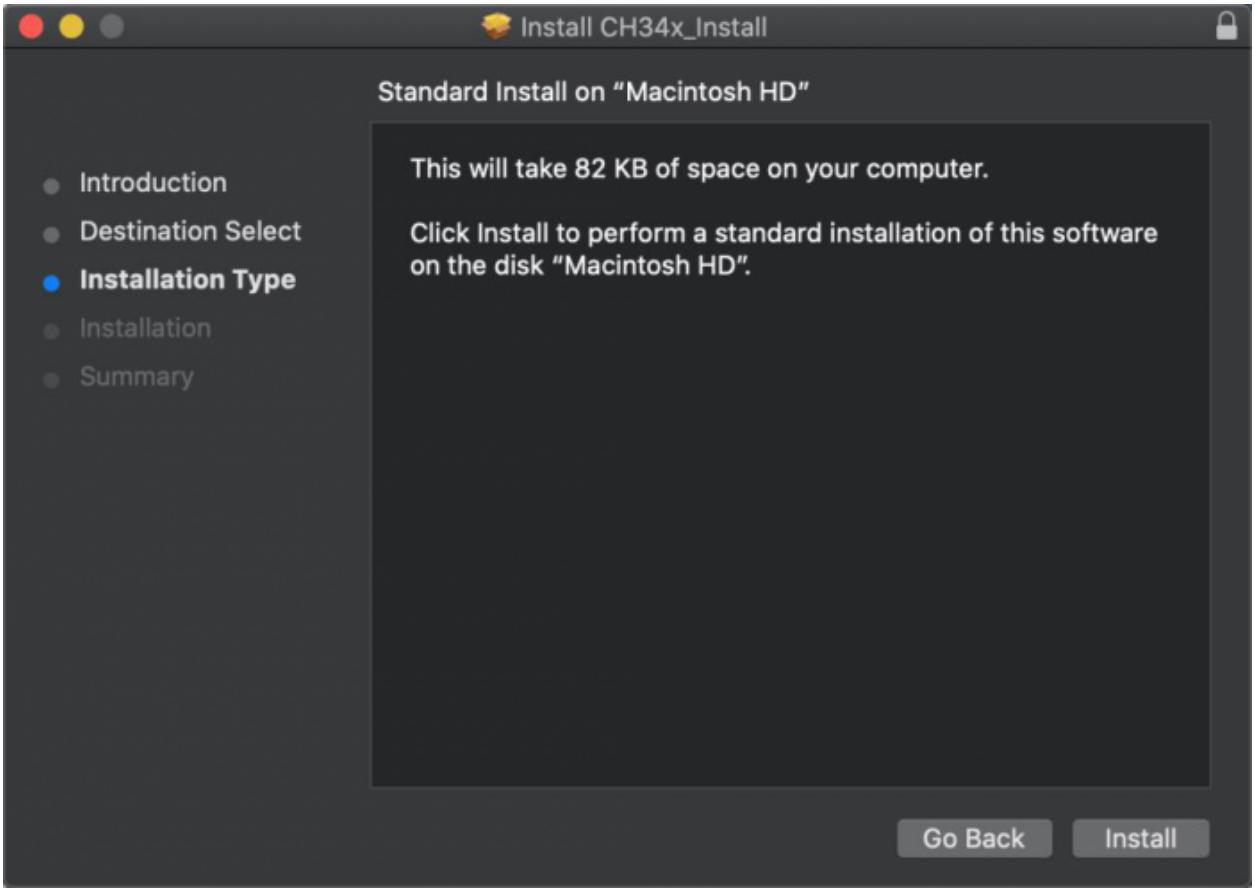
After the download, seen as below:



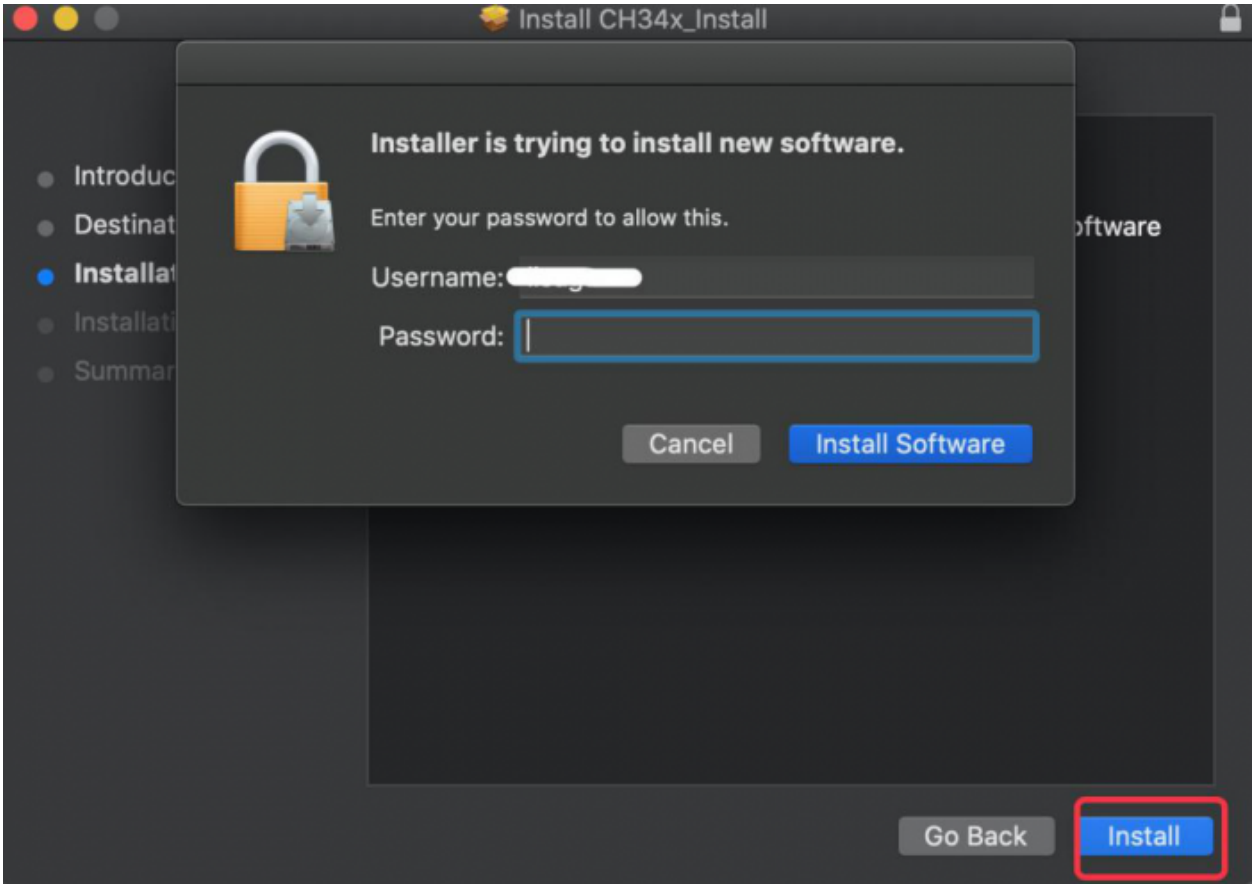


Double-click installation package and tap Continue

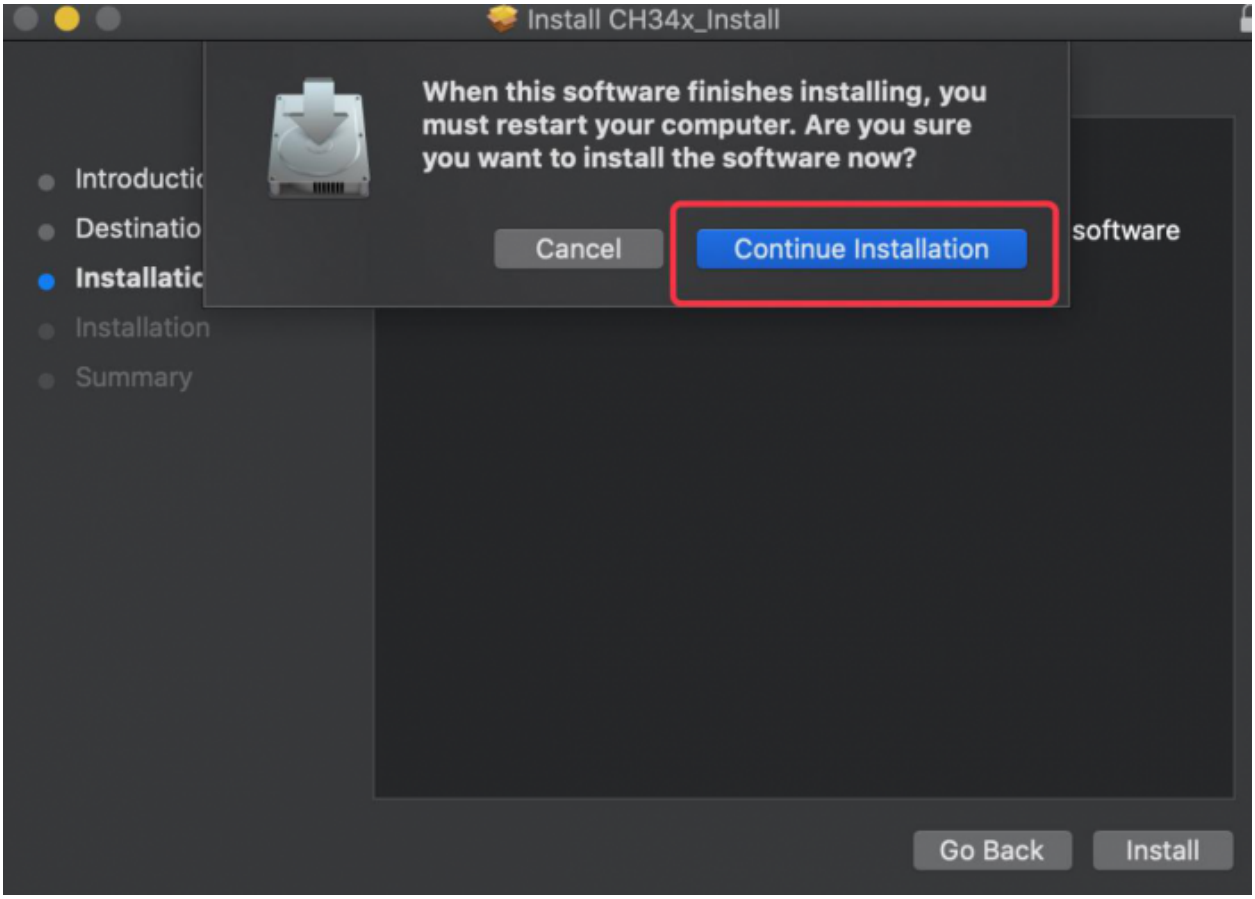
Click Install



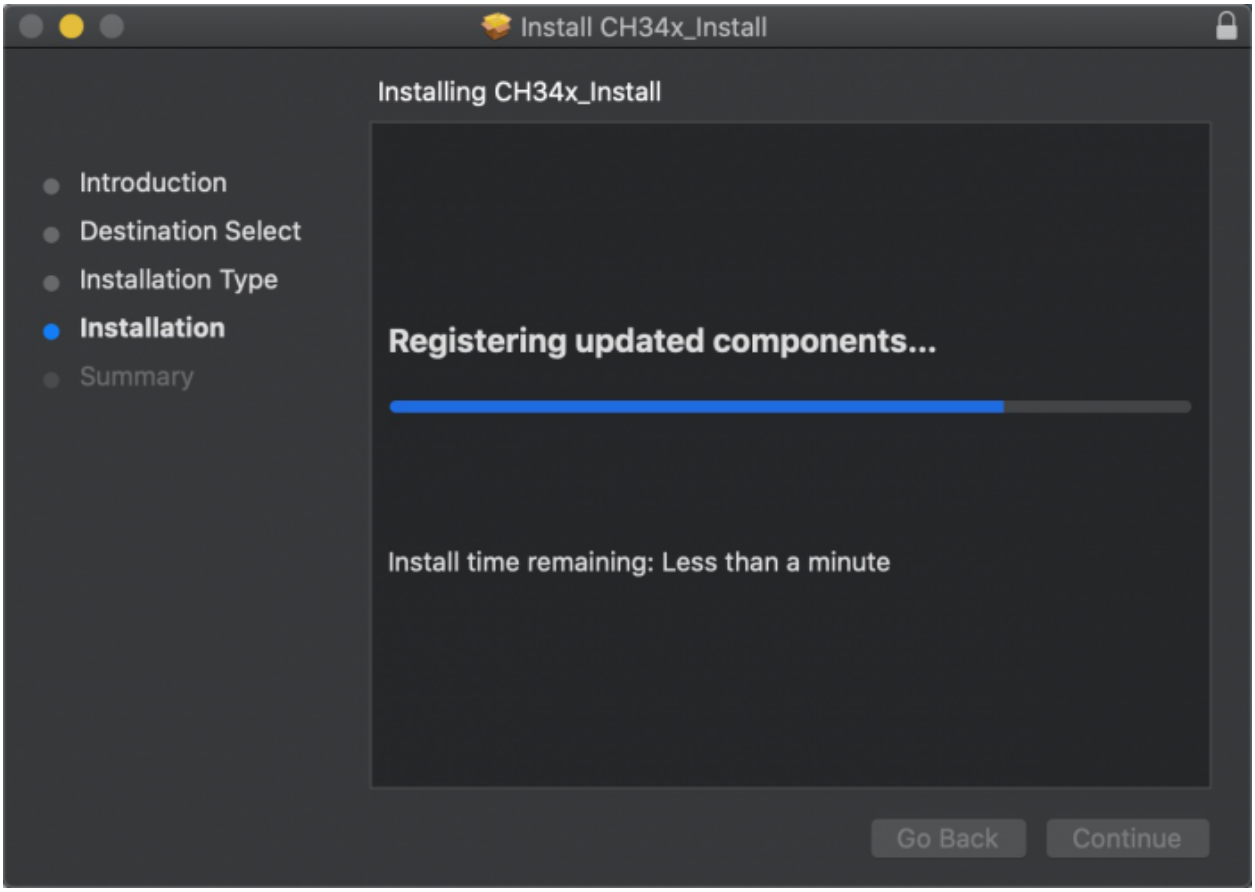
Input your user password and click Install Software



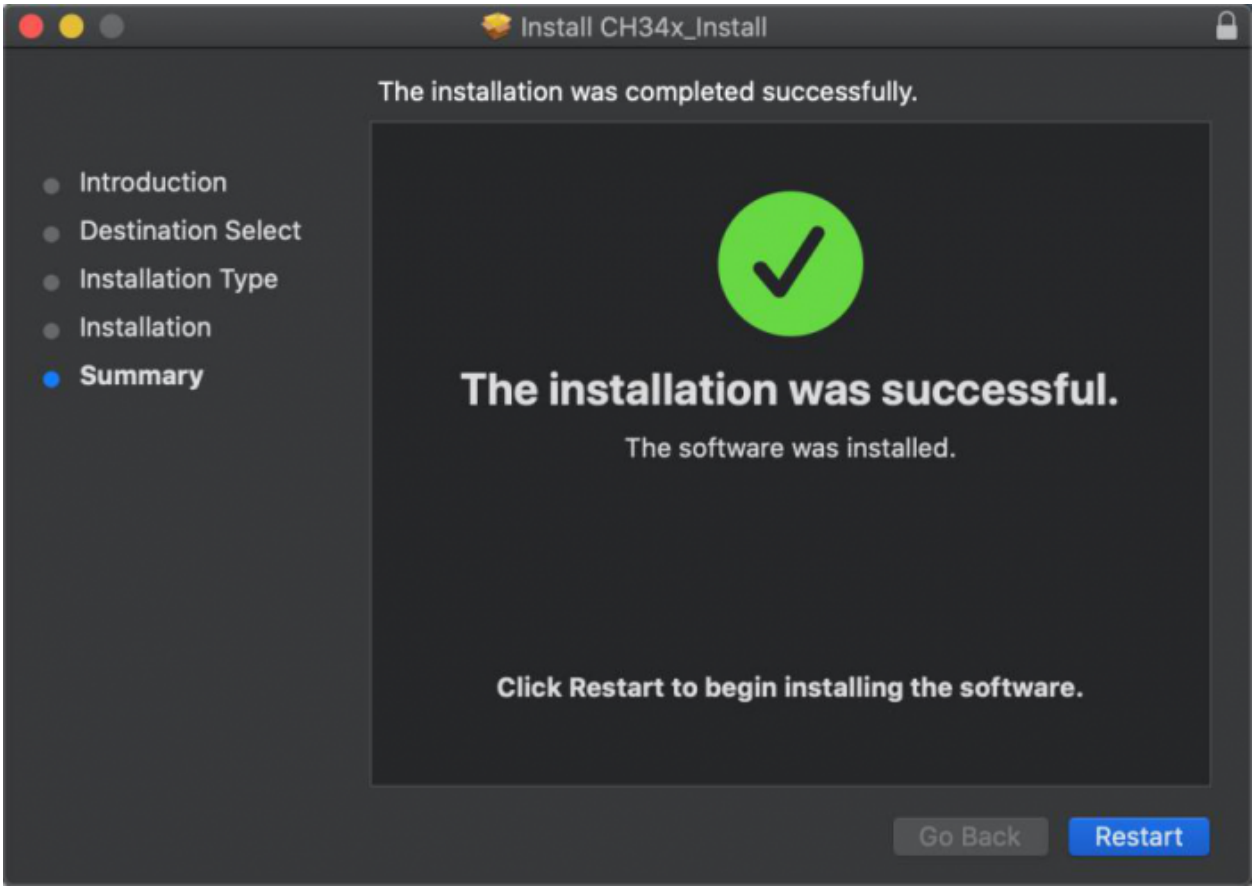
Tap Continue Installation



Wait to install

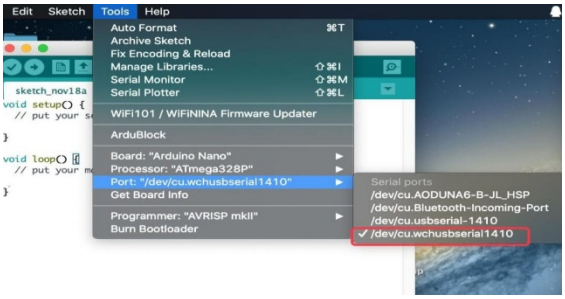


Click Restart after the installation is finished



3.4 Arduino IDE Setting:

Except for COM ports, the setting method is the same as in chapter 1.4:



5.2 How to Add Libraries?

5.2.1 What are Libraries ?

Libraries are a collection of code that makes it easy for you to drive a sensor,display, module, etc.

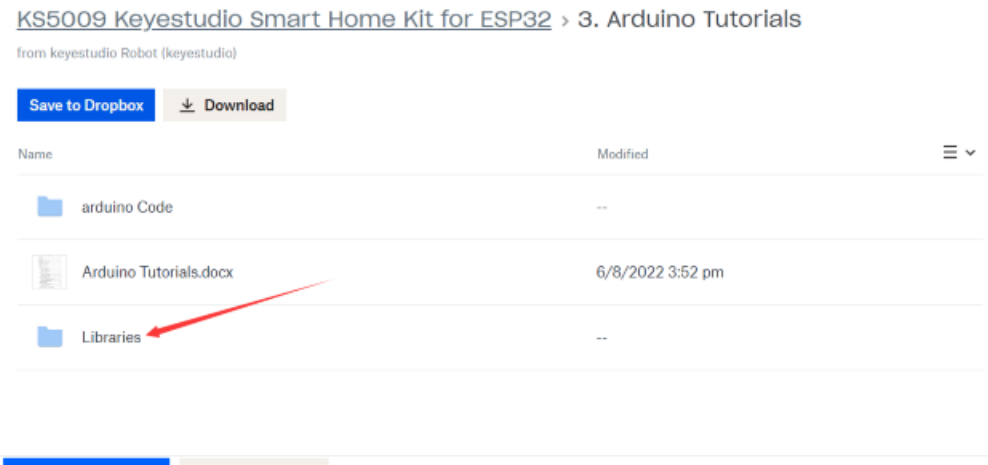
For example, the built-in LiquidCrystal library helps talk to LCD displays. There are hundreds of additional libraries available on the Internet for download.

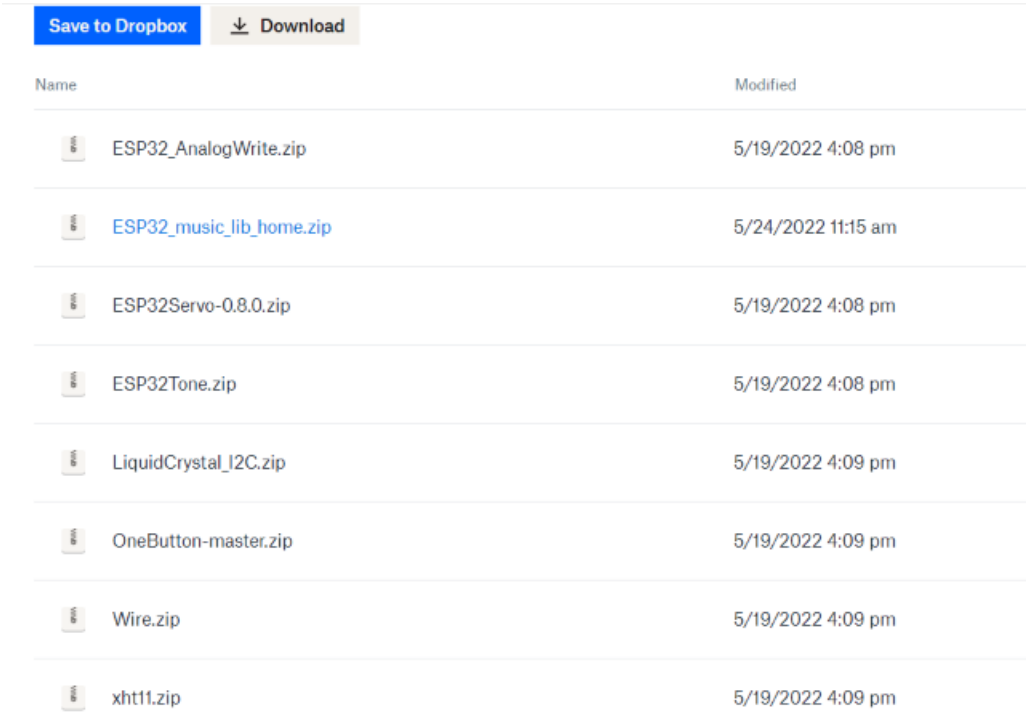
The built-in libraries and some of these additional libraries are listed in the reference.

https://www.arduino.cc/en/Reference/Libraries

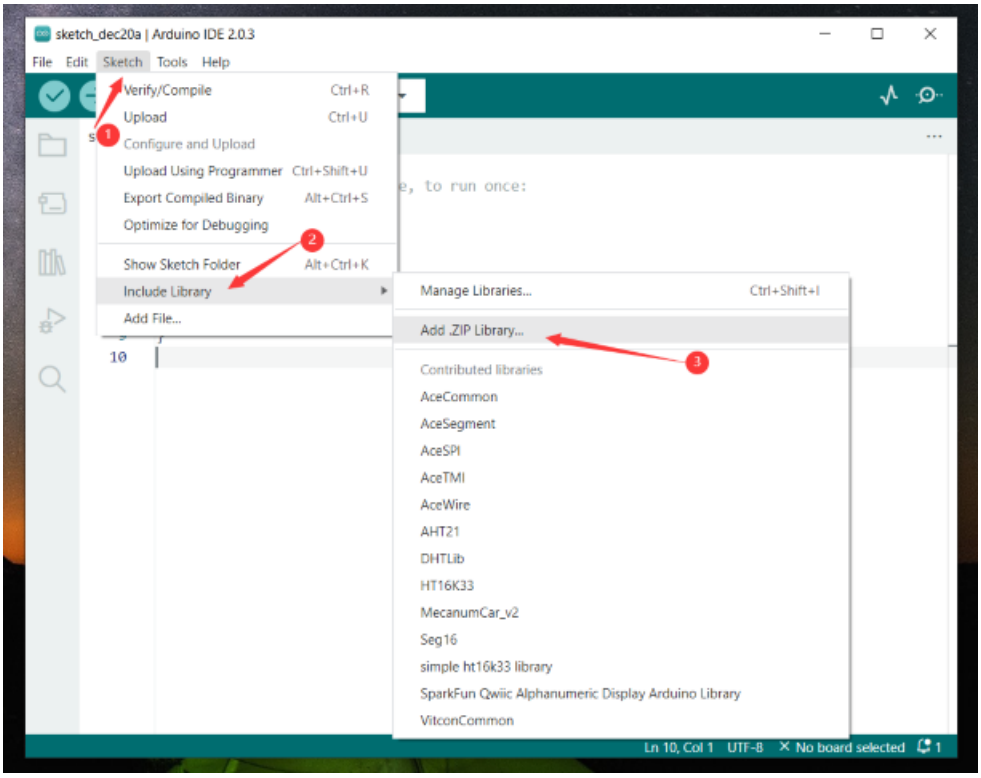
5.2.2 Add ZIP Libraries

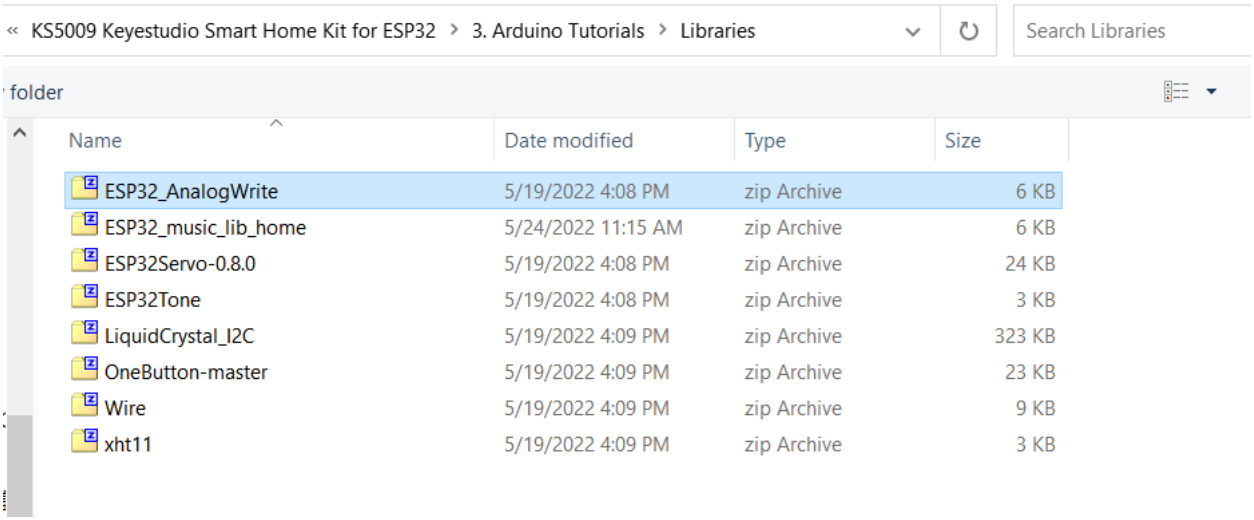
When you want to add a zip library, you need to download it as a ZIP file, put in the proper directory. The Libraries needed to run the mini tank can be found onhttps://fs.keyestudio.com/KS5009



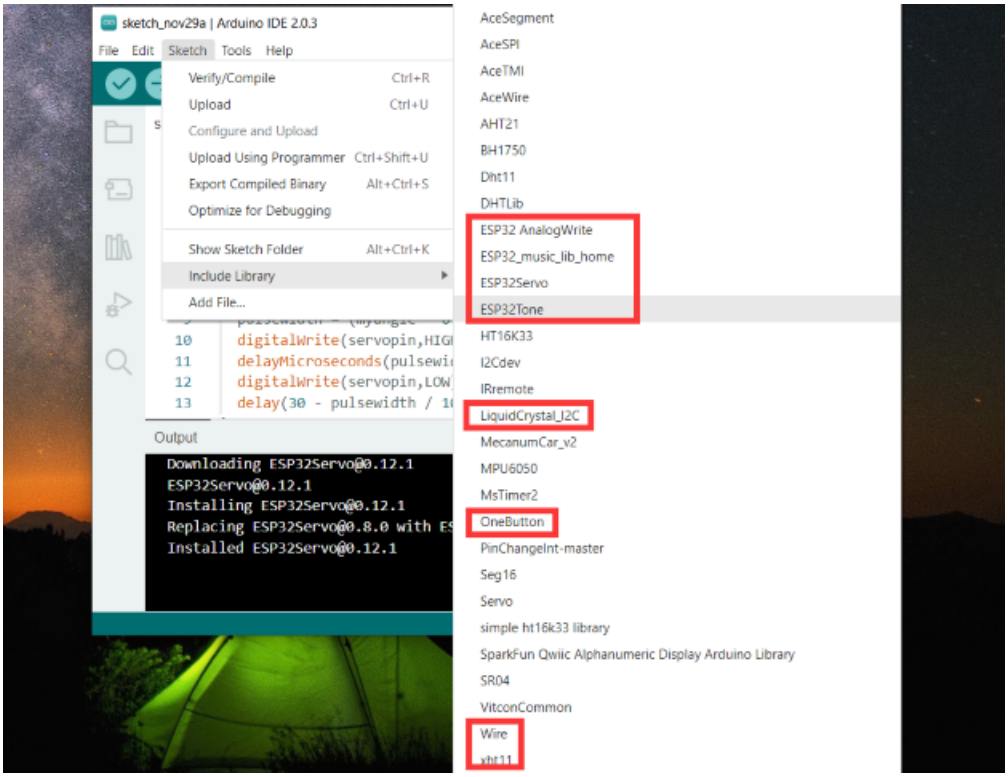


Click Sketch—->Include Library—>Add.ZIP Librarythen Then navigate to the library file you downloaded and click "open."





Import the library. You can find it in the include library list.



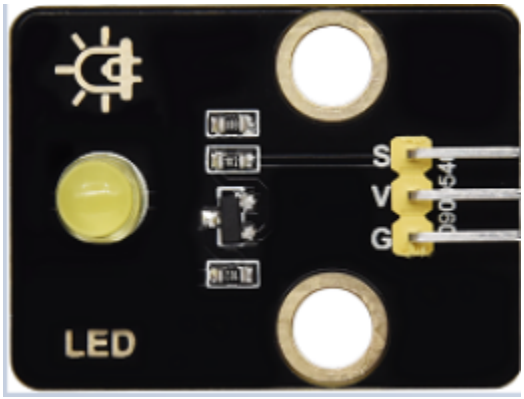
5.3 Arduino Projects

Alright, let's get straight to our projects. We will make you know the smart home deeply from the simple sensor.

Note: In this course, the interface of each sensor / module marked with (G,-, GND) indicates the negative pole, G is connected to G, - or GND of sensor shield or control board; "V" is positive pole and connected with V, VCC or 5V.

5.3.1 Project 1.1 LED Blink

1. Description



We've installed the driver of ESP32 PLUS development board.

In the first lesson, we will conduct an experiment to make LED blink.

Let's connect GND and VCC to power. The LED will be on when signal end S is high level, on the contrary, LED will turn off when signal end S is low level.

In addition, the different blinking frequency can be presented by adjusting the delayed time.

2. Working Principle

LED is also the light-emitting diode, which can be made into an electronic module. It will shine if we control pins to output high level, otherwise it will be off.

3. Parameters

Working voltage	DC 3~5V
Working current	<20mA
Power	0.1W

4. Control Pin

Yellow LED	12

5. Test Code

```
#define led_y 12  //Define the yellow led pin to 12

void setup() {    //The code inside the setup function runs only once
  pinMode(led_y, OUTPUT);  //Set pin to output mode
}

void loop() {     //The code inside the loop function will always run in a loop
  digitalWrite(led_y, HIGH);  //Light up the LED
  delay(200);     //Delay statement, in ms
  digitalWrite(led_y, LOW);   //Close the LED
  delay(200);
}
```

6.Test Result

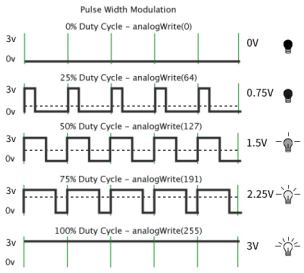
After uploading the code , you can see white and yellow LEDs flashing together.

5.3.2 Project 1.2 Breathing LED

1. Description

A“breathing LED”is a phenomenon where an LED’s brightness smoothly changes from dark to bright and back to dark, continuing to do so and giving the illusion of an LED“breathing. However, how to control LED’s brightness?

It makes sense to take advantage of PWM. Output the number of high level and low level in unit time, the more time the high level occupies, the larger the PWM value, the brighter the LED.



We provide the PWM output library file < analogwrite.h > for ESP32, therefore solely a simple statement analogWrite(); can control the PWM output.

2. Test Code

```
#include <analogWrite.h>  //Import PWM output library files
#define led_y 12    //Define LED pins

void setup(){
  pinMode(led_y, OUTPUT);  //Set pin to output mode
}

void loop(){
  for(int i=0; i<255; i++)  //The for loop statement increments the value of variable i␣
↪until it exits the loop at 255
  {
    analogWrite(led_y, i);  //PWM output, control LED brightness
    delay(3);
  }
  for(int i=255; i>0; i--)  //The for loop statement continues to decrease the value of␣
↪variable i until it exits the loop at 0
    analogWrite(led_y, i);
    delay(3);
  }
}
```

3. Test Result

The LED gradually gets dimmer then brighter, cyclically, like human breathe.

5.3.3 Project 2.1 Read the Button

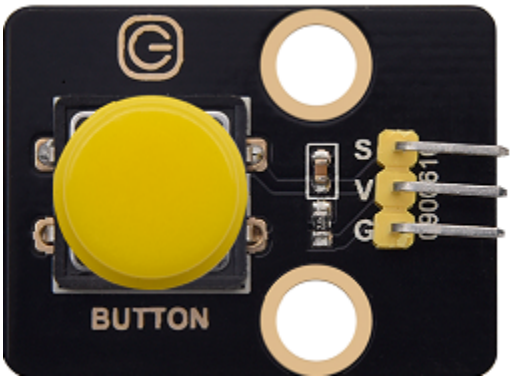
1. Description

The common table lamp uses LED lights and buttons, which can control the light on and off pressing the button.

We will work to read the status value of the button and display it on the serial monitor, so as to see it intuitively.

2. Button Principle

The button module is a digital sensor, which can only read 0 or 1. When the module is not pressed, it is in a high level state, that is, 1, when pressed, it is a low level 0.



3. Pins of the Button

Button 1	16
Button 2	27

4. Test Code

```
#define btn1 16
#define btn2 27

void setup() {
  Serial.begin(9600);
  pinMode(btn1, INPUT);
  pinMode(btn2, INPUT);
}

void loop() {
  boolean btn1_val = digitalRead(btn1);
  boolean btn2_val = digitalRead(btn2);
```

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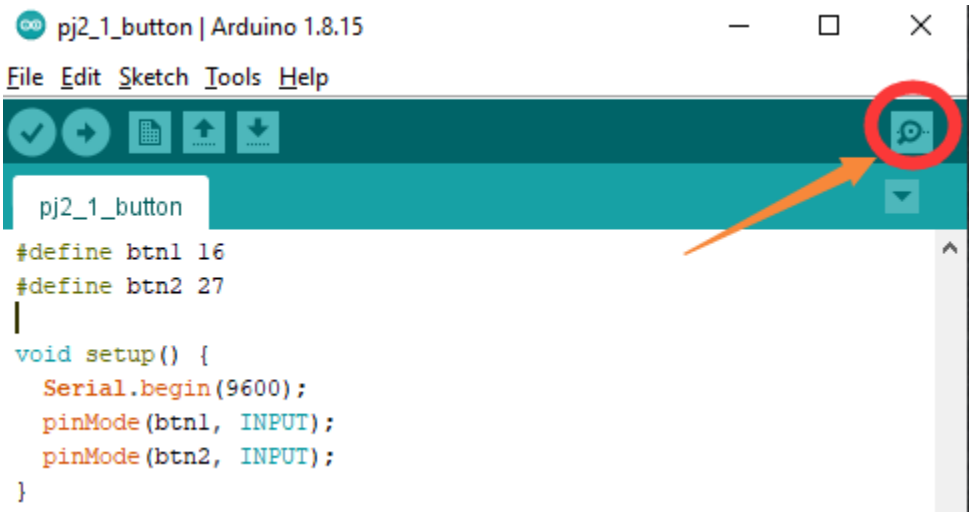
```
  Serial.print("button1 = ");
  Serial.print(btn1_val);
  Serial.print("   ");
  Serial.print("button2 = ");
  Serial.println(btn2_val);
  delay(100);
}
```

5. Test Result

Open the serial monitor of the arduino IDE



Press the button again to see the change of the button state value, as shown below:

5.3.4 Project 2.2. Table Lamp

1. Description

For common simple table lamp, click the button it will be opened, click it again, the lamp will be closed.

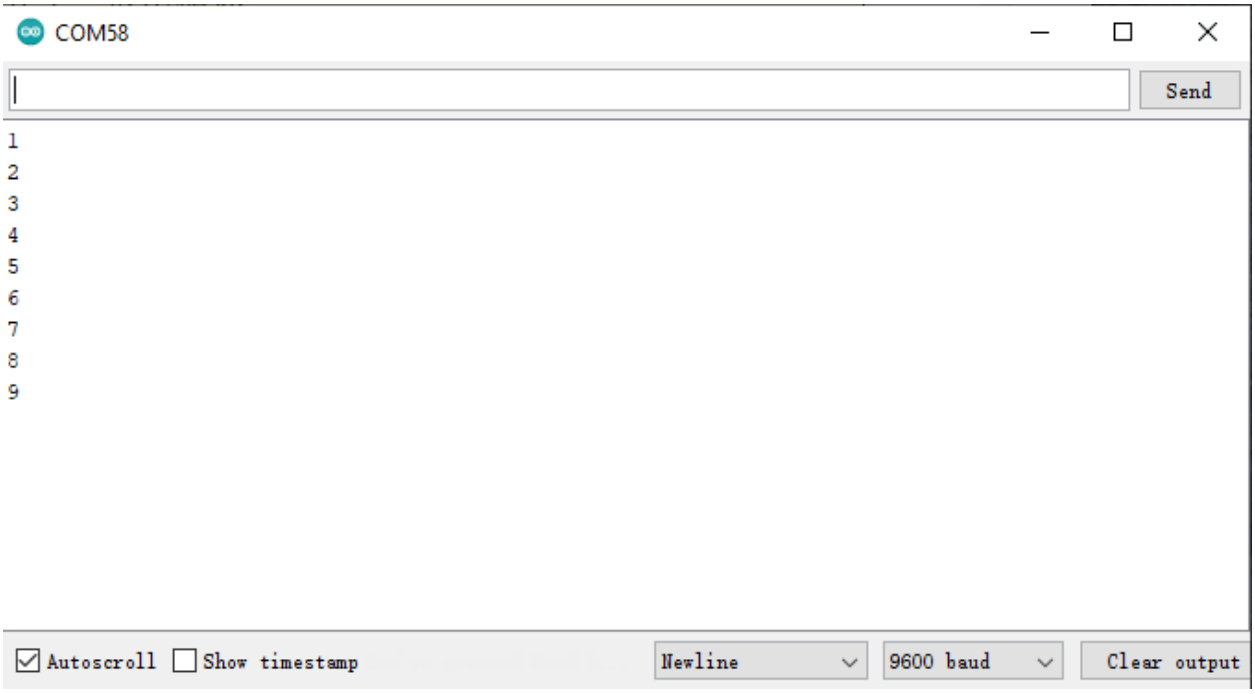
2. Test Code

Calculate the clicked button times and take the remainder of 2, you can get 0 or 1 two state values.

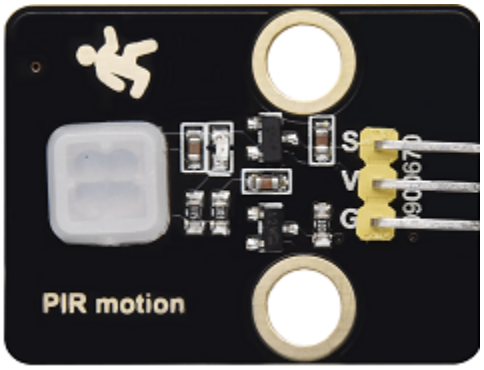
```
#define btn1 16
#define led_y 12
int btn_count = 0; //Used to count the clicked button times

void setup() {
Serial.begin(9600);
pinMode(btn1, INPUT);
pinMode(led_y, OUTPUT);
}

void loop() {
boolean btn1_val = digitalRead(btn1);
if(btn1_val == 0) //If the button is pressed
{
    delay(10);  //Delay 10ms to eliminate button jitter
    if(btn1_val == 0) //Make sure the button is pressed again
    {
    boolean btn_state = 1;
    while(btn_state == 1) //Loop indefinitely until the button is released
    {
        boolean btn_val = digitalRead(btn1);
        if(btn_val == 1)  //If the button is released
        {
        btn_count++;    //Automatically increments by 1, account the  clicked button␣
↪times
        Serial.println(btn_count);
        btn_state = 0;  //The button is released and exits the loop
        }
    }
    }
    boolean value = btn_count % 2; //Take the remainder of the value, you will get 0 or 1
    if(value == 1)
    {
    digitalWrite(led_y, HIGH);
    }
    else{
    digitalWrite(led_y, LOW);
    }
}
}
```

3. Test Result

Open the serial monitor and print out the clicked button times, then click the button once, the LED will be on, click it again, it will be off.



5.3.5 Project 3.1 Read the PIR Motion Sensor



1. Description

The PIR motion sensor has many application scenarios in daily life, such as automatic induction lamp of stairs, automatic induction faucet of washbasin, etc.

It is also a digital sensor like buttons, which has two state

values 0 or 1. And it will be sensed when people are moving.

We will print out the value of the PIR motion sensor through the serial monitor.

2. Control Pin

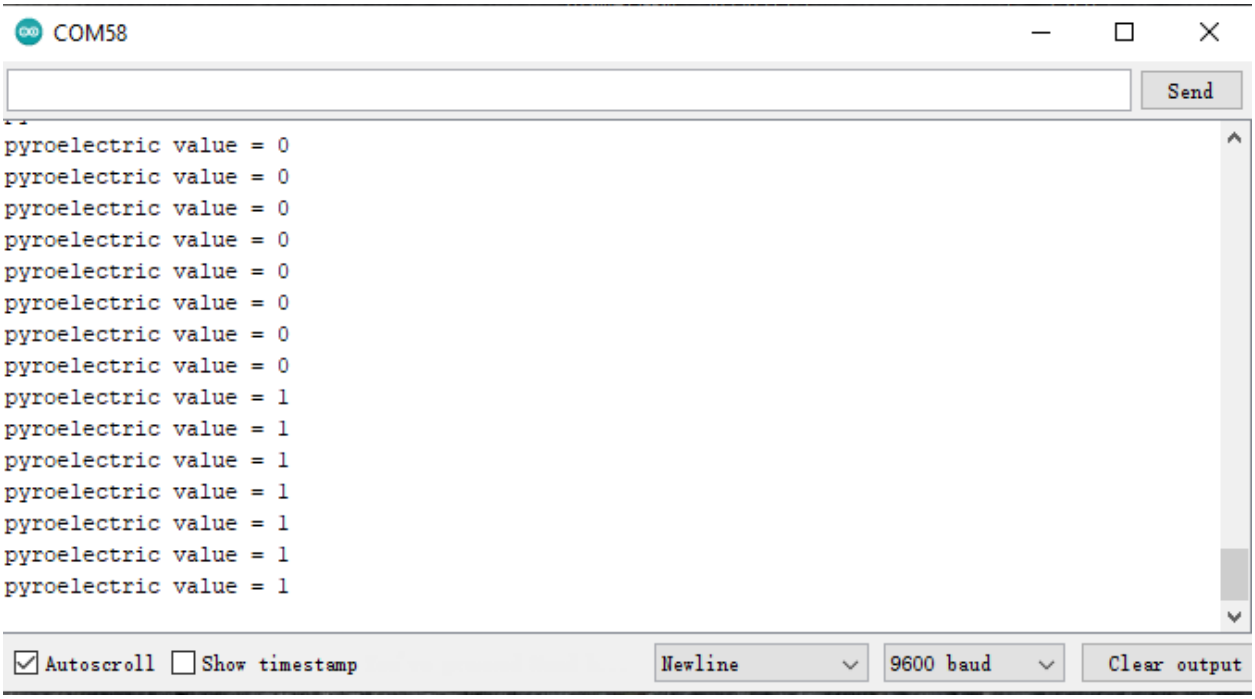
PIR motion sensor	14

3. Test Code

```
#define pyroelectric 14

void setup() {
Serial.begin(9600);
pinMode(pyroelectric, INPUT);
}

void loop() {
boolean pyroelectric_val = digitalRead(pyroelectric);
Serial.print("pyroelectric value = ");
Serial.println(pyroelectric_val);
delay(200);
}
```

4. Test Result

When you stand still in front of the sensor, the reading value is 0, move a little, it will change to 1.



5.3.6 Project 3.2 PIR Motion Sensor

If someone moves in front of the sensor, the LED will light up.

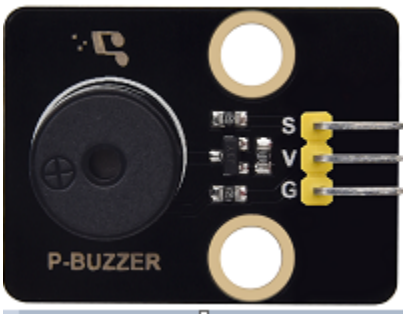
1. Test Code

```
#define pyroelectric 14
#define led_y 12  //Define the yellow led pin to 12
void setup() {
Serial.begin(9600);
pinMode(pyroelectric, INPUT);
pinMode(led_y, OUTPUT);  //Set pin to output mode
}

void loop() {
boolean pyroelectric_val = digitalRead(pyroelectric);
Serial.print("pyroelectric value = ");
Serial.println(pyroelectric_val);
delay(200);
if(pyroelectric_val == 1)
{
    digitalWrite(led_y, HIGH);
}else{
    digitalWrite(led_y, LOW);
}
}
```

2. Test Result

Move your hand in front of the sensor, the LED will turn on. After 5s of immobility, the LED lights will turn off.

5.3.7 Project 4.1 Play Happy Birthday



1. Description

There is a audio power amplifier element in the car expansion board, which is as an external amplification equipment to play music.

In this project, we will work to play a piece of music by using it.

2. Component Knowledge

Passive Buzzer: The audio power amplifier (like the passive buzzer) does not have internal oscillation. When controlling, we need to input square waves of different frequencies to the positive pole of the component and ground the negative pole to control the power amplifier to chime sounds of different frequencies.

3. Control Pin

Passive Buzzer	25

4. Test Code

```
#include <ESP32Tone.h>
#define buzzer_pin 25

void setup() {
pinMode(buzzer_pin, OUTPUT);
birthday();
}

void loop() {

}

void birthday()
{
tone(buzzer_pin,294,250,0);  //The four parameters are pin, frequency, delay and channel
tone(buzzer_pin,440,250,0);
tone(buzzer_pin,392,250,0);
tone(buzzer_pin,532,250,0);
tone(buzzer_pin,494,250,0);
tone(buzzer_pin,392,250,0);
tone(buzzer_pin,440,250,0);
tone(buzzer_pin,392,250,0);
tone(buzzer_pin,587,250,0);
tone(buzzer_pin,532,250,0);
tone(buzzer_pin,392,250,0);
tone(buzzer_pin,784,250,0);
tone(buzzer_pin,659,250,0);
tone(buzzer_pin,532,250,0);
```

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```
tone(buzzer_pin,494,250,0);
tone(buzzer_pin,440,250,0);
tone(buzzer_pin,698,250,0);
tone(buzzer_pin,659,250,0);
tone(buzzer_pin,532,250,0);
tone(buzzer_pin,587,250,0);
tone(buzzer_pin,532,500,0);
noTone(buzzer_pin,0);  //Close
}
```

5. Test Result

The passive buzzer will play happy Birthday.

5.3.8 Project 4.2 Music Box

we will make a music box and switch tunes by pressing buttons.

1. Test Code

```
#include <ESP32Tone.h>
#include <musicESP32_home.h>
music Music(25);
#define btn1 16
int btn_count = 0; //Used to count the clicked button times
boolean music_flag = 0;

void setup() {
Serial.begin(9600);
pinMode(btn1, INPUT);
pinMode(25, OUTPUT);
//  Music.tetris();
//  Music.birthday();
//  Music.Ode_to_Joy();
//  Music.christmas();
//  Music.super_mario();
//  Music.star_war_tone();
}

void loop() {
boolean btn1_val = digitalRead(btn1);
if(btn1_val == 0) //If the button is pressed
{
    delay(10);  //Delay 10ms to eliminate button jitter
    if(btn1_val == 0) //Make sure the button is pressed again
    {
    boolean btn_state = 1;
    while(btn_state == 1) //Loop indefinitely until the button is released
    {
```

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```
        boolean btn_val = digitalRead(btn1);
        if(btn_val == 1)  //If the button is released
        {
        music_flag = 1;
        btn_count++;    //Automatically increments by 1 to count the number of times the␣
↪button is clicked
        Serial.println(btn_count);
        if(btn_count == 4)
        {
            btn_count = 1;
        }
        switch(btn_count)
        {
            case 1: if(music_flag == 1){Music.Ode_to_Joy();music_flag=0;} break;
            case 2: if(music_flag == 1){Music.christmas();music_flag=0;} break;
            case 3: if(music_flag == 1){Music.tetris();music_flag=0;} break;
        }
        btn_state = 0;  //The button is released and exits the loop
        }
    }
    }
}
}
```

2. Test Result

Click button 1 once, it will play a Tetris, then click it again, it will play *Ode to Joy*, after playing, click the button 1 for the third time, it will play Christmas.

5.3.9 Project 5.1 Control the Door

1. Description

Automatic doors and windows need power device, which will become more automatic with a 180 degree servo and some sensors. Adding a raindrop sensor, you can achieve the effect of closing windows automatically when raining. If adding a RFID, we can realize the effect of swiping to open the door and so on.

2. Component Knowledge

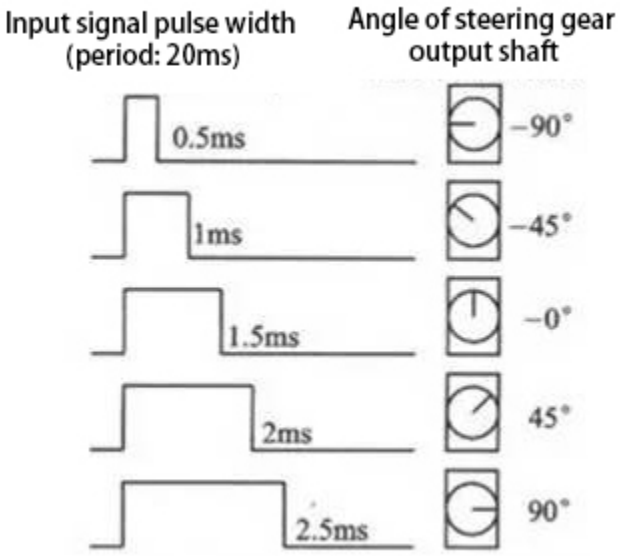
Servo: Servo is a position servo *driver* device consists of a housing, a circuit board, a coreless motor, a gear and a position detector.

Its working principle is that the servo receives the signal sent by MCU or receiver and produces a reference signal with a period of 20ms and width of 1.5ms, then compares the acquired DC bias voltage to the voltage of the potentiometer and obtain the voltage difference output.

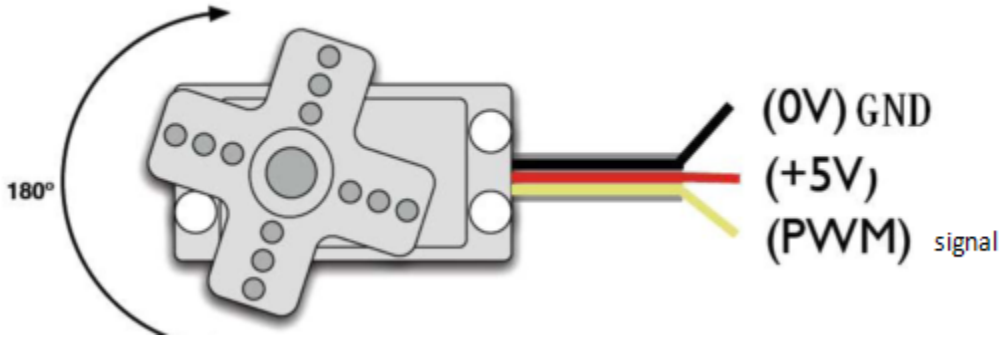
The IC on the circuit board judges the direction of rotation, and then drives the coreless motor to start rotation. The power is transmitted to the swing arm through the reduction gear, and the signal is sent back by the position detector to judge whether the positioning has been reached, which is suitable for those control systems that require constant angle change and can be maintained.

When the motor speed is constant, the potentiometer is driven to rotate through the cascade reduction gear, which leads that the voltage difference is 0, and the motor stops rotating. Generally, the angle range of servo rotation is 0° –180 °.

The pulse period of the control servo is 20ms, the pulse width is 0.5ms ~ 2.5ms, and the corresponding position is -90°~ +90°. Here is an example of a 180° servo:



In general, servo has three lines in brown, red and orange. The brown wire is grounded, the red one is a positive pole line and the orange one is a signal line.



3. Pin

The servo of the window	5
The servo of the door	13

4. Test Code

```
#include <ESP32_Servo.h>
Servo myservo;  // create servo object to control a servo
                // 16 servo objects can be created on the ESP32

int pos = 0;    // variable to store the servo position
// Recommended PWM GPIO pins on the ESP32 include 2,4,12-19,21-23,25-27,32-33
int servoPin = 13;

void setup() {
myservo.attach(servoPin);   // attaches the servo on pin 18 to the servo object

}

void loop() {
for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
}
for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
}
}
```

5. Test Result

The servo of the door turns with the door, back and forth

5.3.10 Project 5.2 Close the Window

1. Description

We will work to use a servo and a raindrop sensor to make an device closing windows automatically when raining.

2. Component Knowledge

Raindrop Sensor: This is an analog input module, the greater the area covered by water on the detection surface, the greater the value returned (range 0~4096).

3. Test Code

```
#include <ESP32_Servo.h>
Servo myservo;
#define servoPin 5
#define waterPin 34


void setup() {
Serial.begin(9600);
pinMode(waterPin, INPUT);
myservo.attach(servoPin);
myservo.write(176);
delay(200);
}

void loop() {
int water_val = analogRead(waterPin);
Serial.println(water_val);
if(water_val > 1500) {
    myservo.write(0);
    delay(200);
}
else {
    myservo.write(176);
    delay(200);
}
}
```

4. Test Result

At first, the window opens automatically, and when you touch the raindrop sensor with your hand (which has water on the skin), the window will close.

5.3.11 Project 6.1 Control SK6812

1. Description

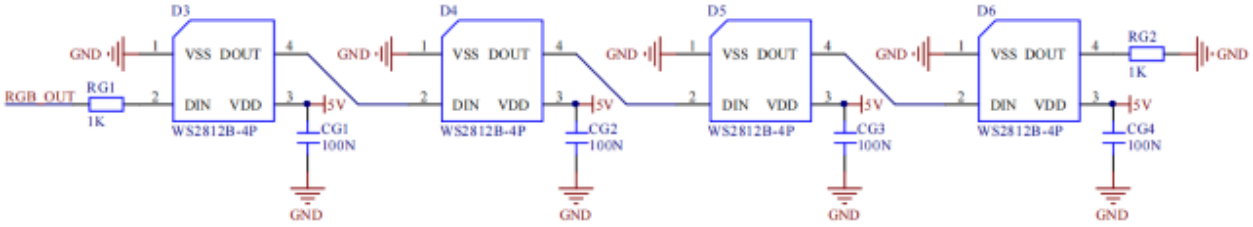
The atmosphere lamp of smart home is 4 SK6812RGB LEDs. RGB LED belongs to a simple luminous module, which can adjust the color to bring out the lamp effect of different colors. Furthermore, it can be widely used in buildings, bridges, roads, gardens, courtyards, floors and other fields of decorative lighting and venue layout, Christmas, Halloween, Valentine's Day, Easter, National Day as well as other festivals during the atmosphere and other scenes.

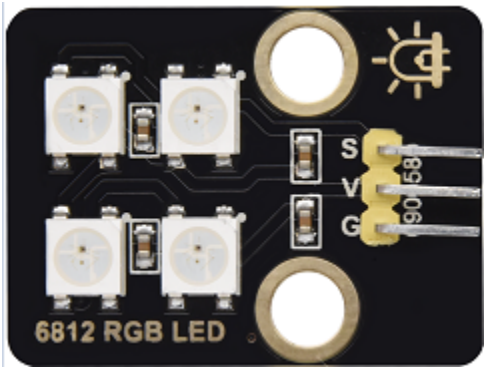
In this experiment, we will make various lighting effects.

2. Component Knowledge

From the schematic diagram, we can see that these four RGB LEDs are all connected in series. In fact, no matter how many they are, we can use a pin to control a RGB LED and let it display any color. Each RGBLED is an independent pixel, composed of R, G and B colors, which can achieve 256 levels of brightness display and complete the full true color display of 16777216 colors.

What's more, the pixel point contains a data latch signal shaping amplifier drive circuit and a signal shaping circuit, which effectively ensures the color of the pixel point light is highly consistent.



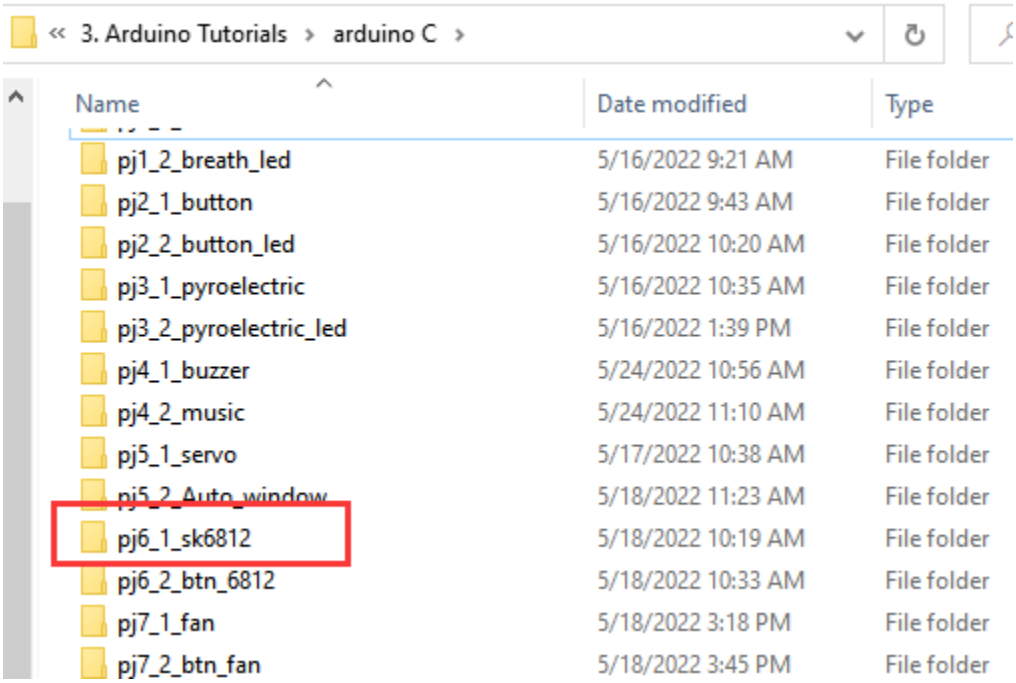


3. Pin

SK6812	26

4. Test Code

Please open the provided test code pj6_1_SK6812, as shown in the image below:



5. Test Result

The atmosphere lamps of the smart home will display a variety of colors and light effects.

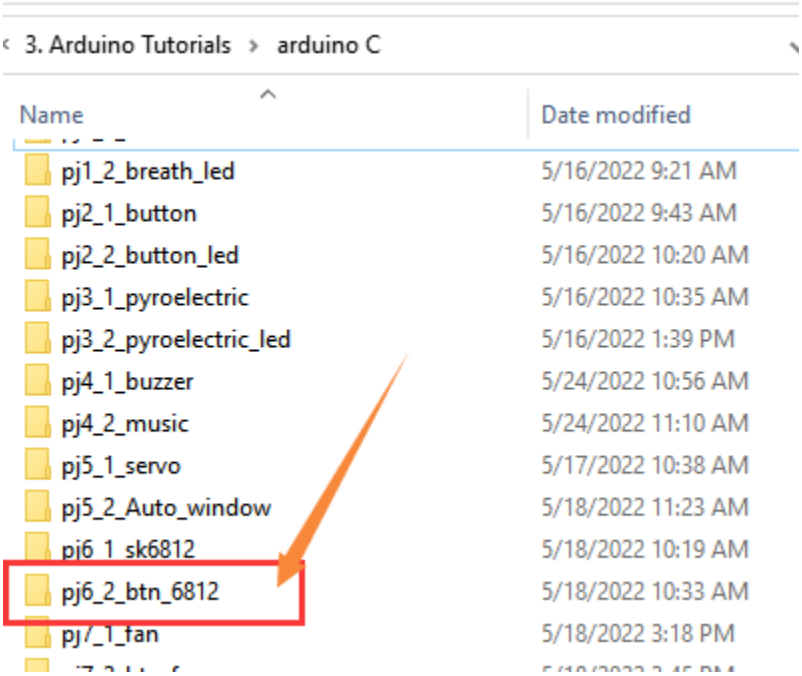
5.3.12 Project 6.2 Button

1. Description

There are two buttons to switch the color of the atmosphere lamp.

2. Test Code

Please open the provided test code pj6_2_btn_6812, as shown below:



3. Test Result

We can switch the color of the atmosphere lamp by clicking buttons 1 and 2.

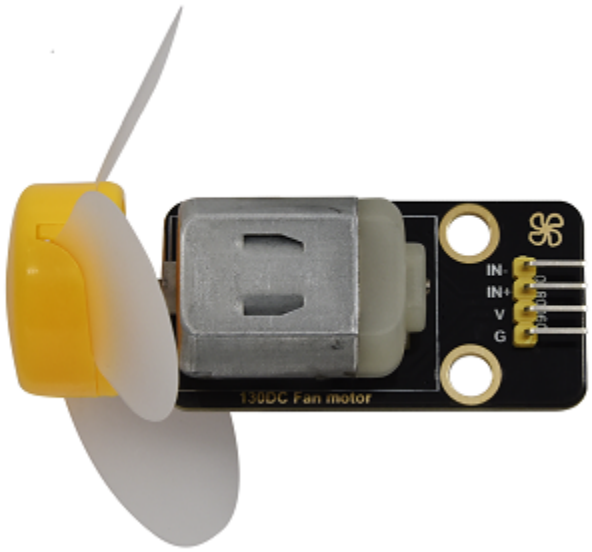
5.3.13 Project 7.1 Control the Fan

1. Description

In this project, we will learn how to make a small fan.

2. Component Knowledge

The small fan uses a 130 DC motor and safe fan blades. You can use PWM output to control the fan speed.



3. Control Method

Two pins are required to control the motor of the fan, one for INA and two for INB. The PWM value range is 0~255. When the PWM output of the two pins is different, the fan can rotate.

INA - INB <= -45	Rotate clockwise
INA - INB >= 45	Rotate *anticlockwise*
INA == 0, INB == 0	Stop

4. Control Pins

INA	19
INB	18

5. Test Code

```
#include <analogWrite.h>
#define fanPin1 19
#define fanPin2 18

void setup() {
pinMode(fanPin1, OUTPUT);
pinMode(fanPin2, OUTPUT);
}
```

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```
void loop() {
digitalWrite(fanPin1, LOW); //pwm = 0
analogWrite(fanPin2, 180);
delay(3000);
digitalWrite(fanPin1, LOW);
digitalWrite(fanPin2, LOW);
delay(1000);
digitalWrite(fanPin1, HIGH); //pwm = 255
analogWrite(fanPin2, 210);
delay(3000);
digitalWrite(fanPin1, LOW);
digitalWrite(fanPin2, LOW);
delay(1000);
}
```

6. Test Result

The fan will rotate clockwise and *anticlockwise* at different speeds.

5.3.14 Project 7.2 Switch On or Off the Fan

One button switches the fan on and the other button controls the speed of the fan.

1. Test Code

```
#include <analogWrite.h>
#define fanPin1 19
#define fanPin2 18
#define btn1 16
int btn_count = 0; //Used to count the clicked button times
#define btn2 27
int btn_count2 = 0;
int speed_val = 130; //Define the speed variables

void setup() {
Serial.begin(9600);
pinMode(btn1, INPUT);
pinMode(btn2, INPUT);
pinMode(fanPin1, OUTPUT);
pinMode(fanPin2, OUTPUT);
}

void loop() {
boolean btn1_val = digitalRead(btn1);
if(btn1_val == 0) //If the button is pressed
{
    delay(10);  //Delay 10ms to eliminate button jitter
    if(btn1_val == 0) //Make sure the button is pressed again
    {
```

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```
    boolean btn_state = 1;
    while(btn_state == 1) //Loop indefinitely until the button is released
    {
        boolean btn_val = digitalRead(btn1);
        if(btn_val == 1)  //If the button is released
        btn_count++;    //Automatically increments by 1 to count the clicked button␣
↪times
        Serial.println(btn_count);
        btn_state = 0;  //The button is released and exits the loop
        }
    }
    }
    boolean value = btn_count % 2; //Take the remainder of the value, you will get 0 or 1
    while(value == 1)
    {
    //Serial.println("on");
    digitalWrite(fanPin1, LOW); //pwm = 0
    analogWrite(fanPin2, speed_val);

    boolean btn2_val = digitalRead(btn2);
    if(btn2_val == 0)
    {
        delay(10);
        if(btn2_val == 0)
        {
        boolean btn_state2 = 1;
        while(btn_state2 == 1)
        {
            boolean btn2_val = digitalRead(btn2);
            if(btn2_val == 1)
            {
            btn_count2++;
            if(btn_count2 > 3)
            {
                btn_count2 = 1;
            }
            switch(btn_count2)
            {
                case 1: speed_val = 130; Serial.println(speed_val);break;  //Adjust the␣
↪speed
                case 2: speed_val = 180; Serial.println(speed_val);break;
                case 3: speed_val = 230; Serial.println(speed_val);break;
            }
            btn_state2 = 0;
            }
        }
        }
    }
    boolean btn1_val = digitalRead(btn1);
    if(btn1_val == 0) //If the button is pressed
    {
        digitalWrite(fanPin1, LOW); //pwm = 0
```

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```
        analogWrite(fanPin2, 0);
        value = 0;  //Exit the loop
    }

    }
}
}
```

2. Test Result

Click button 1, the fan starts to rotate, click button 2, the speed can be adjusted(there are three different speeds), press the button 1 again, the fan stops.

5.3.15 Project 8.1 Display Characters

1. Description

As we all know, screen is one of the best ways for people to interact with electronic devices.

2. Component Knowledge

1602 is a line that can display 16 characters. There are two lines, which use IIC communication protocol.

3. Control Pins

SDA	SDA
SCL	SCL

4. Test Code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C mylcd(0x27,16,2);

void setup(){
mylcd.init();
mylcd.backlight();
}

void loop(){
mylcd.setCursor(0, 0);
mylcd.print("hello");
mylcd.setCursor(0, 1);
mylcd.print("keyestudio");
//mylcd.clear();
}
```

5. Test Result

The first line of the LCD1602 shows hello and the second line shows keyestudio.

5.3.16 Project 8.2 Dangerous Gas Alarm

1. Description

When a gas sensor detects a high concentration of dangerous gas, the buzzer will sound an alarm and the display will show dangerous.

2. Component Knowledge

MQ2 Smoke Sensor: It is a gas leak monitoring device for homes and factories, which is suitable for liquefied gas, benzene, alkyl, alcohol, hydrogen as well as smoke detection. Our sensor leads to digital pin D and analog output pin A, which is connected to D as a digital sensor in this project.

3. Test Code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#define gasPin 23
#define buzPin 25
boolean i = 1;
boolean j = 1;

void setup(){
Serial.begin(9600);
mylcd.init();
mylcd.backlight();
pinMode(buzPin, OUTPUT);
pinMode(gasPin, INPUT);
mylcd.setCursor(0, 0);
mylcd.print("safety");
}

void loop(){
boolean gasVal = digitalRead(gasPin);  //Reads the value detected by the gas sensor
Serial.println(gasVal);
if(gasVal == 0)  //If the hazardous gas is detectedLCD displays dangerousthe buzzer␣
↪makes an alarm
{
    while(i == 1)
    {
    mylcd.clear();
    mylcd.setCursor(0, 0);
    mylcd.print("dangerous");
    i = 0;
    j = 1;
    }
    digitalWrite(buzPin,HIGH);
    delay(1);
    digitalWrite(buzPin,LOW);
    delay(1);
}
```

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```
else{
    digitalWrite(buzPin,LOW);
    while(j == 1)
    {
    mylcd.clear();
    mylcd.setCursor(0, 0);
    mylcd.print("safety");
    i = 1;
    j = 0;
    }
}
}
```

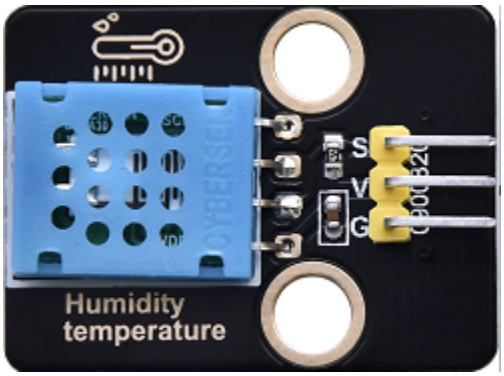
4. Test Result

The screen displays “safety” in normal state. However, when the gas sensor detects some dangerous gases, such as carbon monoxide, at a certain concentration, the buzzer will sound an alarm and the screen displays “dangerous”.

5.3.17 Project 9 Temperature and Humidity Tester

1. Component Knowledge

Its communication mode is serial data and single bus. The temperature measurement range is -20 ~ +60℃, accuracy is ±2℃. However, the humidity range is 5 ~ 95%RH, the accuracy is ±5%RH.



2. Control Pin

Temperature and Humidity Sensor	17

3. Test Code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#include "xht11.h"
xht11 xht(17);

unsigned char dht[4] = {0, 0, 0, 0};//Only the first 32 bits of data are received, not␣
↪the parity bits
void setup() {
Serial.begin(9600);//Start the serial port monitor and set baud rate to 9600
mylcd.init();
mylcd.backlight();
}

void loop() {
if (xht.receive(dht)) { //Returns true when checked correctly
    Serial.print("RH:");
    Serial.print(dht[0]); //The integral part of humidity, DHT [1] is the fractional part
    Serial.print("%  ");
    Serial.print("Temp:");
    Serial.print(dht[2]); //The integral part of temperature, DHT [3] is the fractional␣
↪part
    Serial.println("C");

    mylcd.setCursor(0, 0);
    mylcd.print("T = ");
    mylcd.print(dht[2]);
    mylcd.setCursor(0, 1);
    mylcd.print("H = ");
    mylcd.print(dht[0]);
    //mylcd.clear();
    delay(200);
}
    else {    //Read error
    Serial.println("sensor error");
    }
delay(1000);  //It takes 1000ms to wait for the device to read
}
```

4. Test Result

The LCD1602 displays the temperature (T = ** ° C) and humidity (H = ** %RH). When you breathe into the T/H sensor, you can see that the humidity rises.

5.3.18 Project 10 Open the Door

1. Component Knowledge

Radio frequency identification, the card reader is composed of a radio frequency module and a high-level magnetic field. The Tag transponder is a sensing device, which doesn't contain a battery. It only contains tiny integrated circuit chips and media for storing data and antennas for receiving and transmitting signals.

To read the data in the tag, first put it into the reading range of the card reader. The reader will generate a magnetic field, which can produce electricity according to Lenz's law, then the RFID tag will supply power, thereby activating the device.

2. Control Pins

Use IIC communication

SDA	SDA
SCL	SCL

3. Test Code

```
/*Filename : RFID
 Description : RFID reader UID
 Auther : http//www.keyestudio.com */

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#include <ESP32_Servo.h>
Servo myservo;
```

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```
#include <Wire.h>
#include "MFRC522_I2C.h"
// IIC pins default to GPIO21 and GPIO22 of ESP32
// 0x28 is the i2c address of SDA, if doesn't matchplease check your address with i2c.
MFRC522 mfrc522(0x28);   // create MFRC522.
#define servoPin  13
#define btnPin 16
boolean btnFlag = 0;

String password = "";

void setup() {
Serial.begin(115200);           // initialize and PC's serial communication
mylcd.init();
mylcd.backlight();
Wire.begin();                   // initialize I2C
mfrc522.PCD_Init();             // initialize MFRC522
ShowReaderDetails();            // display PCD - MFRC522 read carder
Serial.println(F("Scan PICC to see UID, type, and data blocks..."));
myservo.attach(servoPin);
pinMode(btnPin, INPUT);
mylcd.setCursor(0, 0);
mylcd.print("Card");
}

void loop() {
//
if ( ! mfrc522.PICC_IsNewCardPresent() || ! mfrc522.PICC_ReadCardSerial() ) {
    delay(50);
    password = "";
    if(btnFlag == 1)
    {
    boolean btnVal = digitalRead(btnPin);
    if(btnVal == 0)  //Swipe the card to open the door and click button 1 to close the␣
↪door
    {
        Serial.println("close");
        mylcd.setCursor(0, 0);
        mylcd.print("close");
        myservo.write(0);
        btnFlag = 0;
    }
    }
    return;
}

// select one of door cards. UID and SAK are mfrc522.uid.

// save UID
Serial.print(F("Card UID:"));
for (byte i = 0; i < mfrc522.uid.size; i++) {
    Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
```

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```
    //Serial.print(mfrc522.uid.uidByte[i], HEX);
    Serial.print(mfrc522.uid.uidByte[i]);
    password = password + String(mfrc522.uid.uidByte[i]);
}
if(password == "17121741227")  //The card number is correct, open the door
{
    Serial.println("open");
    mylcd.setCursor(0, 0);
    mylcd.clear();
    mylcd.print("open");
    myservo.write(180);
    password = "";
    btnFlag = 1;
}
else   //The card number is wrongLCD displays error
{
    password = "";
    mylcd.setCursor(0, 0);
    mylcd.print("error");
}
//Serial.println(password);
}

void ShowReaderDetails() {
//  attain the MFRC522 software
byte v = mfrc522.PCD_ReadRegister(mfrc522.VersionReg);
Serial.print(F("MFRC522 Software Version: 0x"));
Serial.print(v, HEX);
if (v == 0x91)
    Serial.print(F(" = v1.0"));
else if (v == 0x92)
    Serial.print(F(" = v2.0"));
else
    Serial.print(F(" (unknown)"));
Serial.println("");
// when returning to 0x00 or 0xFF, may fail to transmit communication signals
if ((v == 0x00) || (v == 0xFF)) {
    Serial.println(F("WARNING: Communication failure, is the MFRC522 properly connected?
↪"));
}
}
```

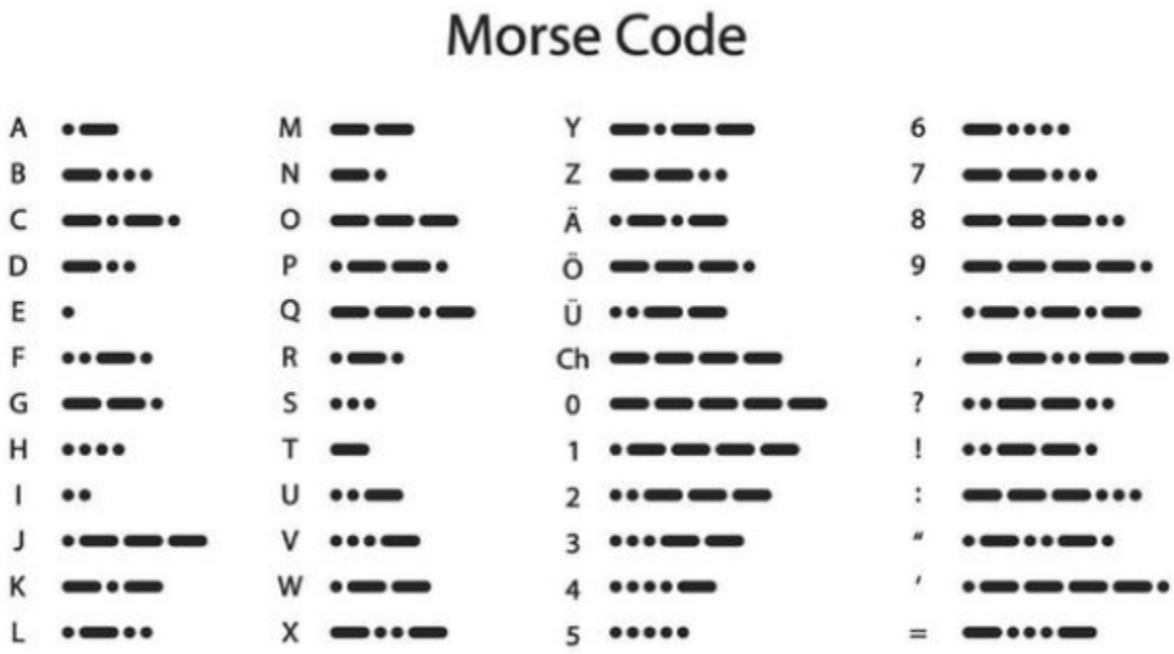
4. Test Result

Close the provided card to the RFID induction area, the door will turn and open, and LCD1602 shows "The door is open". Click button 1 and the door turns and closes. However, when swiping another blue induction block, the LCD1602 shows "Error".

5.3.19 Project 11 Morse Code Open the Door

Morse code, also known as Morse password, is an on-again, off-again signal code that expresses different letters, numbers, and punctuation marks in different sequences. Now we use it as our password gate.

The Morse code corresponds to the following characters:



1. Description

We use  as the correct password. What's more, there is a button library file OneButton, which is very simple to click, double click, long press and other functions. For Morse password, click is".", long press and release is "-".

2. Test Code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#include "OneButton.h"
// Setup a new OneButton on pin 16.
OneButton button1(16, true);
// Setup a new OneButton on pin 27.
OneButton button2(27, true);
```

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```
#include <ESP32_Servo.h>
Servo myservo;
int servoPin = 13;
String password = "";
String correct_p = "-.-";  //The correct password for the password door

// setup code here, to run once:
void setup() {
Serial.begin(115200);
mylcd.init();
mylcd.backlight();
// link the button 1 functions.
button1.attachClick(click1);
button1.attachLongPressStop(longPressStop1);
// link the button 2 functions.
button2.attachClick(click2);
button2.attachLongPressStop(longPressStop2);

myservo.attach(servoPin);
mylcd.setCursor(0, 0);
mylcd.print("Enter password");
}

void loop() {
// keep watching the push buttons:
button1.tick();
button2.tick();
delay(10);
}

// ----- button 1 callback functions
// This function will be called when the button1 was pressed 1 time (and no 2. button␣
↪press followed).
void click1() {
Serial.print(".");
password = password + '.';
mylcd.setCursor(0, 1);
mylcd.print(password);
} // click1

// This function will be called once, when the button1 is released after being pressed␣
↪for a long time.
void longPressStop1() {
Serial.print("-");
password = password + '-';
mylcd.setCursor(0, 1);
mylcd.print(password);
} // longPressStop1

// ... and the same for button 2:
void click2() {
Serial.println(password);
```

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```
if(password == correct_p)
{
    myservo.write(180);  //Open the door if the password is correct
    mylcd.clear();
    mylcd.setCursor(0, 0);
    mylcd.print("open");
}
else
{
    mylcd.clear();
    mylcd.setCursor(0, 0);
    mylcd.print("error");
    delay(2000);
    mylcd.clear();
    mylcd.setCursor(0, 0);
    mylcd.print("input again");
}
password = "";
} // click2

void longPressStop2() {
//Serial.println("Button 2 longPress stop");
myservo.write(0);  //Close the door
mylcd.clear();
mylcd.setCursor(0, 0);
mylcd.print("close");
} // longPressStop2
```

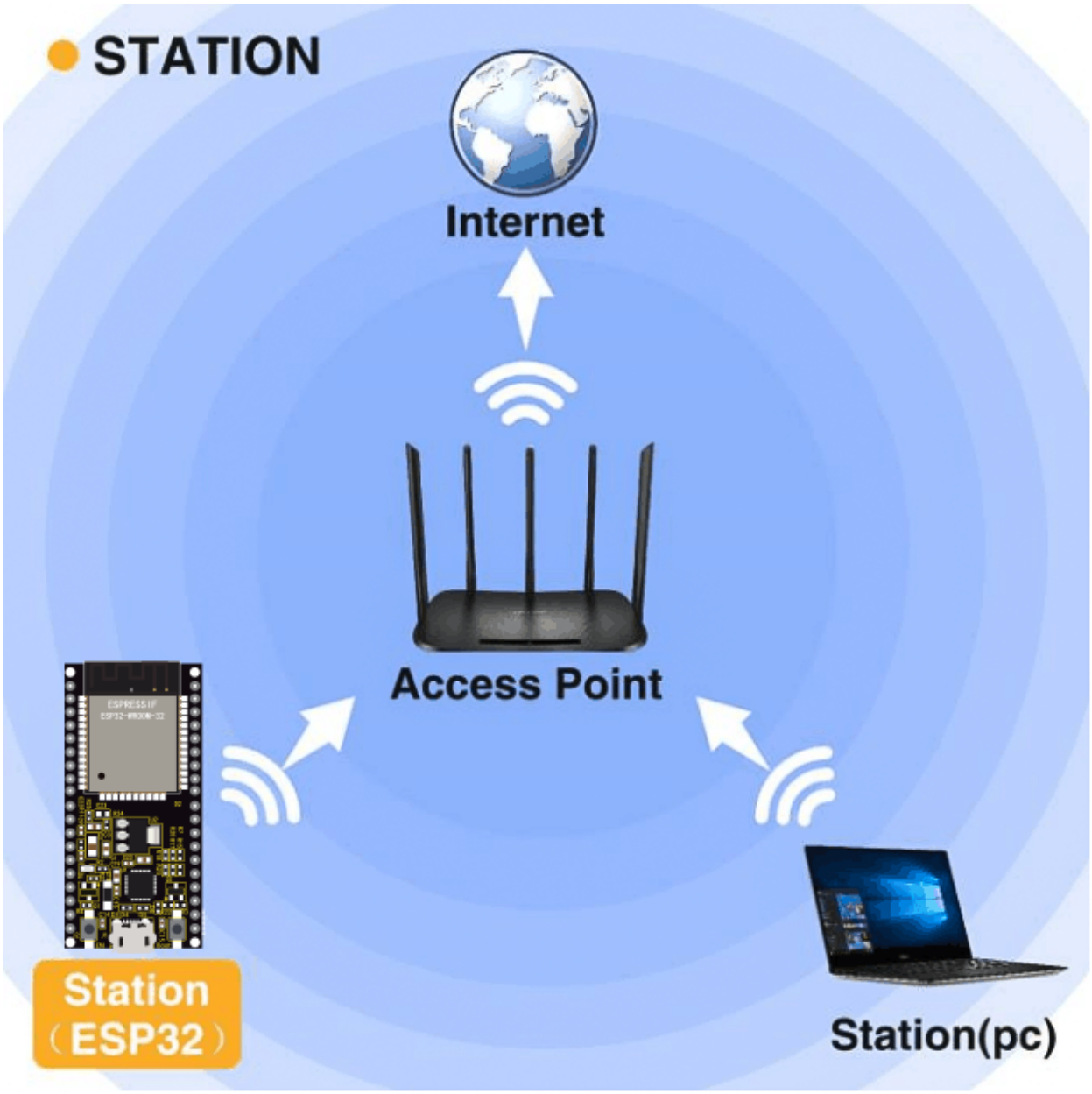
3. Test Result

At first, the LCD1602 displays “Enter password”, then click or long press button 1 to tap the password. If we input the correct password “-.-”, then click button 2, the door will open, and the LCD1602 will display “open”.

If other incorrect passwords are entered, the door will not move, the LCD1602 will display “error” and then “enter again” 2s later. Furthermore, long press button 2 can close the door.

5.3.20 Project 12.1 Smart Home

The easiest way to access the Internet is to use a WiFi to connect. The ESP32 main control board comes with a WiFi module, making our smart home accessible to the Internet easily.



1. Description

We connect the smart home to a LAN, which is the WiFi in your home or the hot spot of your phone. After the connection is successful, an address will be assigned, which can be used for communication. We will print the assigned address in the serial monitor.

2. Test Code

Note: ssiD and password in the code should be filled with your own WiFi name and password.


```
#include <Arduino.h>
#include <WiFi.h>
#include <ESPmDNS.h>
#include <WiFiClient.h>

String item = "0";
const char* ssid = "ChinaNet-2.4G-0DF0";
const char* password = "ChinaNet@233";
WiFiServer server(80);

void setup() {
Serial.begin(115200);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.print("Connected to ");
Serial.println(ssid);
```

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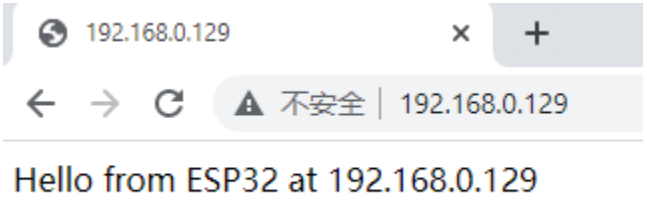
```
Serial.print("IP address: ");
Serial.println(WiFi.localIP());
server.begin();
Serial.println("TCP server started");
MDNS.addService("http", "tcp", 80);
}

void loop() {
Serial.print("Connected to ");
Serial.println(ssid);
Serial.print("IP address: ");
Serial.println(WiFi.localIP());  //The assigned IP address is printed on the serial␣
↪monitor
delay(200);
WiFiClient client = server.available();
if (!client) {
    return;
}
while(client.connected() && !client.available()){
    delay(1);
}
String req = client.readStringUntil('\r');
int addr_start = req.indexOf(' ');
int addr_end = req.indexOf(' ', addr_start + 1);
if (addr_start == -1 || addr_end == -1) {
    Serial.print("Invalid request: ");
    Serial.println(req);
    return;
}
req = req.substring(addr_start + 1, addr_end);
item=req;
Serial.println(item);
String s;
if (req == "/")  //Browser accesses address can read the information sent by the client.
↪println(s);
{
    IPAddress ip = WiFi.localIP();
    String ipStr = String(ip[0]) + '.' + String(ip[1]) + '.' + String(ip[2]) + '.' +␣
↪String(ip[3]);
    s = "HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\n<!DOCTYPE HTML>\r\n<html>
↪Hello from ESP32 at ";
    s += ipStr;
    s += "</html>\r\n\r\n";
    Serial.println("Sending 200");
    client.println(s);  //Send the string S, you can read the information when visiting␣
↪the address of E smart home using a browser.
//client.print(s);
client.stop();
}
```

3. Test Result

If the WiFi is connected successfully, the serial monitor will print out the assigned IP address.

Open a browser to access the IP address, then we will read the contents of the string S sent out by the client.println(s); in the code.



5.3.21 Project 12.2 Control Smart Home

1. Description

In this project, we will learn how to realize different functions of the smart home through accessing different strings under the address. There is a LCD screen that can print out the IP address, which is much more convenient.

2. Test Code

```
#include <Arduino.h>
#include <WiFi.h>
#include <ESPmDNS.h>
#include <WiFiClient.h>

String item = "0";
const char* ssid = "ChinaNet-2.4G-0DF0";
const char* password = "ChinaNet@233";
WiFiServer server(80);
```

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```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#include <analogWrite.h>
#define fanPin1 19
#define fanPin2 18
#define led_y 12  //Define the yellow led pin to 12

void setup() {
Serial.begin(115200);
mylcd.init();
mylcd.backlight();
pinMode(led_y, OUTPUT);
pinMode(fanPin1, OUTPUT);
pinMode(fanPin2, OUTPUT);

WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.print("Connected to ");
Serial.println(ssid);
Serial.print("IP address: ");
Serial.println(WiFi.localIP());
server.begin();
Serial.println("TCP server started");
MDNS.addService("http", "tcp", 80);
mylcd.setCursor(0, 0);
mylcd.print("ip:");
mylcd.setCursor(0, 1);
mylcd.print(WiFi.localIP());  //LCD displays the ip adress
}

void loop() {
WiFiClient client = server.available();
if (!client) {
    return;
}
while(client.connected() && !client.available()){
    delay(1);
}
String req = client.readStringUntil('\r');
int addr_start = req.indexOf(' ');
int addr_end = req.indexOf(' ', addr_start + 1);
if (addr_start == -1 || addr_end == -1) {
    Serial.print("Invalid request: ");
    Serial.println(req);
    return;
}
req = req.substring(addr_start + 1, addr_end);
```

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(continued from previous page)

```
item=req;
Serial.println(item);
String s;
if (req == "/")  //Browser accesses address can read the information sent by the client.
↪println(s);
{
    IPAddress ip = WiFi.localIP();
    String ipStr = String(ip[0]) + '.' + String(ip[1]) + '.' + String(ip[2]) + '.' +␣
↪String(ip[3]);
    s = "HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\n<!DOCTYPE HTML>\r\n<html>
↪Hello from ESP32 at ";
    s += ipStr;
    s += "</html>\r\n\r\n";
    Serial.println("Sending 200");
    client.println(s);  //Send the string S, you can read the information when visiting␣
↪the address of E smart home using a browser.
//client.print(s);
}
if(req == "/led/on") //Browser accesses the ip address/led/on
{
    client.println("turn on the LED");
    digitalWrite(led_y, HIGH);
}
if(req == "/led/off") //Browser accesses the ip address/led/off
{
    client.println("turn off the LED");
    digitalWrite(led_y, LOW);
}
if(req == "/fan/on") //Browser accesses the ip address/fan/on
{
    client.println("turn on the fan");
    digitalWrite(fanPin1, LOW); //pwm = 0
    analogWrite(fanPin2, 180);
}
if(req == "/fan/off") //Browser accesses the ip address/fan/off
{
    client.println("turn off the fan");
    digitalWrite(fanPin1, LOW); //pwm = 0
    analogWrite(fanPin2, 0);
}
//client.print(s);
client.stop();
}
```

3. Test Result

If the smart home is successfully connected to WiFi, the LCD screen will display the assigned address.

Accessing address must add / led/on when using the browser, such as my address is 192.168.0.129/ led/on. Then the smart home LED lights will be turned on, if accessing 192.168.0.129/ led /off, then the LED lights will be off.


```
turn off the LED
```

When the browser accesses 192.168.0.129/fan/ on, the fan of the smart home will be turned on and at 192.168.0.129/fan/ off will be turned off.

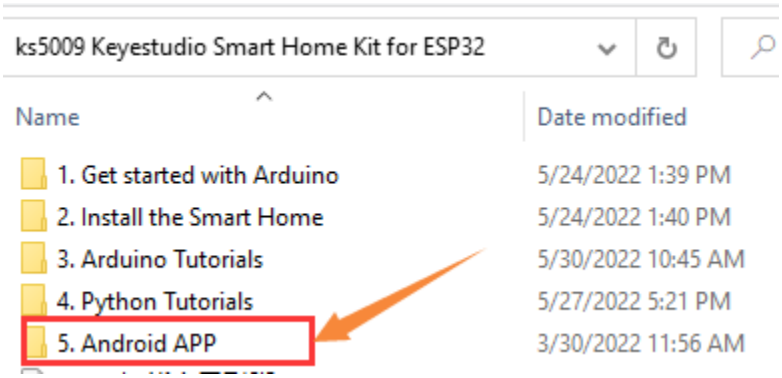

```
turn off the fan
```

5.3.22 Project 13.1: Mobile Phone APP test

Download APP

Android APP

The Android apk installation package is available in our resource pack, as shown below:

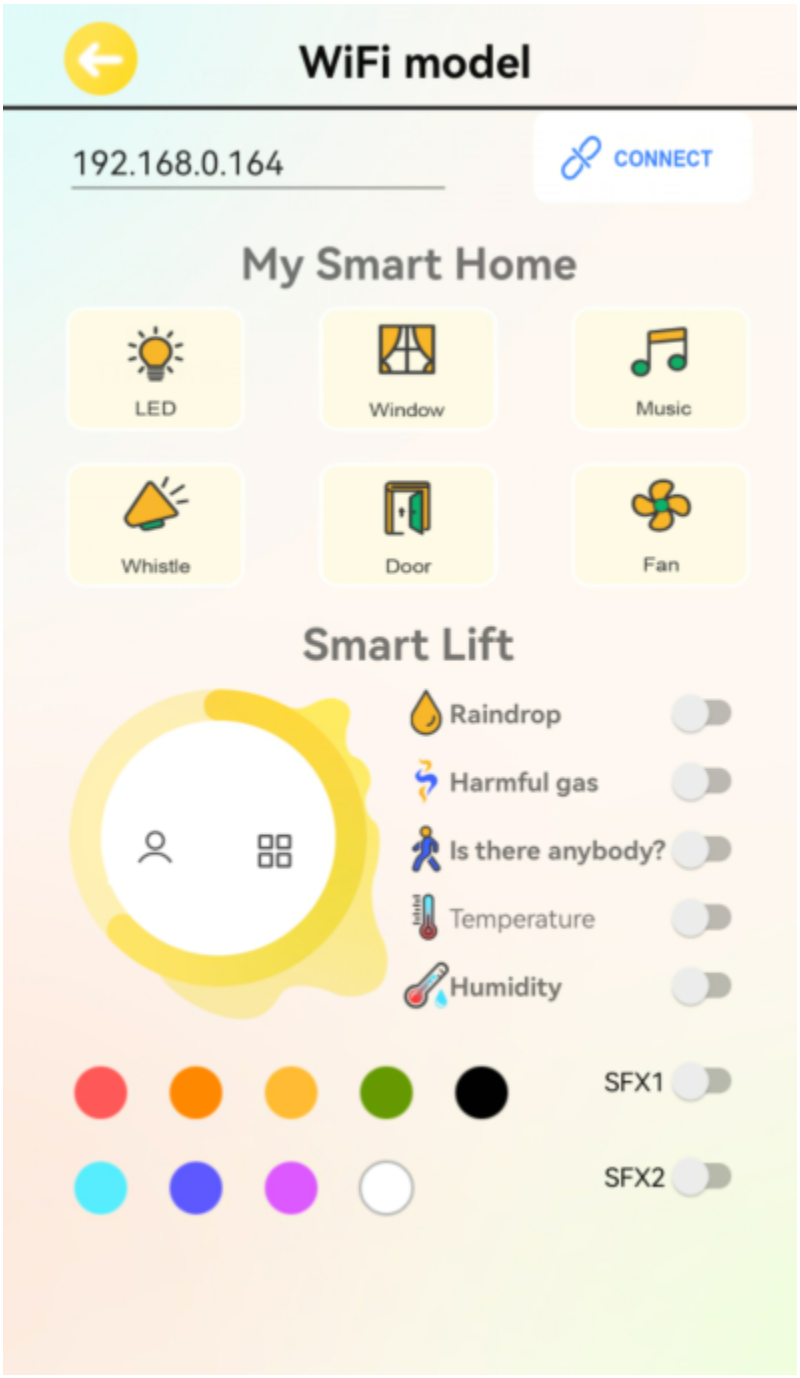


Download from Google play:

Please search for keyes IoT home on Google play to download it.

Icon:

APP *Interface*


WiFi model
192.168.0.164
CONNECT
My Smart Home
LED
Window
Music
Whistle
Door
Fan
Smart Lift
Raindrop
Harmful gas
Is there anybody?
Temperature
Humidity
SFX1
SFX2

Download iOS APP

Please search for keyes IoT home on APP Store to download it.

1. Description

We will use APP to control the smart home LED lights and fan switches.

2. Test Code

```
#include <Arduino.h>
#include <WiFi.h>
#include <ESPmDNS.h>
#include <WiFiClient.h>

String item = "0";
const char* ssid = "ChinaNet-2.4G-0DF0";
const char* password = "ChinaNet@233";
WiFiServer server(80);

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C mylcd(0x27,16,2);
#include <analogWrite.h>
#define fanPin1 19
#define fanPin2 18
#define led_y 12  //Define the yellow led pin to 12

void setup() {
Serial.begin(115200);
mylcd.init();
mylcd.backlight();
pinMode(led_y, OUTPUT);
pinMode(fanPin1, OUTPUT);
pinMode(fanPin2, OUTPUT);

WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.print("Connected to ");
Serial.println(ssid);
Serial.print("IP address: ");
Serial.println(WiFi.localIP());
server.begin();
Serial.println("TCP server started");
MDNS.addService("http", "tcp", 80);
mylcd.setCursor(0, 0);
mylcd.print("ip:");
```

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```
mylcd.setCursor(0, 1);
mylcd.print(WiFi.localIP());  //LCD displays ip adress
}

void loop() {
WiFiClient client = server.available();
if (!client) {
    return;
}
while(client.connected() && !client.available()){
    delay(1);
}
String req = client.readStringUntil('\r');
int addr_start = req.indexOf(' ');
int addr_end = req.indexOf(' ', addr_start + 1);
if (addr_start == -1 || addr_end == -1) {
    Serial.print("Invalid request: ");
    Serial.println(req);
    return;
}
req = req.substring(addr_start + 1, addr_end);
item=req;
Serial.println(item);
String s;
if (req == "/")  //Browser accesses address can read the information sent by the client.
↪println(s);
{
    IPAddress ip = WiFi.localIP();
    String ipStr = String(ip[0]) + '.' + String(ip[1]) + '.' + String(ip[2]) + '.' +␣
↪String(ip[3]);
    s = "HTTP/1.1 200 OK\r\nContent-Type: text/html\r\n\r\n<!DOCTYPE HTML>\r\n<html>
↪ESP32 ip:";
    s += ipStr;
    s += "</html>\r\n\r\n";
    Serial.println("Sending 200");
    client.println(s);  //Send the string S, then you can read the information when␣
↪visiting the address of E smart home using a browser.
}
if(req == "/led/on") //Browser accesses address ip address/led/on
{
    client.println("turn on the LED");
    digitalWrite(led_y, HIGH);
}
if(req == "/led/off") //Browser accesses address ip address/led/off
{
    client.println("turn off the LED");
    digitalWrite(led_y, LOW);
}
if(req == "/fan/on") //Browser accesses address ip address/fan/on
{
    client.println("turn on the fan");
    digitalWrite(fanPin1, LOW); //pwm = 0
```

(continues on next page)

(continued from previous page)

```
    analogWrite(fanPin2, 180);
}
if(req == "/fan/off") //Browser accesses address ip address/fan/off
{
    client.println("turn off the fan");
    digitalWrite(fanPin1, LOW); //pwm = 0
    analogWrite(fanPin2, 0);
}
//client.print(s);
client.stop();
}
```

3. Test Result

1. Open the APP and select WIFI

2. APP controls LED and the fan

The mobile phone and the smart home must share the same WiFi, or the smart home connects to the hotspot of the mobile phone.

APP input IP address (LCD1602 displays the assigned IP address), then click connect, the connection is successful if ESP32 IP: 192.168… is displayed.

Next, you can click the LED, then the smart home LED will be turned on. Click the fan button and the fan will be turned on, as shown below:

5.3.23 Project 13.2 IoT Smart Home

1. Description

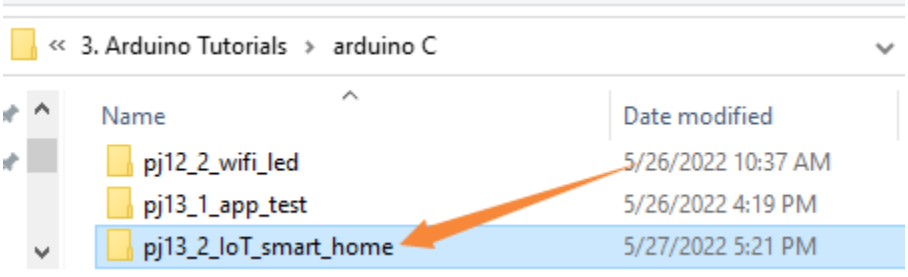
The IOT smart home connects to the family WiFi through

WiFi, and the mobile phone used for operation should also be connected to the same WiFi.

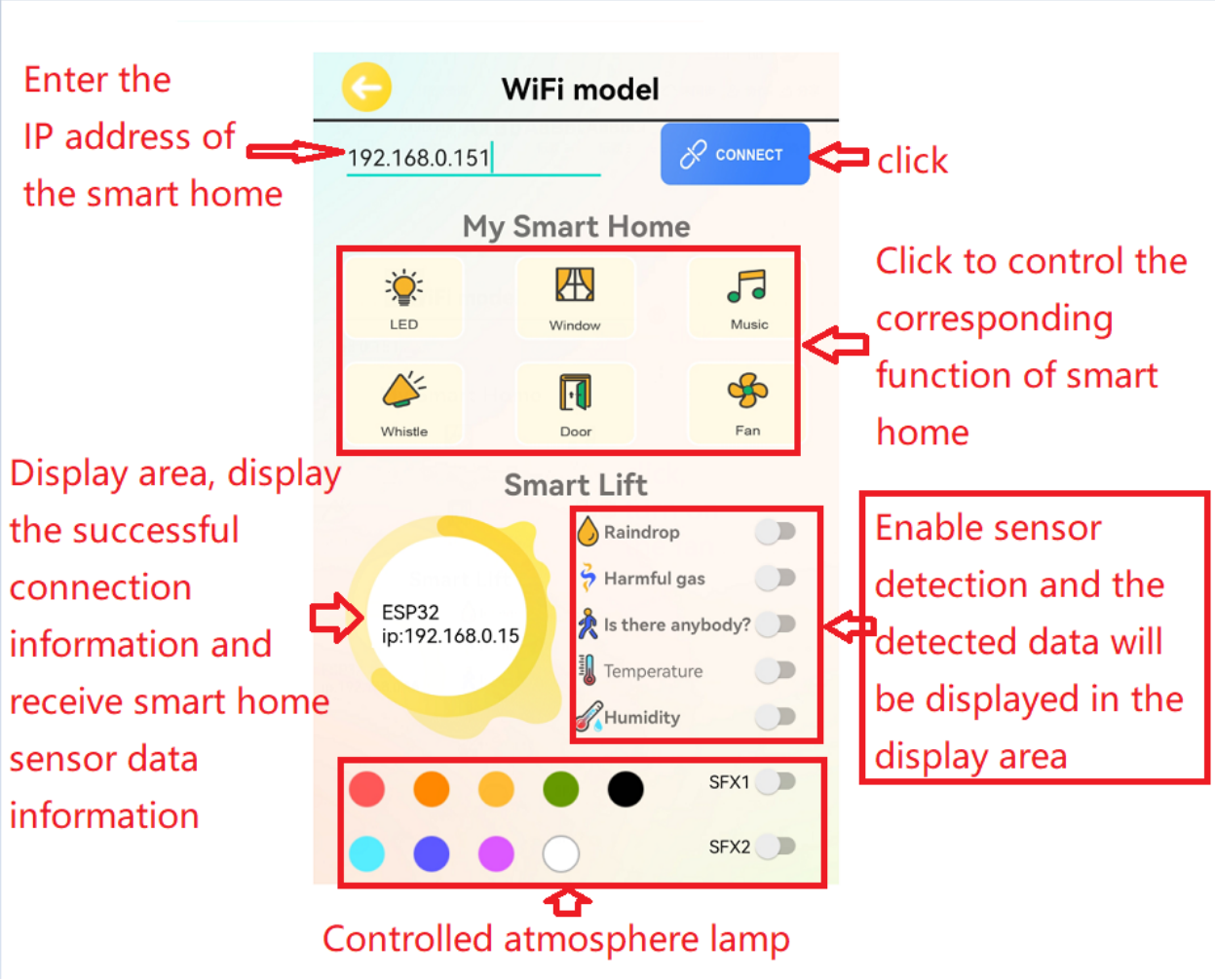
What's more, the smart home also can connect to the hotspot of the mobile phone. If the connection is successful, the LCD1602 will display the IP address. Using the phone APP to input the corresponding IP for communication is enable to realize the APP control of various functions of the smart home.

2. Test Code

Please refer to the sample code, as shown below:



3. Test Result



5.4 Resources

Download code, libraries and more details, please refer to the following link: https://fs.keyestudio.com/KS5009

CHAPTER

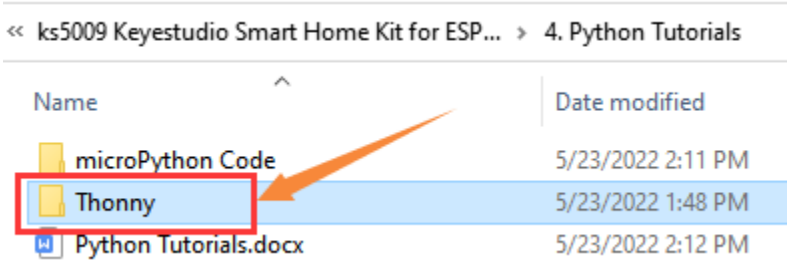
SIX

PYTHON TUTORIAL

6.1 get starter with thonny

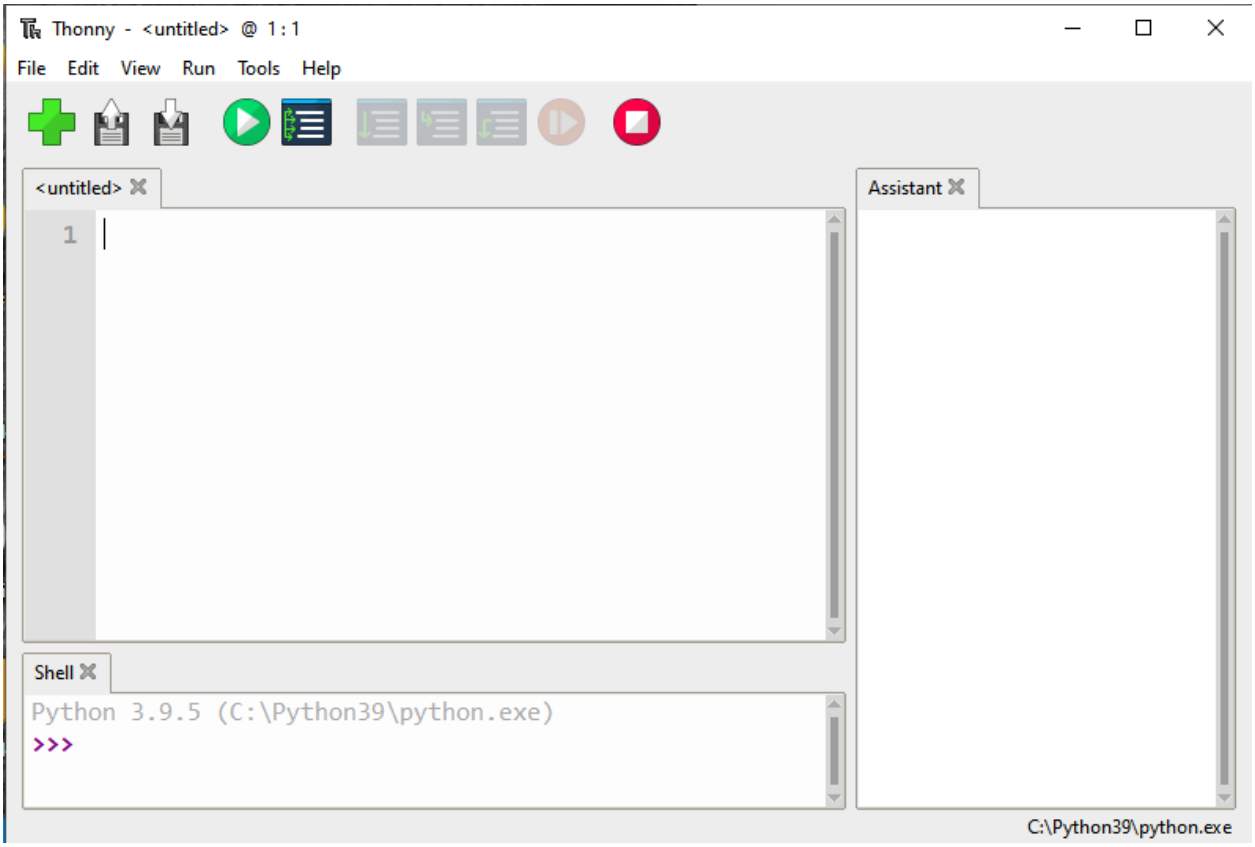
6.1.1 Open the Thonny Package

Please refer to the folder shown below:

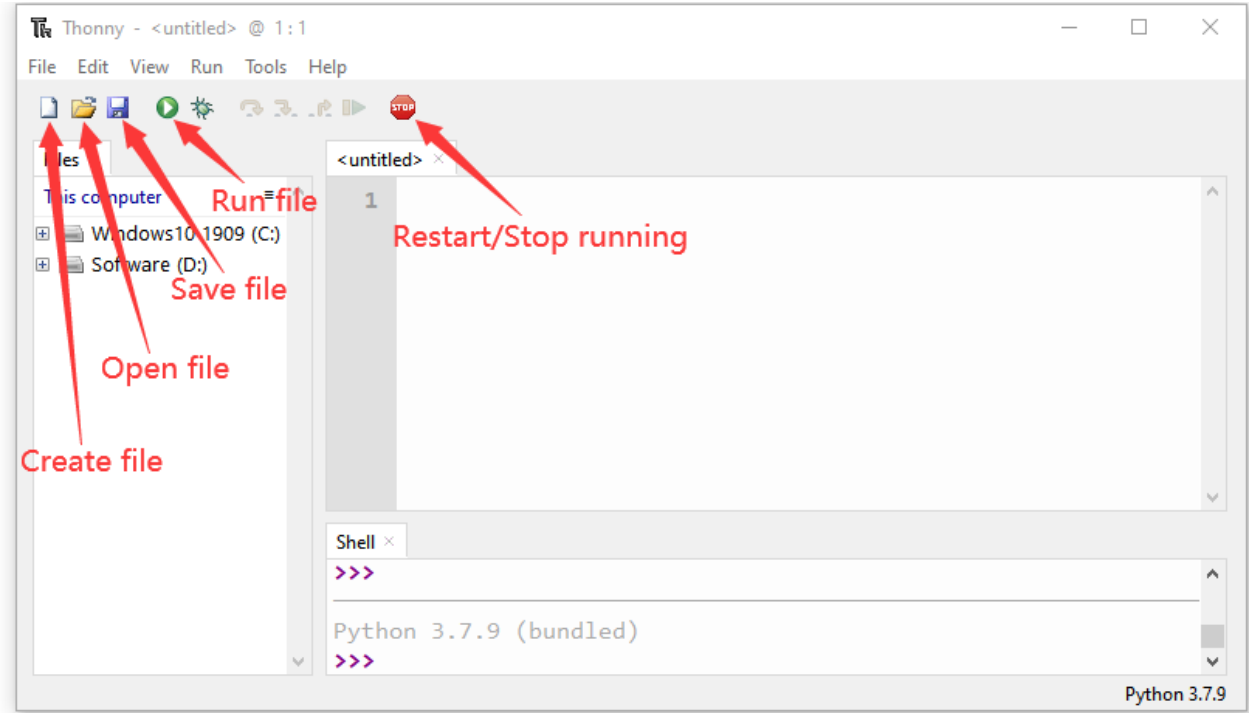


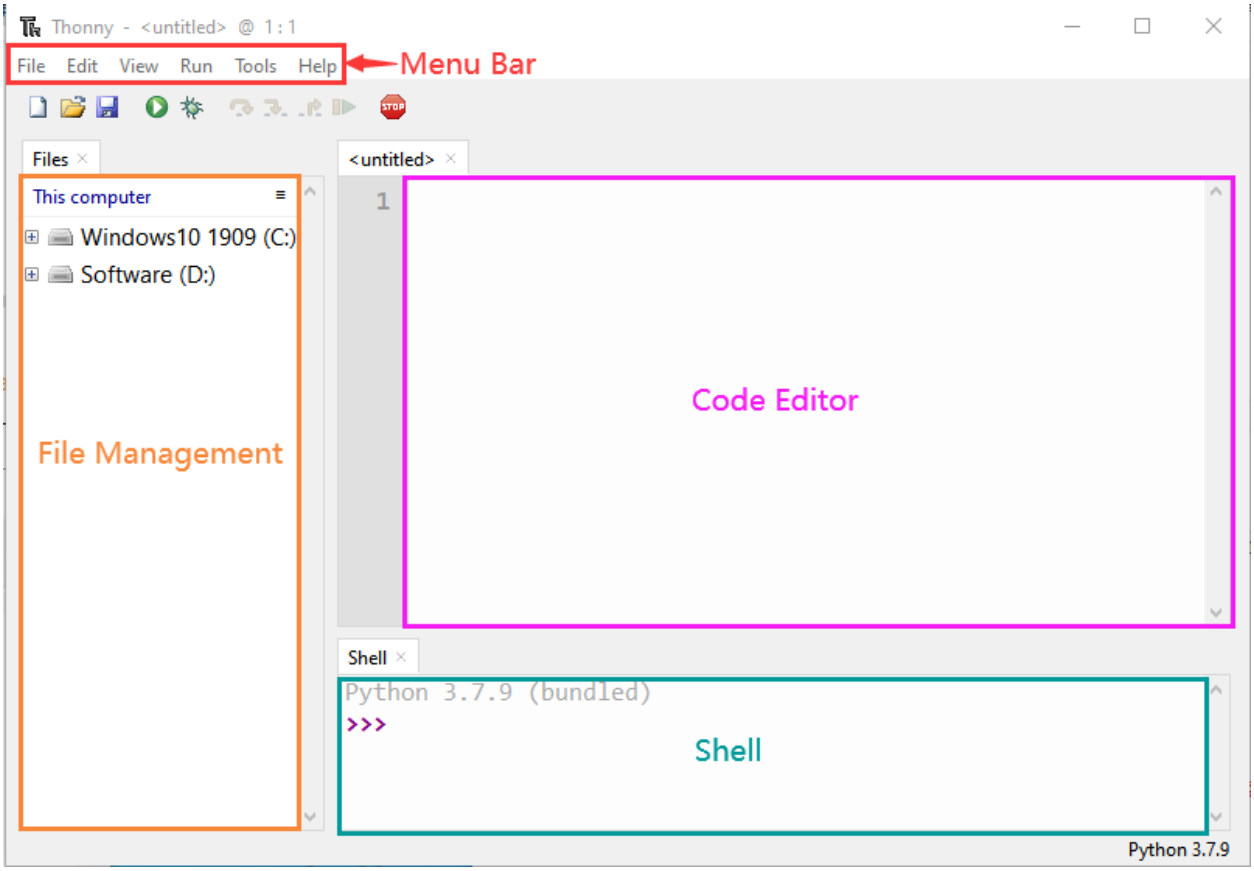
6.1.2 Thonny Interface

Open the Thonny



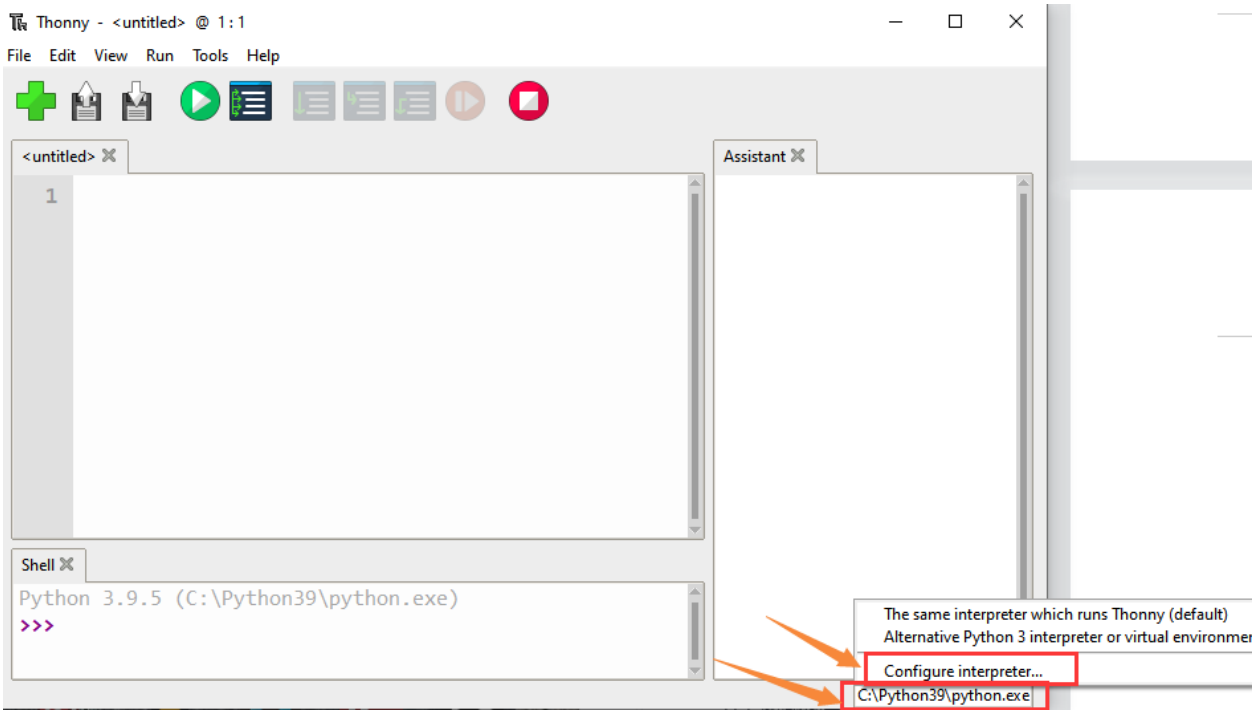
Main interface functions:



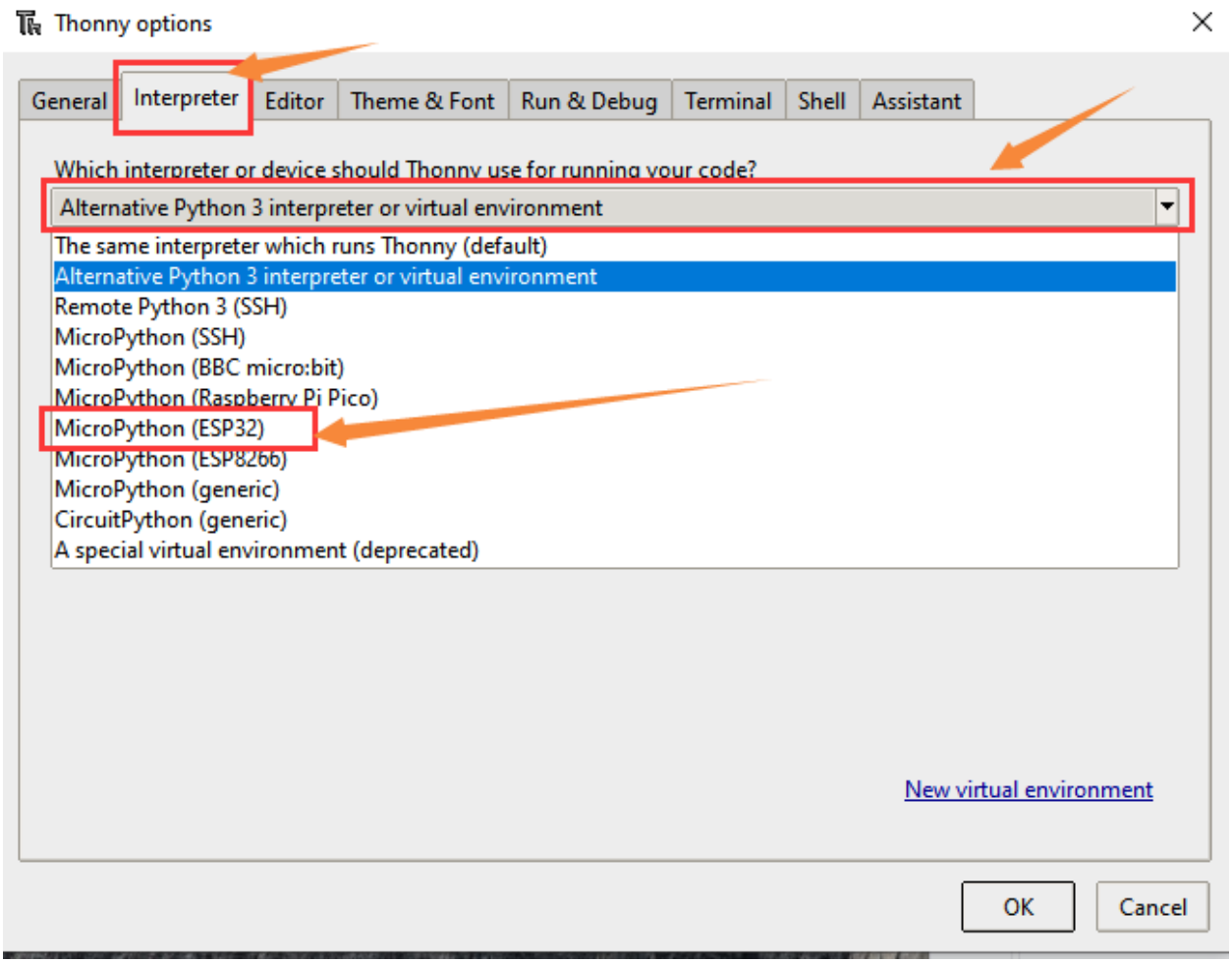


6.1.3 Select ESP32 Development Environment

Click Python.exethen select Configure interpreter



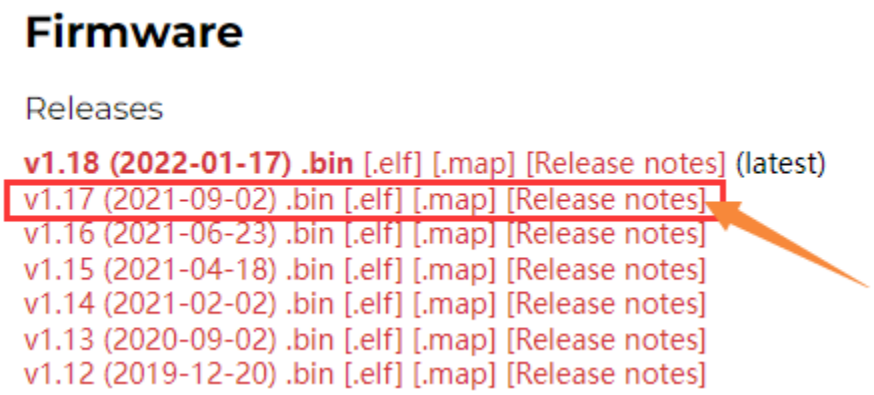
Select MicroPython(ESP32) from the Interpreter interface



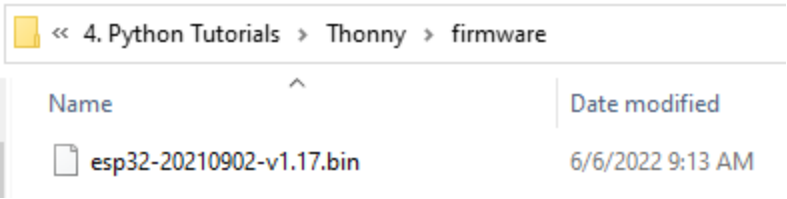
6.1.4 Installing Firmware

Download linkhttps://micropython.org/download/esp32/

Choose to download version V1.17



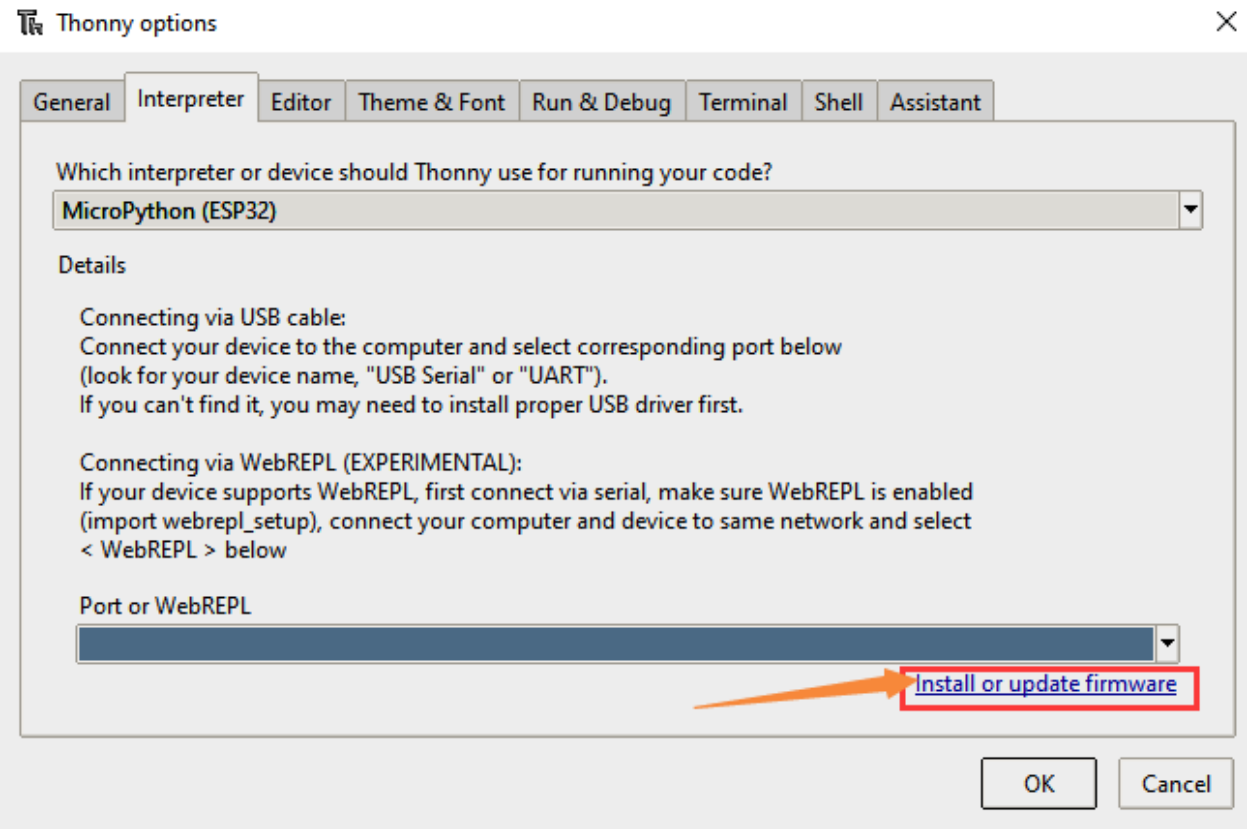
Of course, we also provide the downloaded firmware, as shown below.



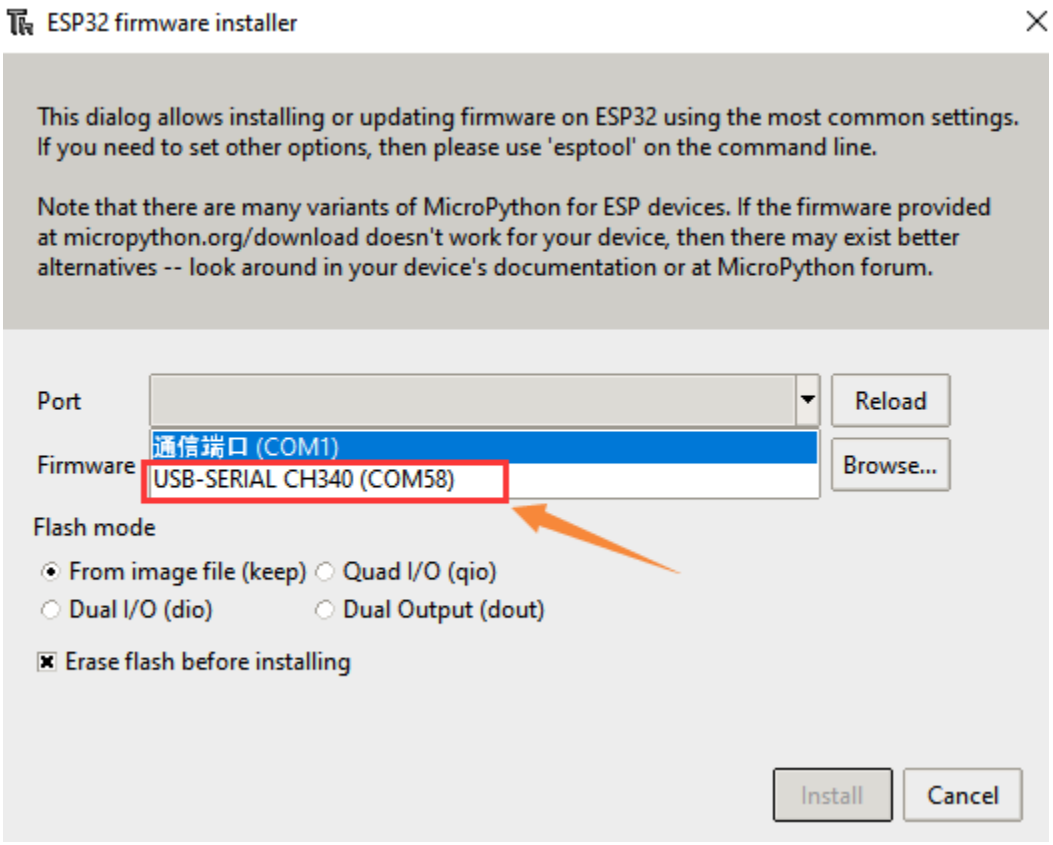
Burn microPython firmware

Connect the smart home to your computer with a USB.

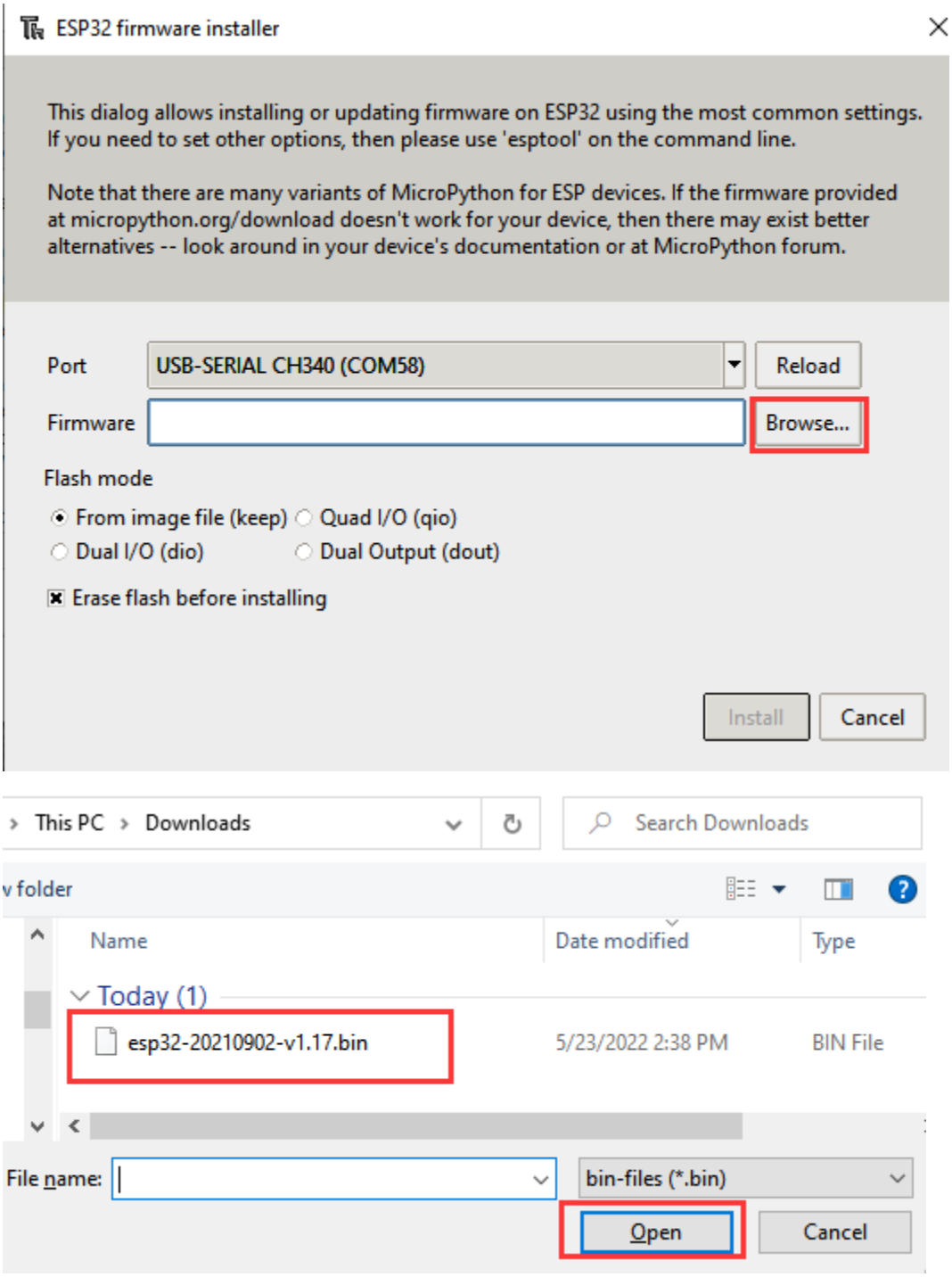
Click Install or update firmware



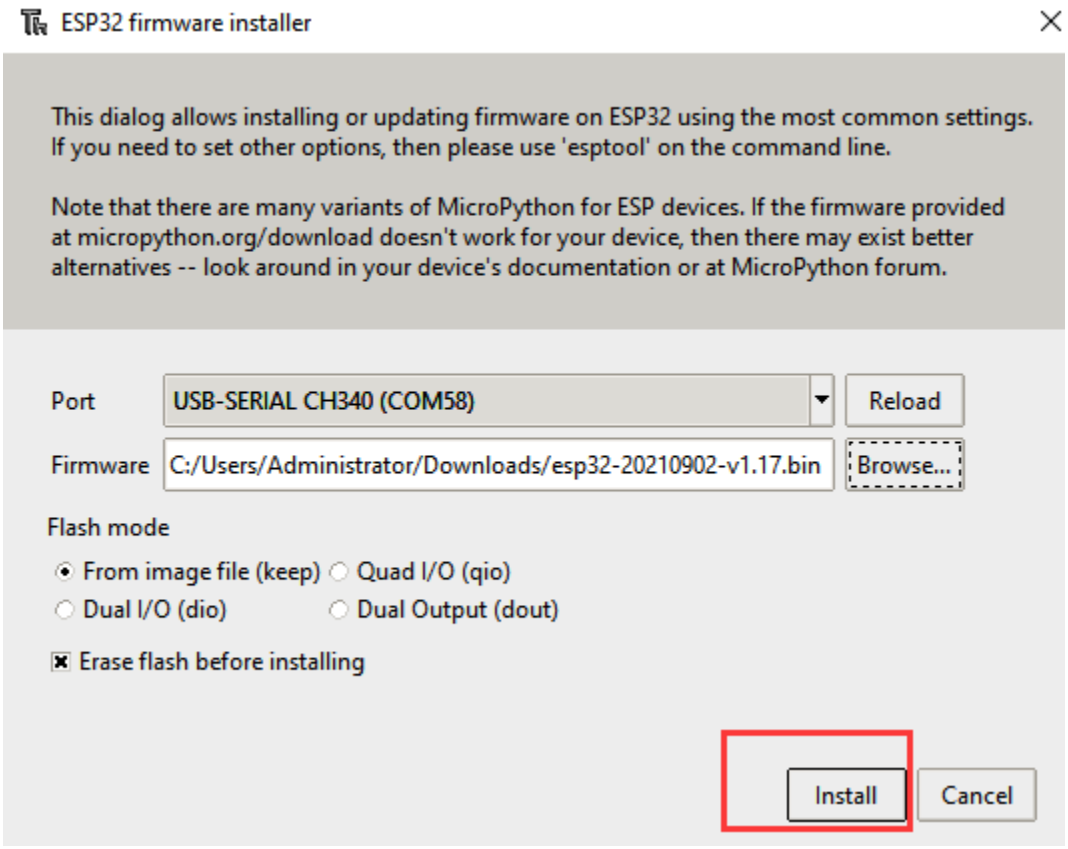
Select Port



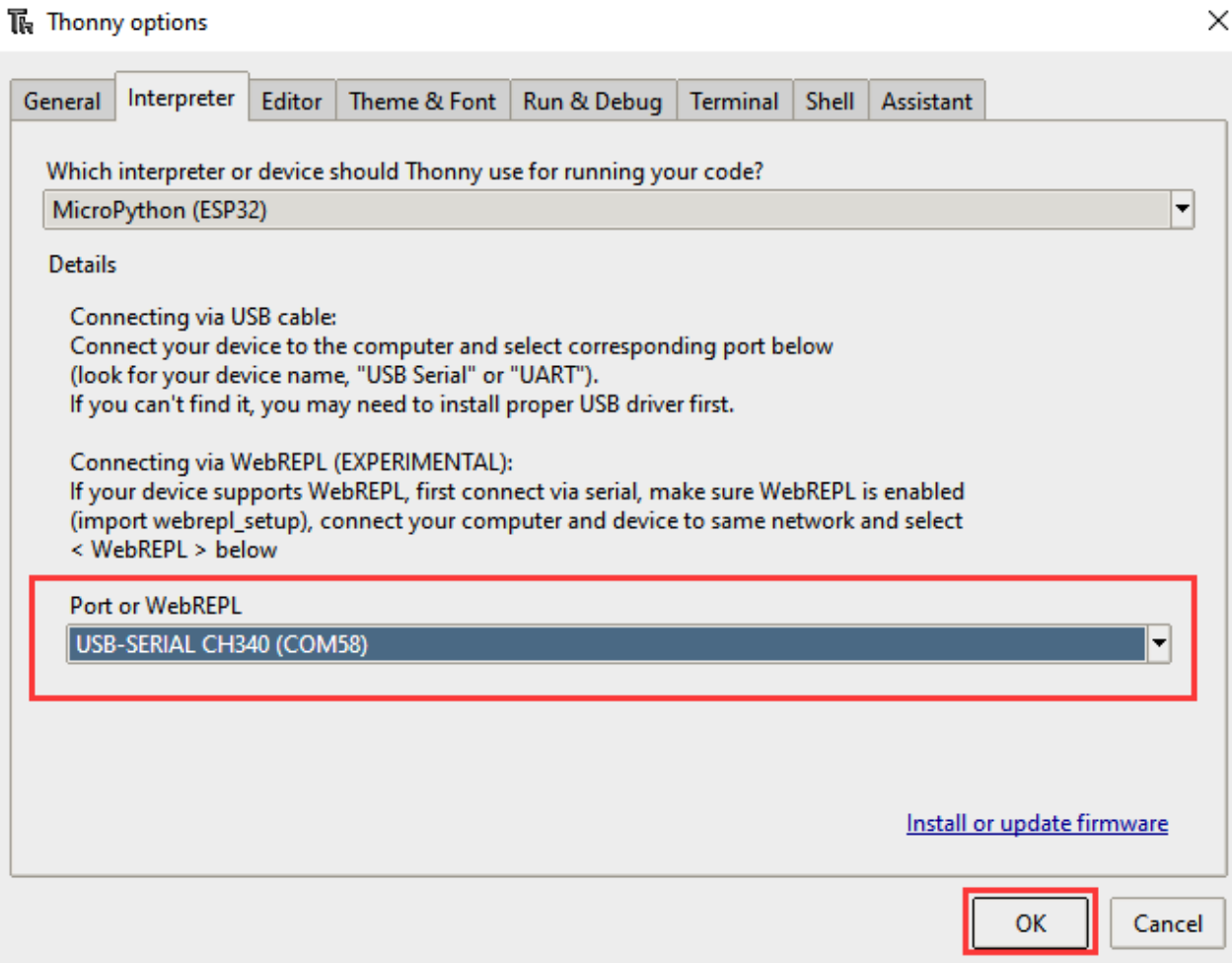
Click Browser to find the the downloaded version V1.17 firmware



Click install

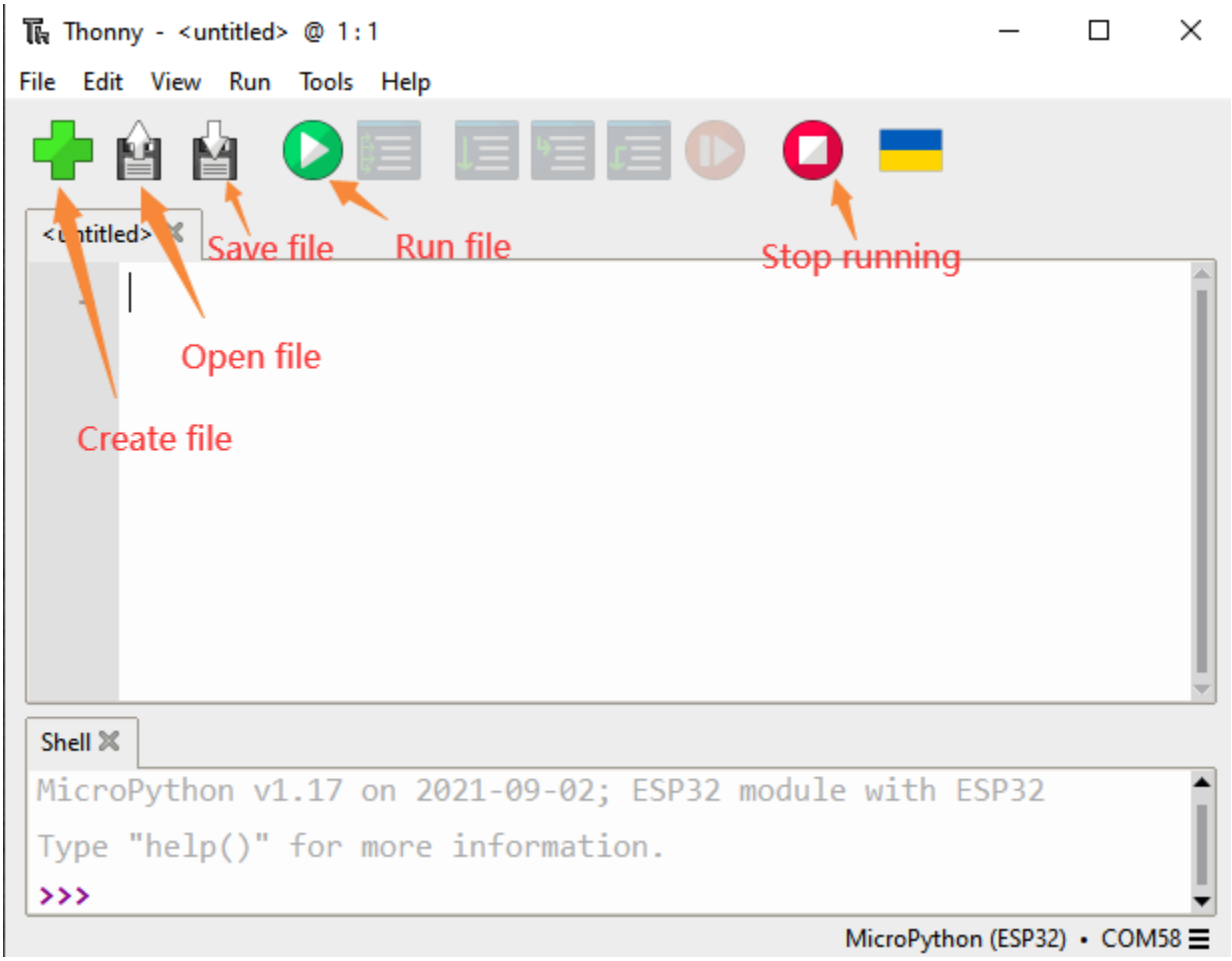


Choose Port or WebREPL as the driver of ESP32 mainboard CH340(COM)


Thonny options
General
Interpreter
Editor
Theme & Font
Run & Debug
Terminal
Shell
Assistant
Which interpreter or device should Thonny use for running your code?
MicroPython (ESP32)
Details
Connecting via USB cable:
Connect your device to the computer and select corresponding port below
(look for your device name, "USB Serial" or "UART").
If you can't find it, you may need to install proper USB driver first.
Connecting via WebREPL (EXPERIMENTAL):
If your device supports WebREPL, first connect via serial, make sure WebREPL is enabled
(import webrepl_setup), connect your computer and device to same network and select
< WebREPL > below
Port or WebREPL
USB-SERIAL CH340 (COM58)
Install or update firmware
OK
Cancel

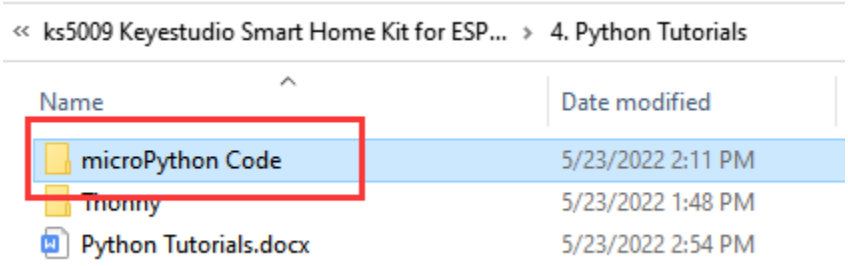
The ESP32 environment has been installed.

Thonny interface



6.2 Python Projects

Please refer to the file below



6.2.1 Project 1: Control LED

we will first learn how to control LED.

Working Principle

LED is also the light-emitting diode, which can be made into an electronic module. It will shine if we control pins to output high level, otherwise it will be off.

Parameters

Working voltage	**DC 3~5V**
Working current	**<20mA**
Power	**0.1W**

Control Pin

Yellow LED	12

6.2.2 Project 1.1 LED Flashing

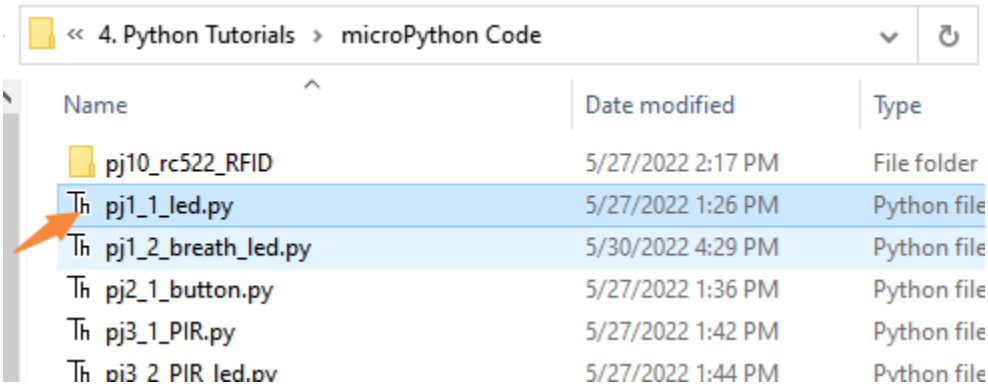
Description

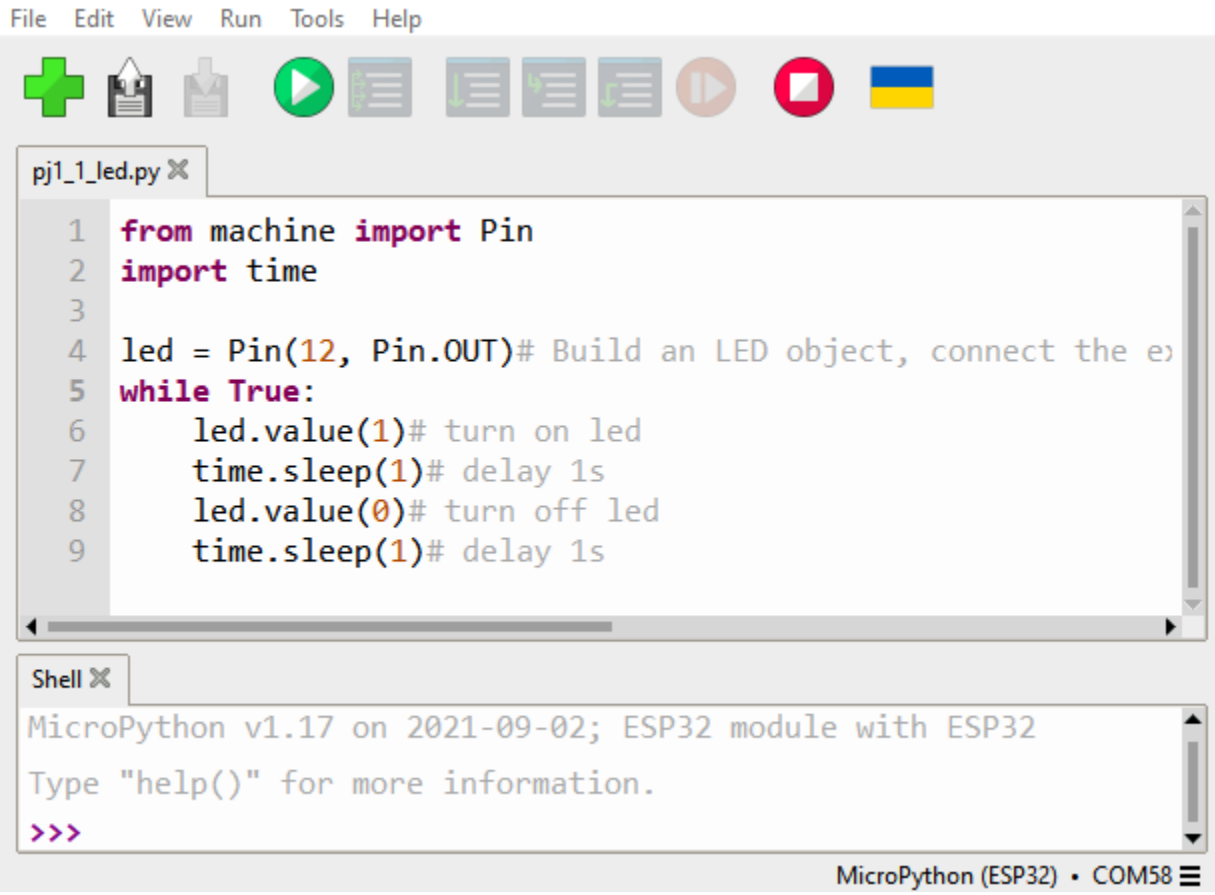
We can make the LED pin output high level and low level to make the LED flash.

Test Code

```
from machine import Pin
import time

led = Pin(12, Pin.OUT)# Build an LED object, connect the external LED light to pin 0,␣
↪and set pin 0 to output mode
while True:
    led.value(1)# turn on led
    time.sleep(1)# delay 1s
    led.value(0)# turn off led
    time.sleep(1)# delay 1s
```

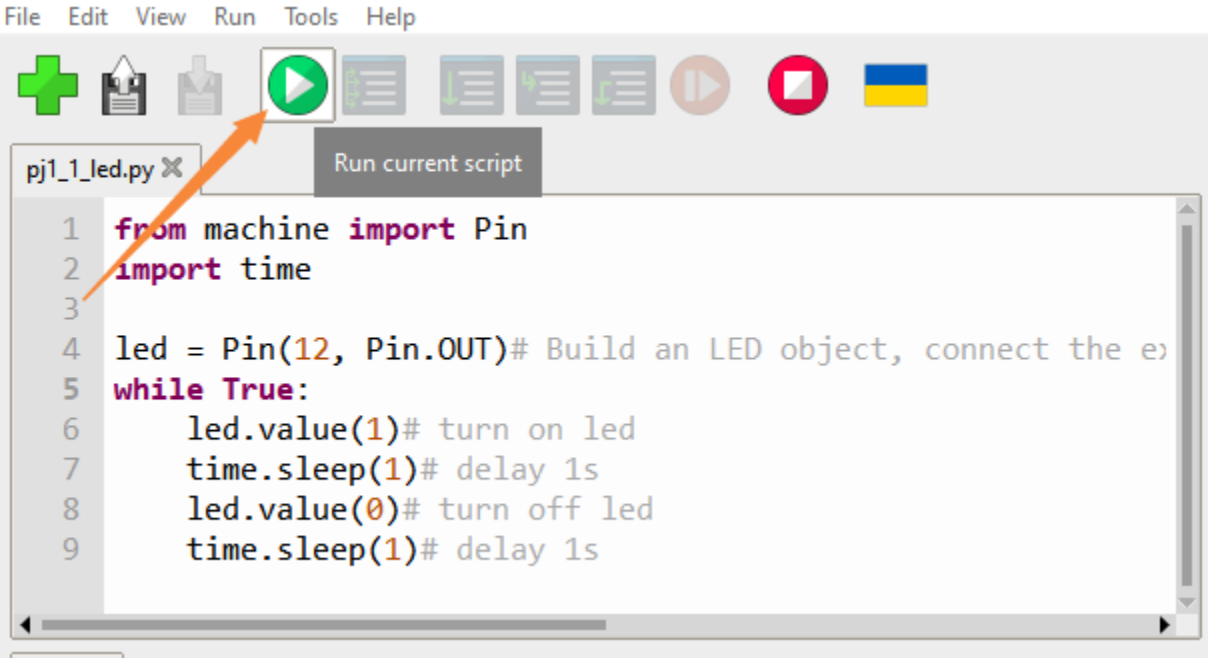
Open the sample code





Operation and test result

Click the button



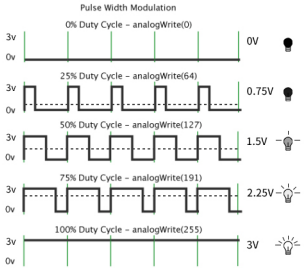
We can see that the yellow LED is flashing .

6.2.3 Project 1.2 Breathing LED

Description

A“breathing LED”is a phenomenon where an LED’s brightness smoothly changes from dark to bright and back to dark, continuing to do so and giving the illusion of an LED“breathing. However, how to control LED’s brightness?

It makes sense to take advantage of PWM. Output the number of high level and low level in unit time, the more time the high level occupies, the larger the PWM value, the brighter the LED.

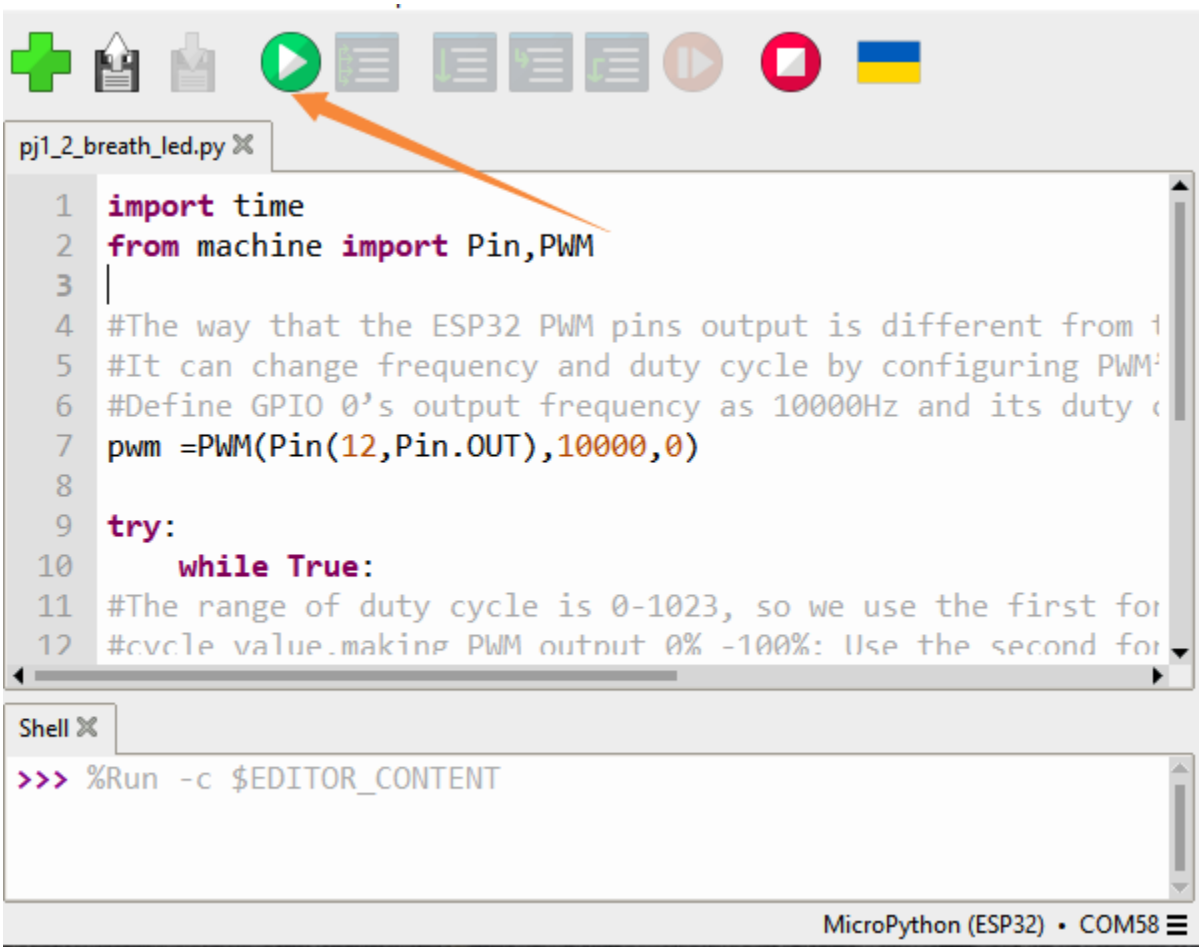


Test Code

```
import time
from machine import Pin,PWM

#The way that the ESP32 PWM pins output is different from traditionally controllers. It␣
↪can change frequency and duty cycle by configuring PWM's parameters at the␣
↪initialization stage. Define GPIO 0's output frequency as 10000Hz and its duty cycle␣
↪as 0, and assign them to PWM.
pwm =PWM(Pin(12,Pin.OUT),10000,0)

try:
    while True:
#The range of duty cycle is 0-1023, so we use the first for loop to control PWM to␣
↪change the duty cycle value,making PWM output 0% -100%; Use the second for loop to␣
↪make PWM output 100%-0%.
        for i in range(0,1023):
            pwm.duty(i)
            time.sleep_ms(1)

        for i in range(0,1023):
            pwm.duty(1023-i)
            time.sleep_ms(1)
except:
#Each time PWM is used, the hardware Timer will be turned ON to cooperate it. Therefore,␣
↪after each use of PWM, deinit() needs to be called to turned OFF the timer. Otherwise,␣
↪the PWM may fail to work next time.
    pwm.deinit()
```

Test Result

Click the button.



The LED gradually gets dimmer then brighter, cyclically, like human breathe.

6.2.4 Project 2: Table Lamp

Description

The common table lamp uses LED lights and buttons, which can control the light on and off pressing the button.

Button Principle

The button module is a digital sensor, which can only read 0 or 1. When the module is not pressed, it is in a high level state, that is, 1, when pressed, it is a low level 0.

Pins of the Button

Button 1	**16**
Button 2	**27**

6.2.5 Project 2.1 Read the Button

1. Description

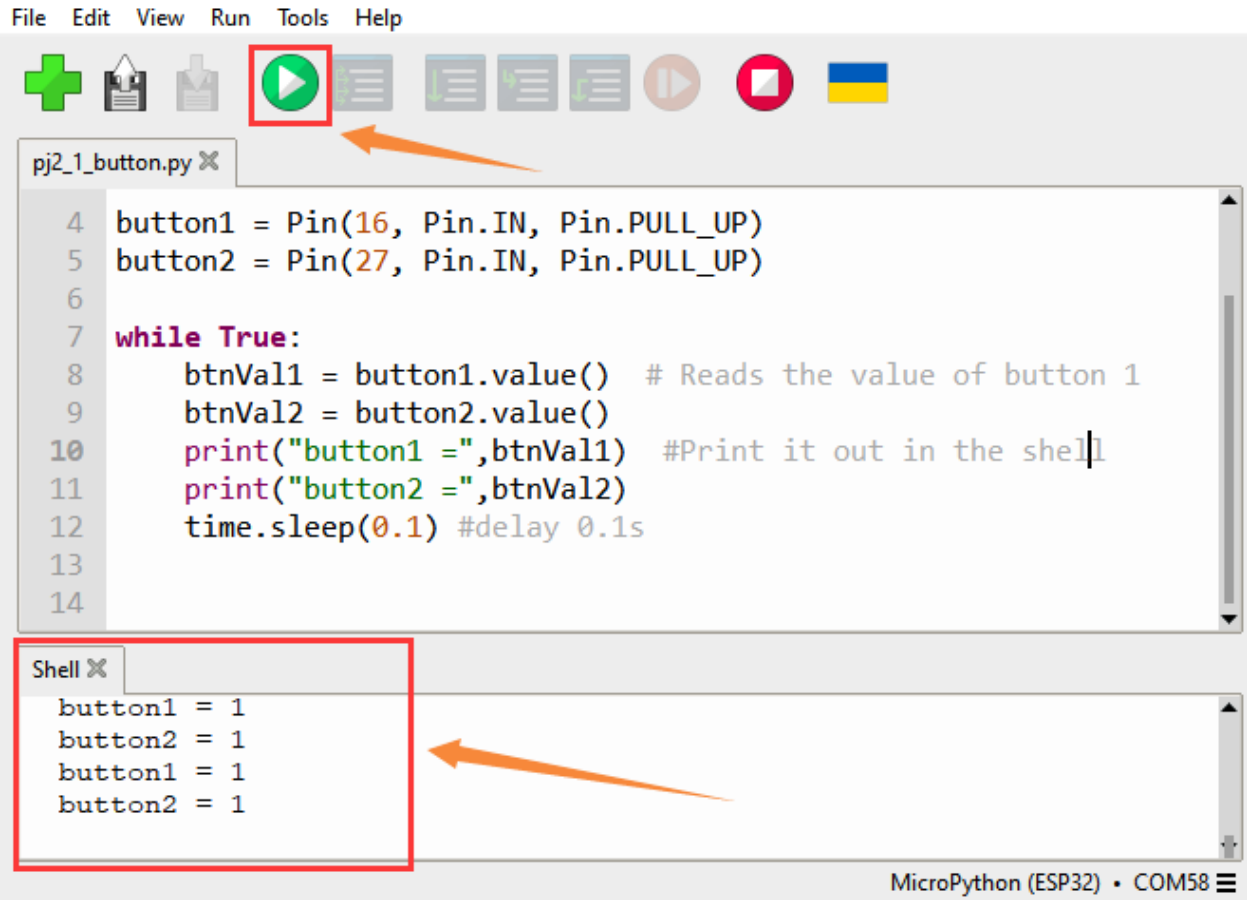
We will work to read the status value of the button and display it on the serial monitor, so as to see it intuitively.

2. Test Code

```
button1 = Pin(16, Pin.IN, Pin.PULL_UP)
button2 = Pin(27, Pin.IN, Pin.PULL_UP)

while True:
    btnVal1 = button1.value()  # Reads the value of button 1
    btnVal2 = button2.value()
    print("button1 =",btnVal1)  #Print it out in the shell
    print("button2 =",btnVal2)
    time.sleep(0.1) #delay 0.1s
```

3. Test Result

Click the run button, then you can see the status values of button1 and button 2 printed in shell. Click the button of the smart home, and you can see the change of the status values.



6.2.6 Project 2.2. Table Lamp

Description

For common simple table lamp, click the button it will be opened, click it again, the lamp will be closed.

Test Code

Calculate the clicked button times and take the remainder of 2, you can get 0 or 1 two state values.

```
from machine import Pin
import time

button1 = Pin(16, Pin.IN, Pin.PULL_UP)
led = Pin(12, Pin.OUT)
count = 0

while True:
    btnVal1 = button1.value()  # Reads the value of button 1
    #print("button1 =",btnVal1)  #Print it out in the shell
    if(btnVal1 == 0):
        time.sleep(0.01)
```

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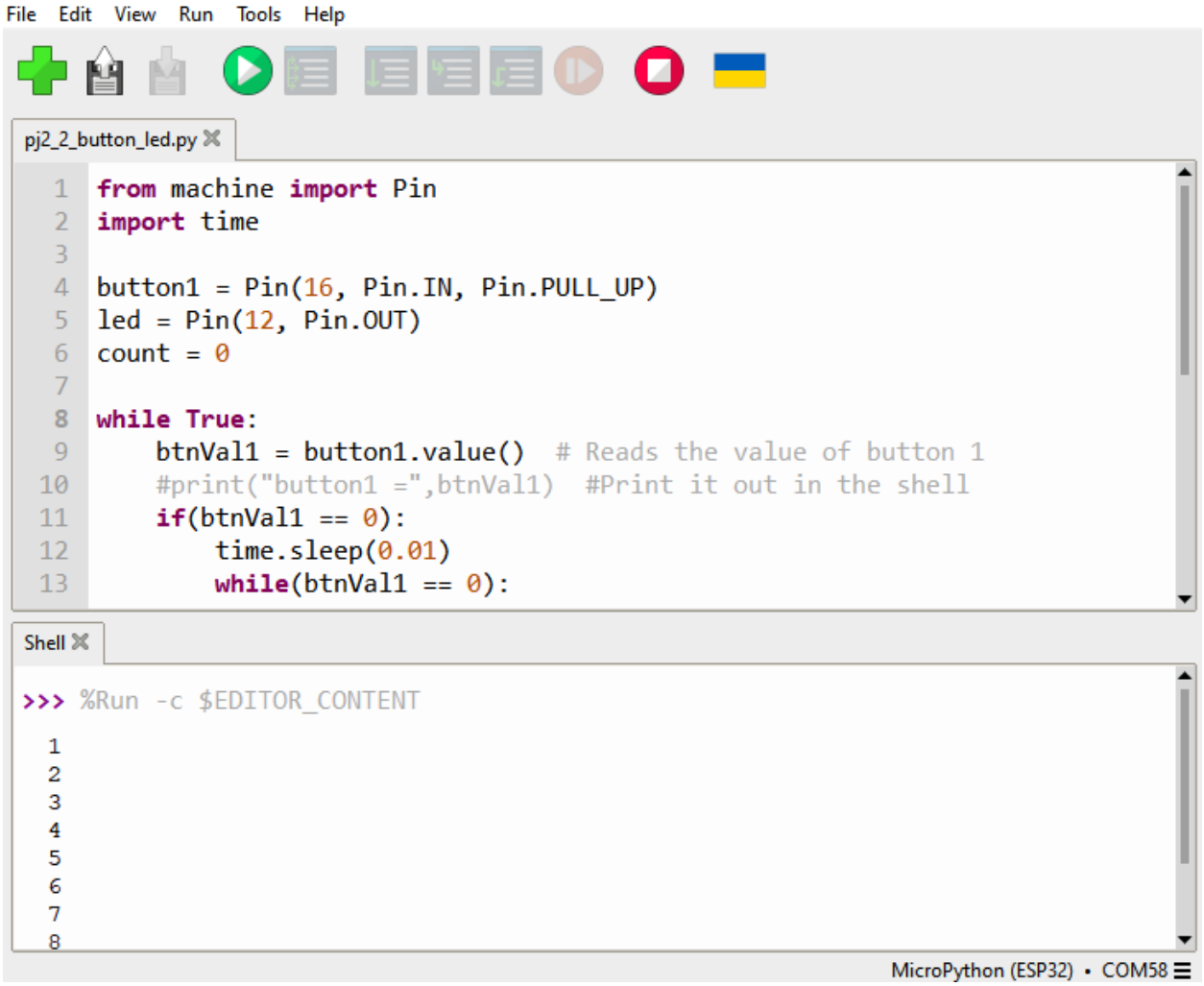
```
        while(btnVal1 == 0):
            btnVal1 = button1.value()
            if(btnVal1 == 1):
                count = count + 1
                print(count)
    val = count % 2
    if(val == 1):
        led.value(1)
    else:
        led.value(0)
    time.sleep(0.1) #delay 0.1s
```

Test Result

The shell will print out the clicked button times, then click the button once, the LED will be on, click it again, it will be off.

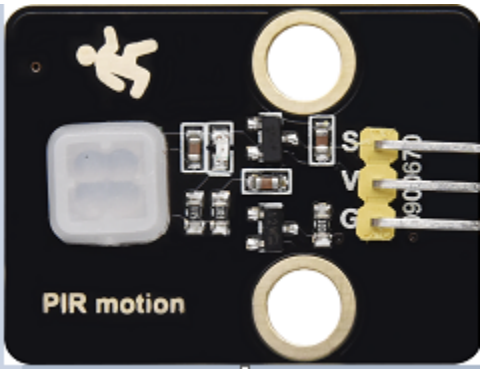


6.2.7 Project 3: PIR Motion Sensor

Description

The PIR motion sensor has many application scenarios in daily life, such as automatic induction lamp of stairs, automatic induction faucet of washbasin, etc.

It is also a digital sensor like buttons, which has two state values 0 or 1. And it will be sensed when people are moving.



Control Pin

PIR motion sensor	14

6.2.8 Project 3.1 Read the PIR Motion Sensor

We will print out the value of the PIR motion sensor through the serial monitor.

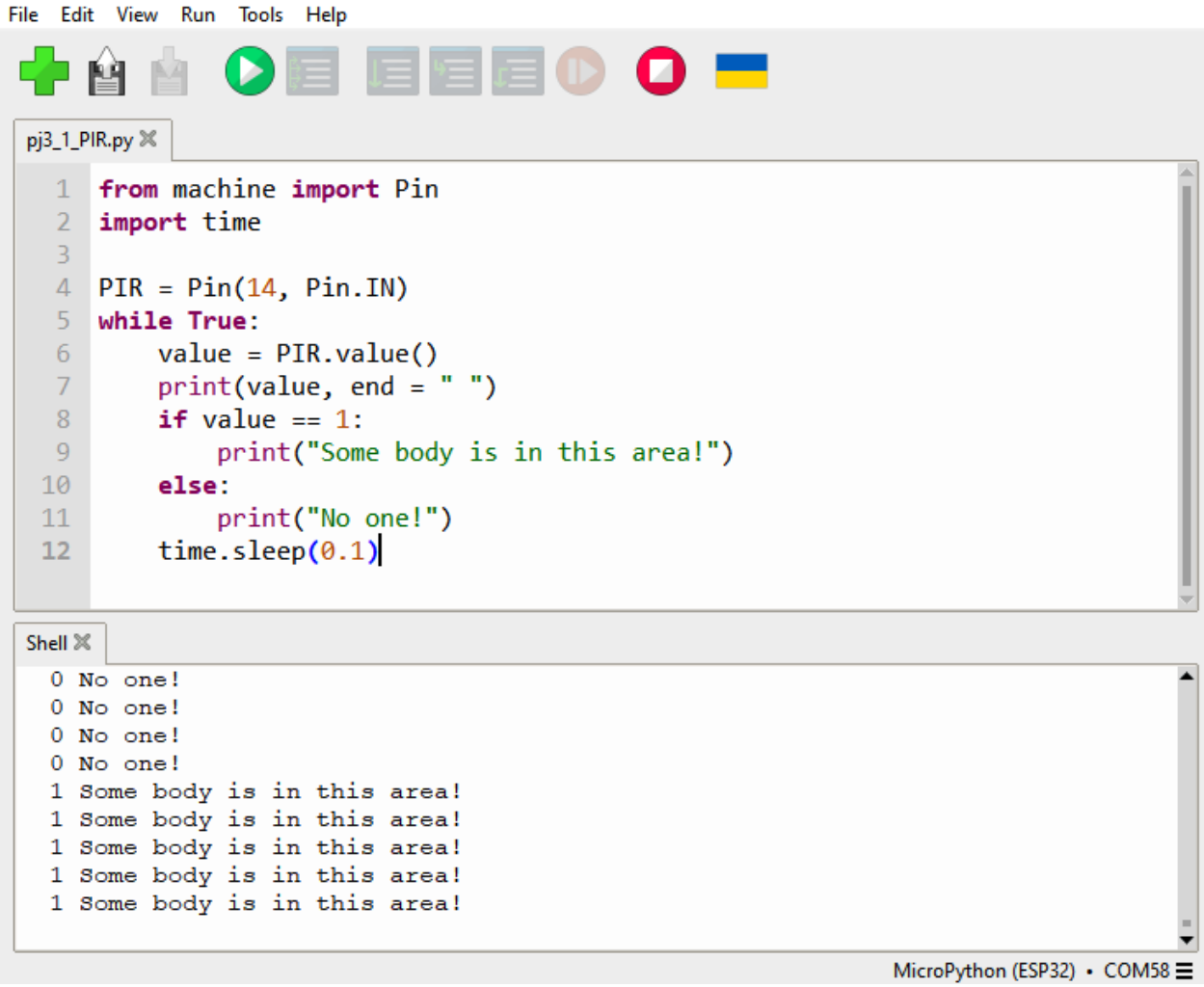
Test Code

```
from machine import Pin
import time

PIR = Pin(14, Pin.IN)
while True:
    value = PIR.value()
    print(value, end = " ")
    if value == 1:
        print("Some body is in this area!")
    else:
        print("No one!")
    time.sleep(0.1)
```

Test Result

When you stand still in front of the sensor, the reading value is 0, move a little, it will change to 1.



6.2.9 Project 3.2 PIR Motion Sensor

If someone moves in front of the sensor, the LED will light up.

Test Code

```
from machine import Pin
import time

PIR = Pin(14, Pin.IN)
led = Pin(12, Pin.OUT)

while True:
    value = PIR.value()
```

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(continued from previous page)

```
    print(value)
    if value == 1:
        led.value(1)# turn on led
    else:
        led.value(0)
    time.sleep(0.1)
```

Test Result

Move your hand in front of the sensor, the LED will turn on. After a few seconds of immobility, the LED will turn off.

6.2.10 Project 4: Play Music

1. Description

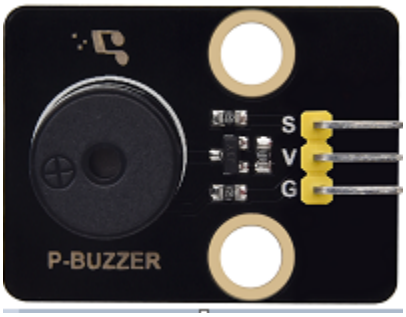
There is a audio power amplifier element in the car expansion board, which is as an external amplification equipment to play music.

In this project, we will work to play a piece of music by using it.

2. Component Knowledge

Passive Buzzer:

The audio power amplifier (like the passive buzzer) does not have internal oscillation. When controlling, we need to input square waves of different frequencies to the positive pole of the component and ground the negative pole to control the power amplifier to chime sounds of different frequencies.



Control Pin

Passive Buzzer	25

6.2.11 Project 4.1 Play Happy Birthday

1. Test Code

```
from machine import Pin, PWM
from time import sleep
buzzer = PWM(Pin(25))

buzzer.duty(1000)

# Happy birthday
buzzer.freq(294)
sleep(0.25)
buzzer.freq(440)
sleep(0.25)
buzzer.freq(392)
sleep(0.25)
buzzer.freq(532)
sleep(0.25)
buzzer.freq(494)
sleep(0.25)
buzzer.freq(392)
sleep(0.25)
buzzer.freq(440)
sleep(0.25)
buzzer.freq(392)
sleep(0.25)
buzzer.freq(587)
sleep(0.25)
buzzer.freq(532)
sleep(0.25)
buzzer.freq(392)
sleep(0.25)
buzzer.freq(784)
sleep(0.25)
buzzer.freq(659)
sleep(0.25)
buzzer.freq(532)
sleep(0.25)
buzzer.freq(494)
sleep(0.25)
buzzer.freq(440)
sleep(0.25)
buzzer.freq(698)
sleep(0.25)
buzzer.freq(659)
sleep(0.25)
buzzer.freq(532)
sleep(0.25)
buzzer.freq(587)
sleep(0.25)
buzzer.freq(532)
sleep(0.5)
```

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```
buzzer.duty(0)
```

2. Test Result

The passive buzzer will play happy Birthday.

6.2.12 Project 5: Automatic Doors and Windows

Description

Automatic doors and windows need power device, which will become more automatic with a 180 degree servo and some sensors. Adding a raindrop sensor, you can achieve the effect of closing windows automatically when raining. If adding a RFID, we can realize the effect of swiping to open the door and so on.

Component Knowledge

Servo:

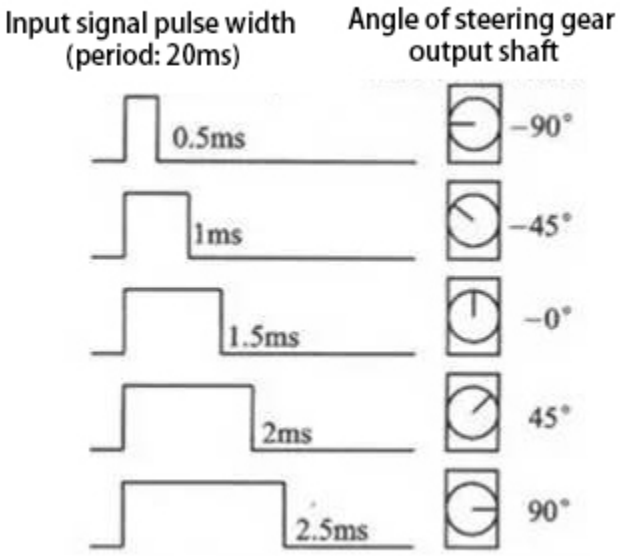
Servo is a position servo driver device consists of a housing, a circuit board, a coreless motor, a gear and a position detector.

Its working principle is that the servo receives the signal sent by MCU or receiver and produces a reference signal with a period of 20ms and width of 1.5ms, then compares the acquired DC bias voltage to the voltage of the potentiometer and obtain the voltage difference output.

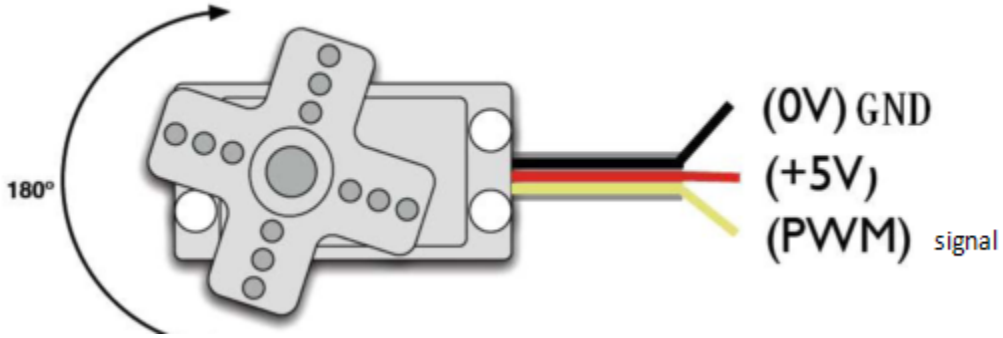
The IC on the circuit board judges the direction of rotation, and then drives the coreless motor to start rotation. The power is transmitted to the swing arm through the reduction gear, and the signal is sent back by the position detector to judge whether the positioning has been reached, which is suitable for those control systems that require constant angle change and can be maintained.

When the motor speed is constant, the potentiometer is driven to rotate through the cascade reduction gear, which leads that the voltage difference is 0, and the motor stops rotating. Generally, the angle range of servo rotation is 0° –180 °.

The pulse period of the control servo is 20ms, the pulse width is 0.5ms ~ 2.5ms, and the corresponding position is -90°~ +90°. Here is an example of a 180° servo:



In general, servo has three lines in brown, red and orange. The brown wire is grounded, the red one is a positive pole line and the orange one is a signal line.



Pin

The servo of the window	5
The servo of the door	13

6.2.13 Project 5.1 Control the Door

1. Test Code

```
from machine import Pin, PWM
import time
pwm = PWM(Pin(13))
pwm.freq(50)

'''
Duty cycle corresponding to the Angle
0°----2.5%----25
45°----5%----51.2
90°----7.5%----77
135°----10%----102.4
180°----12.5%----128
'''
angle_0 = 25
angle_90 = 77
angle_180 = 128

while True:
    pwm.duty(angle_0)
    time.sleep(1)
    pwm.duty(angle_90)
    time.sleep(1)
    pwm.duty(angle_180)
    time.sleep(1)
```

2. Test Result

The servo of the door turns with the door, back and forth

6.2.14 Project 5.2 Close the Window

Description

We will work to use a servo and a raindrop sensor to make an device closing windows automatically when raining.

Component Knowledge

Raindrop Sensor: This is an analog input module, the greater the area covered by water on the detection surface, the greater the value returned (range 0~4096).

Test Code

```
# Import Pin, ADC and DAC modules.
from machine import ADC,Pin,DAC,PWM
import time
pwm = PWM(Pin(5))
pwm.freq(50)

# Turn on and configure the ADC with the range of 0-3.3V
adc=ADC(Pin(34))
adc.atten(ADC.ATTN_11DB)
adc.width(ADC.WIDTH_12BIT)

# Read ADC value once every 0.1seconds, convert ADC value to DAC value and output it,␣
↪and print these data to "Shell".
try:
    while True:
        adcVal=adc.read()
        dacVal=adcVal//16
        voltage = adcVal / 4095.0 * 3.3
        print("ADC Val:",adcVal,"DACVal:",dacVal,"Voltage:",voltage,"V")
        if(voltage > 0.6):
            pwm.duty(46)
        else:
            pwm.duty(100)
        time.sleep(0.1)
except:
    pass
```

Test Result

At first, the window opens automatically, and when you touch the raindrop sensor with your hand (which has water on the skin), the window will close.

6.2.15 Project 6: Atmosphere Lamp

Description

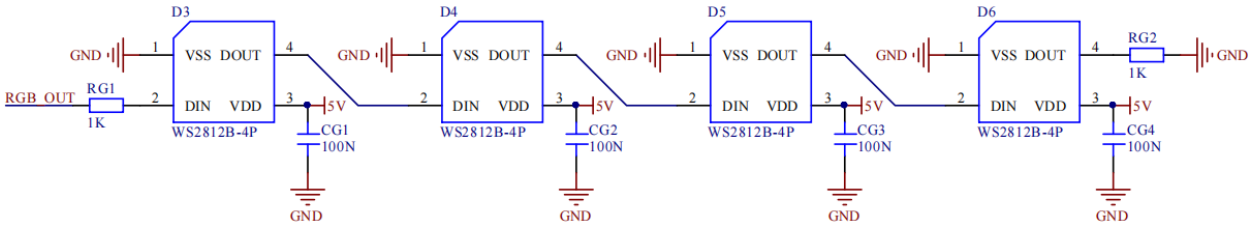
The atmosphere lamp of smart home is 4 SK6812RGB LEDs. RGB LED belongs to a simple luminous module, which can adjust the color to bring out the lamp effect of different colors. Furthermore, it can be widely used in buildings, bridges, roads, gardens, courtyards, floors and other fields of decorative lighting and venue layout, Christmas, Halloween, Valentine's Day, Easter, National Day as well as other festivals during the atmosphere and other scenes.

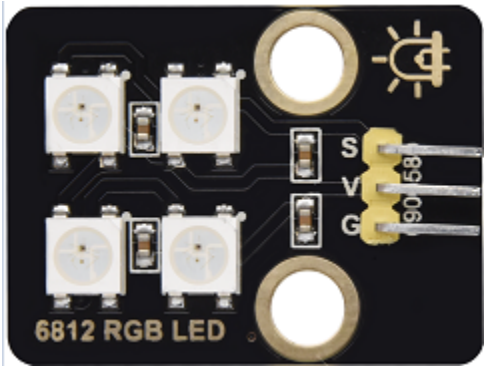
In this experiment, we will make various lighting effects.

Component Knowledge

From the schematic diagram, we can see that these four RGB LEDs are all connected in series. In fact, no matter how many they are, we can use a pin to control a RGB LED and let it display any color. Each RGBLED is an independent pixel, composed of R, G and B colors, which can achieve 256 levels of brightness display and complete the full true color display of 16777216 colors.

What's more, the pixel point contains a data latch signal shaping amplifier drive circuit and a signal shaping circuit, which effectively ensures the color of the pixel point light is highly consistent.





Pin

SK6812	26

6.2.16 Project 6.1 Control SK6812

We will control SK6812 to display various lighting effects.

1. Test Code

```
#Import Pin, neopiexl and time modules.
from machine import Pin
import neopixel
import time

#Define the number of pin and LEDs connected to neopixel.
pin = Pin(26, Pin.OUT)
```

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```
np = neopixel.NeoPixel(pin, 4)

#brightness :0-255
brightness=100
colors=[[brightness,0,0],                    #red
        [0,brightness,0],                    #green
        [0,0,brightness],                    #blue
        [brightness,brightness,brightness],  #white
        [0,0,0]]                             #close

#Nest two for loops to make the module repeatedly display five states of red, green,␣
↪blue, white and OFF.
while True:
    for i in range(0,5):
        for j in range(0,4):
            np[j]=colors[i]
            np.write()
            time.sleep_ms(50)
        time.sleep_ms(500)
    time.sleep_ms(500)
```

2. Test Result

The atmosphere lamps of the smart home will display red,greenish blue as well as white.

6.2.17 Project 6.2 Button

Description

There are two switch buttons to change the color of the atmosphere lamp.

Test Code

```
#Import Pin, neopiexl and time modules.
from machine import Pin
import neopixel
import time

button1 = Pin(16, Pin.IN, Pin.PULL_UP)
button2 = Pin(27, Pin.IN, Pin.PULL_UP)
count = 0

#Define the number of pin and LEDs connected to neopixel.
pin = Pin(26, Pin.OUT)
np = neopixel.NeoPixel(pin, 4)

#brightness :0-255
brightness=100
colors=[[0,0,0],
```

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```
        [brightness,0,0],                    #red
        [0,brightness,0],                    #green
        [0,0,brightness],                    #blue
        [brightness,brightness,brightness]  #white
        ]                                #close

def func_color(val):
    for j in range(0,4):
        np[j]=colors[val]
        np.write()
        time.sleep_ms(50)

#Nest two for loops to make the module repeatedly display five states of red, green,␣
↪blue, white and OFF.
while True:
    btnVal1 = button1.value()  # Reads the value of button 1
    #print("button1 =",btnVal1)  #Print it out in the shell
    if(btnVal1 == 0):
        time.sleep(0.01)
        while(btnVal1 == 0):
            btnVal1 = button1.value()
            if(btnVal1 == 1):
                count = count - 1
                print(count)
                if(count <= 0):
                    count = 0

    btnVal2 = button2.value()
    if(btnVal2 == 0):
        time.sleep(0.01)
        while(btnVal2 == 0):
            btnVal2 = button2.value()
            if(btnVal2 == 1):
                count = count + 1
                print(count)
                if(count >= 4):
                    count = 4

    if(count == 0):
        func_color(0)
    elif(count == 1):
        func_color(1)
    elif(count == 2):
        func_color(2)
    elif(count == 3):
        func_color(3)
    elif(count == 4):
        func_color(4)
```

Test Result

We can switch the color of the atmosphere lamp by clicking buttons 1 and 2.

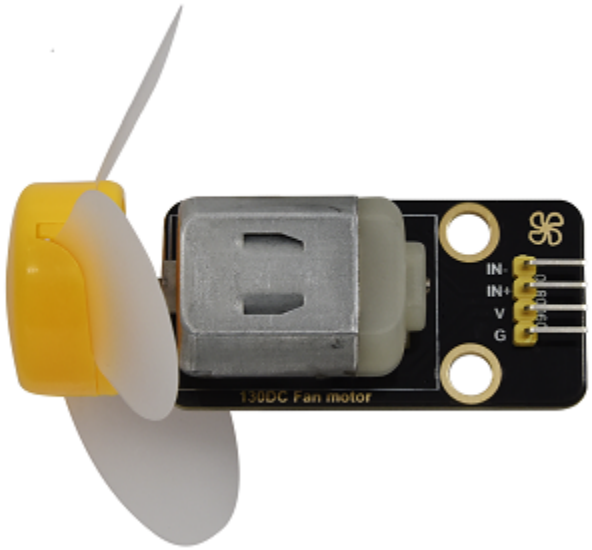
6.2.18 Project 7: Fan

Description

In this project, we will learn how to make a small fan.

Component Knowledge

The small fan uses a 130 DC motor and safe fan blades. You can use PWM output to control the fan speed.



Control Method

Two pins are required to control the motor of the fan, one for INA and two for INB. The PWM value range is 0~255. When the PWM output of the two pins is different, the fan can rotate.

INA - INB <= -45	Rotate clockwise
INA - INB >= 45	Rotate anticlockwise
INA ==0, INB == 0	Stop

Control Pins

INA	19
INB	18

6.2.19 Project 7.1 Control the Fan

We can control the *anticlockwise* and clockwise rotation speed of the fan.

1. Test Code

```
from machine import Pin,PWM
import time
#Two pins of the motor
INA =PWM(Pin(19,Pin.OUT),10000,0)#INA corresponds to IN+
INB =PWM(Pin(18,Pin.OUT),10000,2)#INB corresponds to IN-

try:
    while True:
        #Counterclockwise 2s
        INA.duty(0) #The range of duty cycle is 0-1023
        INB.duty(700)
        time.sleep(2)
        #stop 1s
        INA.duty(0)
        INB.duty(0)
        time.sleep(1)
        #Turn clockwise for 2s
        INA.duty(600)
        INB.duty(0)
        time.sleep(2)
        #stop 1s
        INA.duty(0)
        INB.duty(0)
        time.sleep(1)
except:
    INA.duty(0)
    INB.duty(0)
    INA.deinit()
    INB.deinit()
```

2. Test Result

The fan will rotate clockwise and anticlockwise at different speeds.

6.2.20 Project 7.2 Switch On or Off the Fan

One button switches the fan on and the other button controls the speed of the fan.

1. Test Code

```
from machine import Pin,PWM
import time
#Two pins of the motor
INA =PWM(Pin(19,Pin.OUT),10000,0)#INA corresponds to IN+
INB =PWM(Pin(18,Pin.OUT),10000,2)#INB corresponds to IN-
button1 = Pin(16, Pin.IN, Pin.PULL_UP)
count = 0

try:
    while True:
        btnVal1 = button1.value()  # Reads the value of button 1
        if(btnVal1 == 0):
            time.sleep(0.01)
            while(btnVal1 == 0):
                btnVal1 = button1.value()
                if(btnVal1 == 1):
                    count = count + 1
                    print(count)
        val = count % 2
        if(val == 1):
            INA.duty(0) #The range of duty cycle is 0-1023
            INB.duty(700)
        else:
            INA.duty(0)
            INB.duty(0)
except:
    INA.duty(0)
    INB.duty(0)
    INA.deinit()
    INB.deinit()
```

2. Test Result

Click button 1, the fan starts to rotate, click button 2, the

speed can be adjusted(there are three different speeds), press the button 1 again, the fan stops.

6.2.21 Project 8: LCD1602 Display

Description

As we all know, screen is one of the best ways for people to interact with electronic devices.

Component Knowledge

1602 is a line that can display 16 characters. There are two lines, which use IIC communication protocol.

Control Pins

SDA	SDA
SCL	SCL

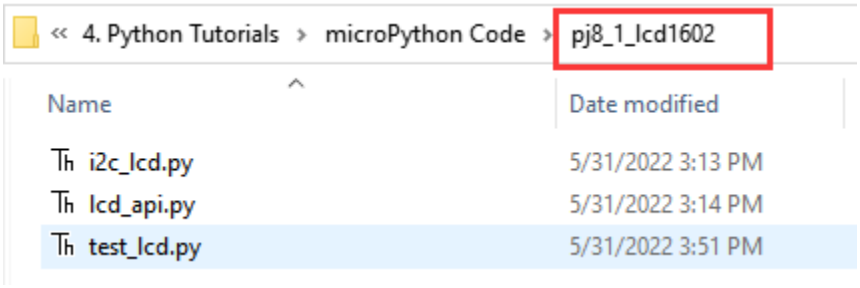
6.2.22 Project 8.1 Display Characters

Description

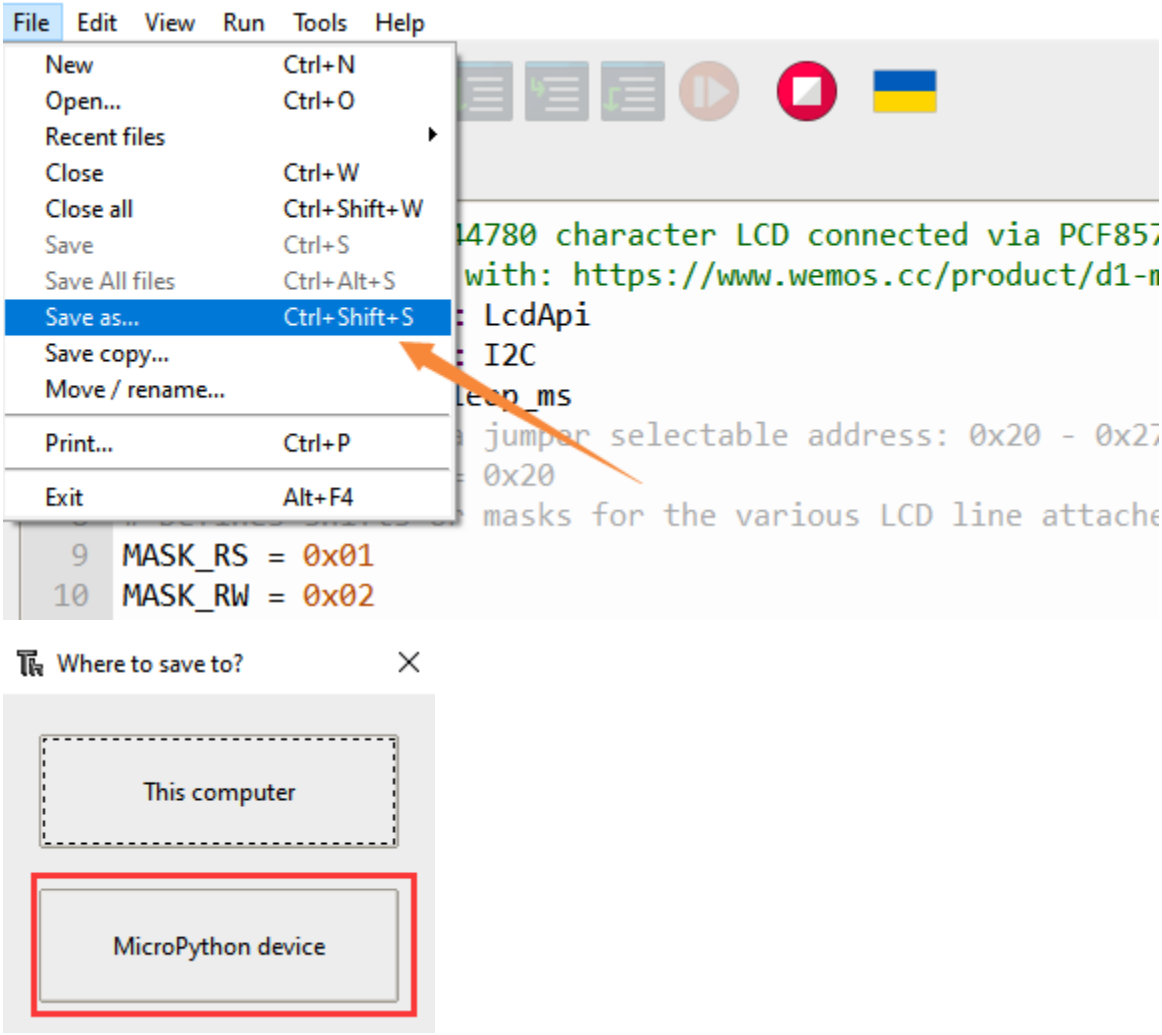
We will use library file i2c_lcd.py and lcd_api.py, which should be saved in the ESP32 memory.

Operations

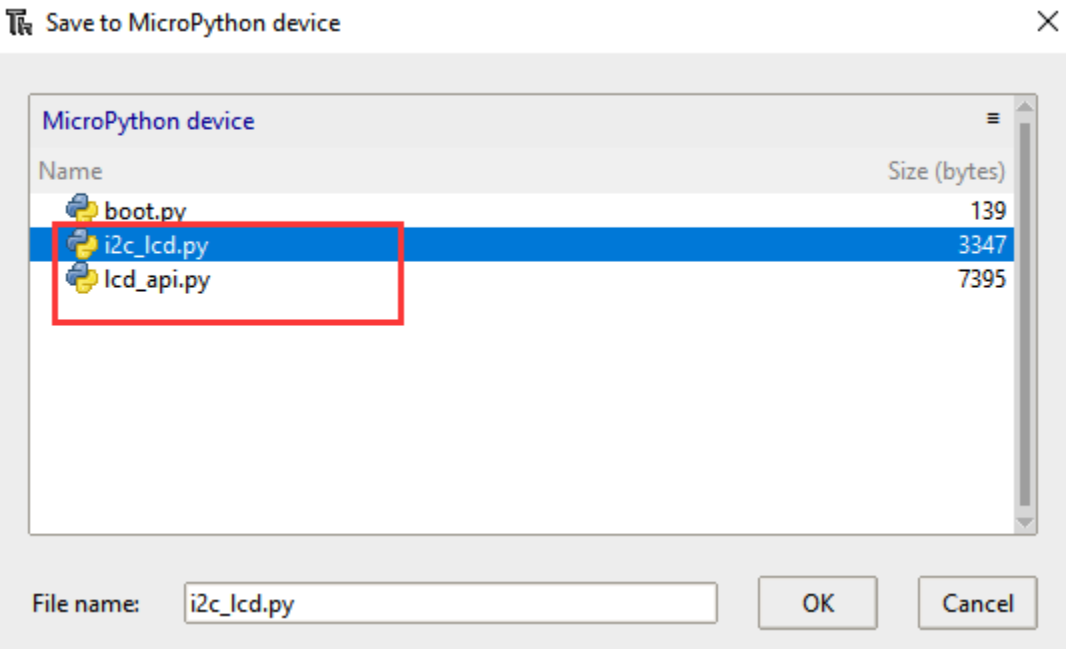
Open the i2c_lcd.py and lcd_api.py



Select File > save as > MicroPython device



The saved name id i2c_lcd.py and lcd_api.py



Test Code

```
from time import sleep_ms, ticks_ms
from machine import I2C, Pin
from i2c_lcd import I2cLcd

DEFAULT_I2C_ADDR = 0x27

i2c = I2C(scl=Pin(22), sda=Pin(21), freq=400000)
lcd = I2cLcd(i2c, DEFAULT_I2C_ADDR, 2, 16)

lcd.move_to(1, 0)
lcd.putstr('Hello')
lcd.move_to(1, 1)
lcd.putstr('keyestudio')

# The following line of code should be tested
# using the REPL:

# 1. To print a string to the LCD:
#    lcd.putstr('Hello world')
# 2. To clear the display:
#lcd.clear()
# 3. To control the cursor position:
# lcd.move_to(2, 1)
# 4. To show the cursor:
# lcd.show_cursor()
# 5. To hide the cursor:
#lcd.hide_cursor()
# 6. To set the cursor to blink:
#lcd.blink_cursor_on()
```

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```
# 7. To stop the cursor on blinking:
#lcd.blink_cursor_off()
# 8. To hide the currently displayed character:
#lcd.display_off()
# 9. To show the currently hidden character:
#lcd.display_on()
# 10. To turn off the backlight:
#lcd.backlight_off()
# 11. To turn ON the backlight:
#lcd.backlight_on()
# 12. To print a single character:
#lcd.putchar('x')
# 13. To print a custom character:
#happy_face = bytearray([0x00, 0x0A, 0x00, 0x04, 0x00, 0x11, 0x0E, 0x00])
#lcd.custom_char(0, happy_face)
#lcd.putchar(chr(0))
```

Test Result

The first line of the LCD1602 shows hello and the second line shows keyestudio.

6.2.23 Project 8.2 Dangerous Gas Alarm

1. Description

When a gas sensor detects a high concentration of dangerous gas, the buzzer will sound an alarm and the display will show dangerous.

2. Component Knowledge

MQ2 Smoke Sensor:

It is a gas leak monitoring device for homes and factories, which is suitable for liquefied gas, benzene, alkyl, alcohol, hydrogen as well as smoke detection. Our sensor leads to digital pin D and analog output pin A, which is connected to D as a digital sensor in this project .

3. Control Pin

Gas Sensor	23

4. Test Code

```
from time import sleep_ms, ticks_ms
from machine import I2C, Pin
from i2c_lcd import I2cLcd

DEFAULT_I2C_ADDR = 0x27

i2c = I2C(scl=Pin(22), sda=Pin(21), freq=400000)
lcd = I2cLcd(i2c, DEFAULT_I2C_ADDR, 2, 16)

from machine import Pin
import time
gas = Pin(23, Pin.IN, Pin.PULL_UP)

while True:
    gasVal = gas.value()  # Reads the value of button 1
    print("gas =",gasVal)  #Print it out in the shell
    lcd.move_to(1, 1)
    lcd.putstr('val: {}'.format(gasVal))
    if(gasVal == 1):
        #lcd.clear()
        lcd.move_to(1, 0)
        lcd.putstr('Safety       ')
    else:
        lcd.move_to(1, 0)
        lcd.putstr('dangerous')
    time.sleep(0.1) #delay 0.1s
```

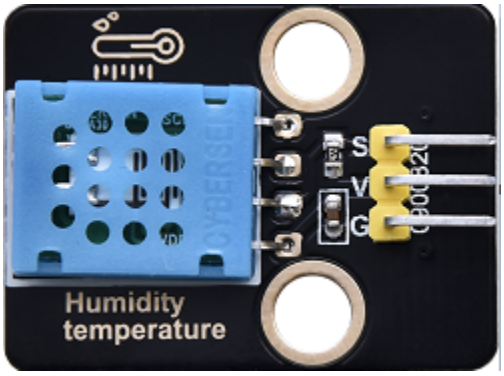
Test Result

The screen displays “safety” in normal state. However, when the gas sensor detects some dangerous gases, such as carbon monoxide, at a certain concentration, the buzzer will sound an alarm and the screen displays “dangerous”.

6.2.24 Project 9: Temperature and Humidity Sensor

Component Knowledge

Its communication mode is serial data and single bus. The temperature measurement range is -20 ~ +60℃, accuracy is ±2℃. However, the humidity range is 5 ~ 95%RH, the accuracy is ±5%RH.



Control Pin

Temperature and Humidity Sensor	17

6.2.25 Project 9.1 Temperature and Humidity Tester

1. Test Code

```
# Import machine, time and dht modules.
import machine
import time
import dht
from time import sleep_ms, ticks_ms
from machine import I2C, Pin
from i2c_lcd import I2cLcd

#Associate DHT11 with Pin(17).
DHT = dht.DHT11(machine.Pin(17))

DEFAULT_I2C_ADDR = 0x27

i2c = I2C(scl=Pin(22), sda=Pin(21), freq=400000)
lcd = I2cLcd(i2c, DEFAULT_I2C_ADDR, 2, 16)
```

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```
while True:
    DHT.measure() # Start DHT11 to measure data once.
# Call the built-in function of DHT to obtain temperature and humidity data and print␣
↪them in “Shell”.
    print('temperature:',DHT.temperature(),'℃','humidity:',DHT.humidity(),'%')
    lcd.move_to(1, 0)
    lcd.putstr('T: {}'.format(DHT.temperature()))
    lcd.move_to(1, 1)
    lcd.putstr('H: {}'.format(DHT.humidity()))
    time.sleep_ms(1000)
```

2. Test Result

The LCD1602 displays the temperature (T = ** ° C) and humidity (H = ** %RH). When you breathe into the T/H sensor, you can see that the humidity rises.

6.2.26 Project 10: RFID RC522 Module

Component Knowledge

Radio frequency identification, the card reader is composed of a radio frequency module and a high-level magnetic field. The Tag transponder is a sensing device, which doesn't contain a battery. It only contains tiny integrated circuit chips and media for storing data and antennas for receiving and transmitting signals.

To read the data in the tag, first put it into the reading range of the card reader. The reader will generate a magnetic field, which can produce electricity according to Lenz's law, then the RFID tag will supply power, thereby activating the device.

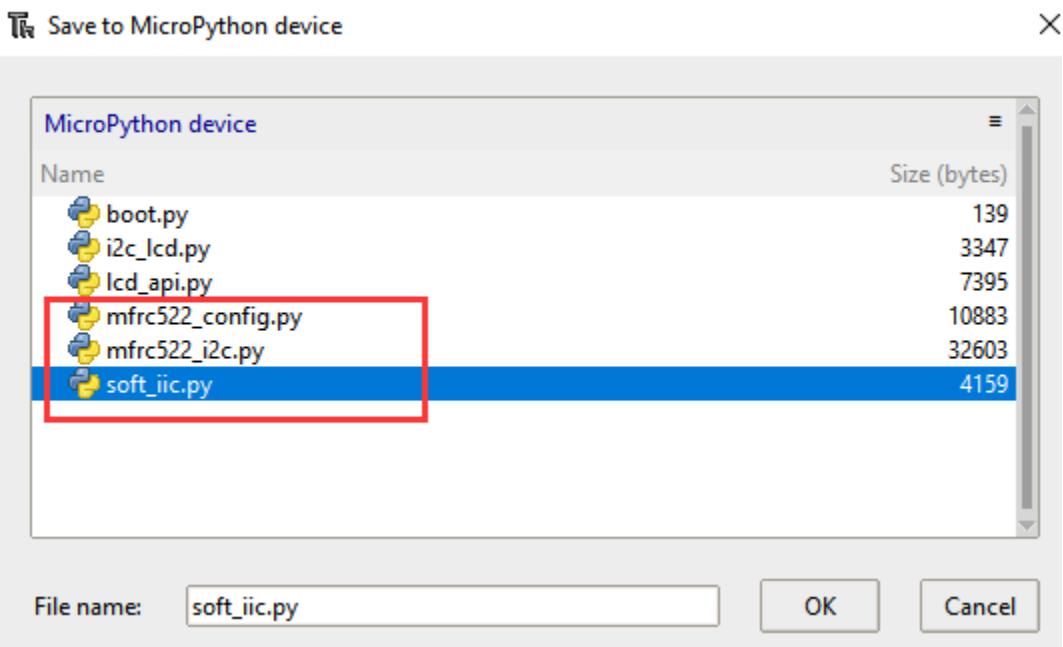
Control Pins

Use IIC communication

SDA	SDA
SCL	SCL

6.2.27 Project 10.1 Open the Door

1. Test Code




```
from machine import Pin, PWM,I2C, Pin
import time
from mfrc522_i2c import mfrc522
pwm = PWM(Pin(13))
pwm.freq(50)
button1 = Pin(16, Pin.IN, Pin.PULL_UP)
#i2c config
addr = 0x28
scl = 22
sda = 21

rc522 = mfrc522(scl, sda, addr)
rc522.PCD_Init()
rc522.ShowReaderDetails() # Show details of PCD - MFRC522 Card Reader details

data = 0

while True:
    if rc522.PICC_IsNewCardPresent():
        #print("Is new card present!")
        if rc522.PICC_ReadCardSerial() == True:
            print("Card UID:")
            #print(rc522.uid.uidByte[0 : rc522.uid.size])
            for i in rc522.uid.uidByte[0 : rc522.uid.size]:
                data = data + i
        print(data)
        if(data == 656):
            pwm.duty(128)
```

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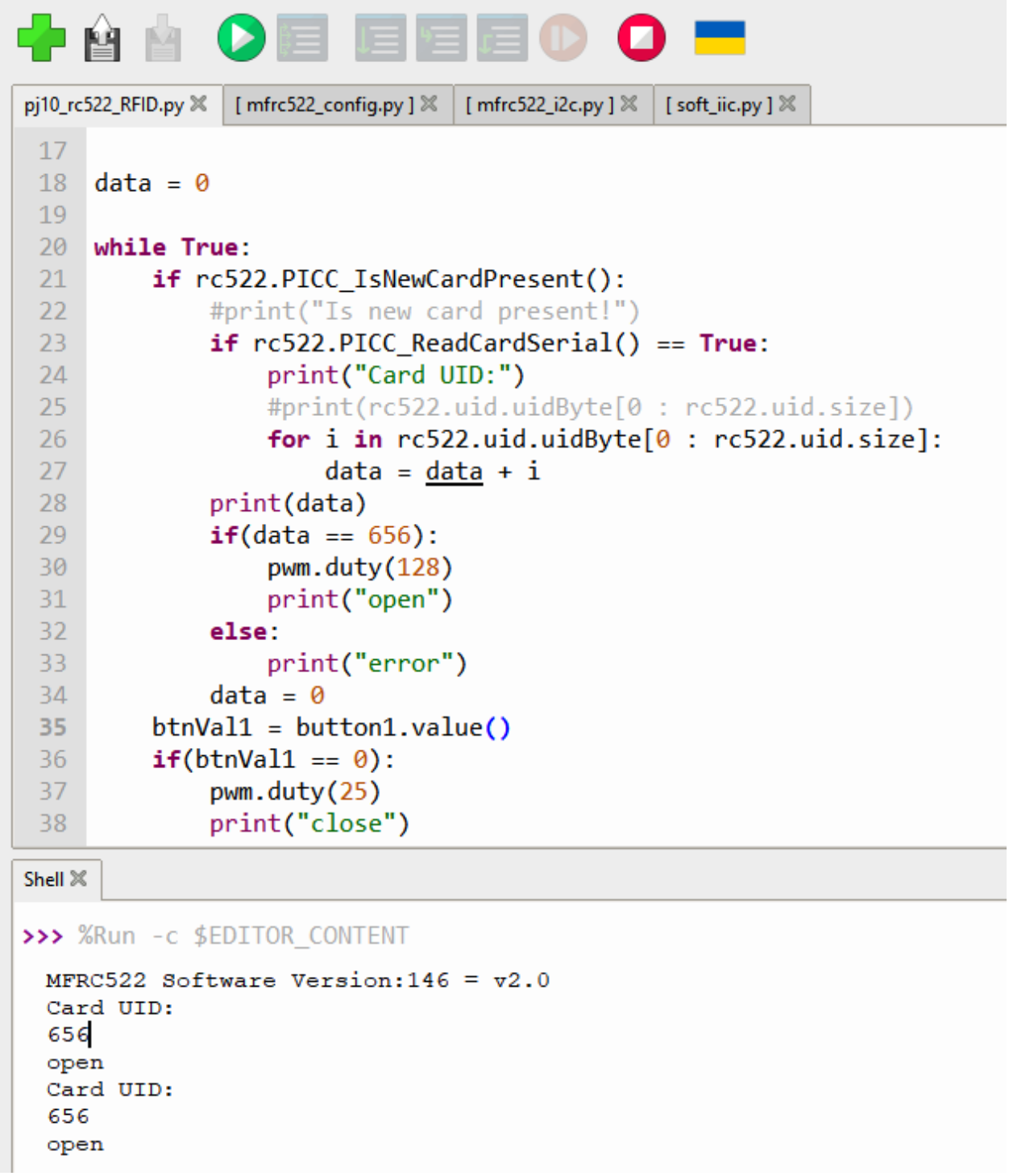
```
            print("open")
        else:
            print("error")
        data = 0
    btnVal1 = button1.value()
    if(btnVal1 == 0):
        pwm.duty(25)
        print("close")
    time.sleep(1)
```

2. Test Result

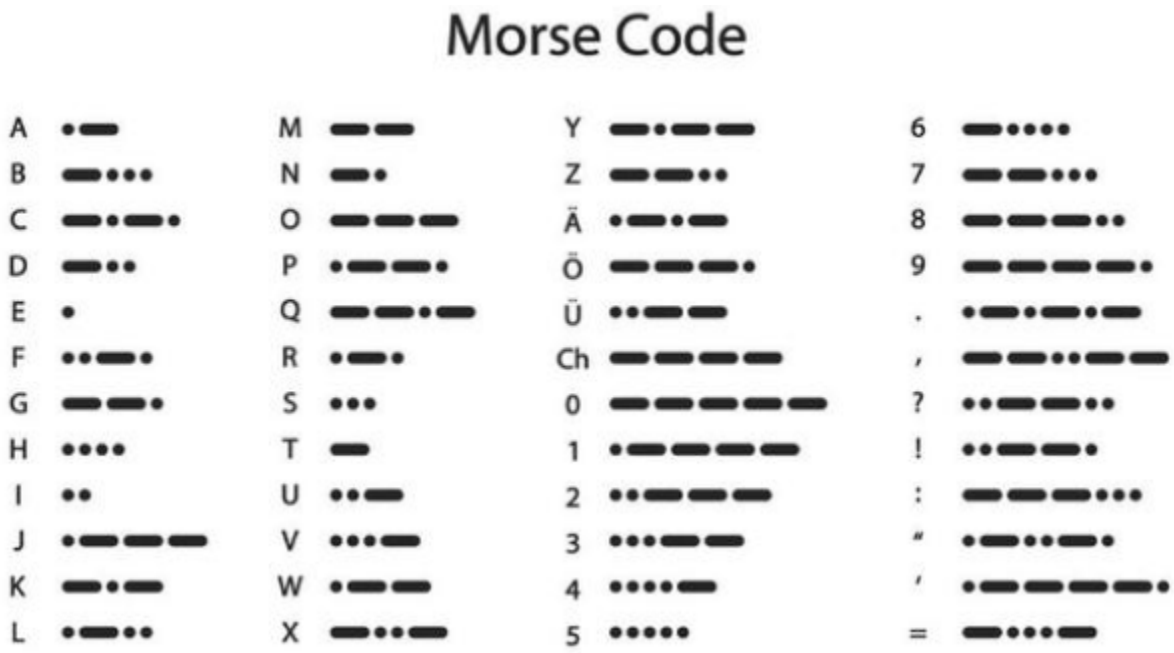
Close the provided card to the RFID induction area, the door will turn and open, and the shell shows “open”. Click button 1 and the door turns and closes. However, when swiping another blue induction block, the shell shows “Error”.


pj10_rc522_RFID.py
[mfrc522_config.py]
[mfrc522_i2c.py]
[soft_iic.py]
17
18 data = 0
19
20 while True:
21 if rc522.PICC_IsNewCardPresent():
22 #print("Is new card present!")
23 if rc522.PICC_ReadCardSerial() == True:
24 print("Card UID:")
25 #print(rc522.uid.uidByte[0 : rc522.uid.size])
26 for i in rc522.uid.uidByte[0 : rc522.uid.size]:
27 data = data + i
28 print(data)
29 if(data == 656):
30 pwm.duty(128)
31 print("open")
32 else:
33 print("error")
34 data = 0
35 btnVal1 = button1.value()
36 if(btnVal1 == 0):
37 pwm.duty(25)
38 print("close")
Shell
>>> %Run -c $EDITOR_CONTENT
MFRC522 Software Version:146 = v2.0
Card UID:
656
open
Card UID:
656
open

6.2.28 Project 11: Morse Code

Morse code, also known as Morse password, is an on-again, off-again signal code that expresses different letters, numbers, and punctuation marks in different sequences. Now we use it as our password gate.

The Morse code corresponds to the following characters:



6.2.29 Project 11.1 Morse Code Open the Door

1. Description

We use  as the correct password. What's more, there is a button library file OneButton, which is very simple to click, double click, long press and other functions. For Morse password, click is ".", long press and release is "-".

2. Test Code

```
# Import machine, time and dht modules.
from machine import Pin, PWM
from time import sleep_ms, ticks_ms
from machine import I2C, Pin
from i2c_lcd import I2cLcd

DEFAULT_I2C_ADDR = 0x27

i2c = I2C(scl=Pin(22), sda=Pin(21), freq=400000)
lcd = I2cLcd(i2c, DEFAULT_I2C_ADDR, 2, 16)

button1 = Pin(16, Pin.IN, Pin.PULL_UP)
```

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```
button2 = Pin(27, Pin.IN, Pin.PULL_UP)
count = 0
time_count = 0
password = ""   #Enter password
correct_password = "-.-"  #Correct password
lcd.putstr("Enter password")
pwm = PWM(Pin(13))
pwm.freq(50)

while True:
    btnVal1 = button1.value()  # Read the value of button 1
    if(btnVal1 == 0):
        sleep_ms(10)
        while(btnVal1 == 0):
            time_count = time_count + 1  #Start counting the pressed time of the button
            sleep_ms(200)                #The time is 200ms cumulative
            btnVal1 = button1.value()
            if(btnVal1 == 1):
                count = count + 1
                print(count)
                print(time_count)
                if(time_count > 3):      #If the pressed time of the button is more than␣
↪200*3msadd"-" to  password
                    lcd.clear()
                    #lcd.move_to(1, 1)
                    password = password + "-"
                else:
                    lcd.clear()
                    password = password + "."  #Otherwise add "."
                lcd.putstr('{}'.format(password))
                time_count = 0

    btnVal2 = button2.value()
    if(btnVal2 == 0):
        if(password == correct_password):  #If the password is correct
            lcd.clear()
            lcd.putstr("open")
            pwm.duty(128)  #Open the door
            password = ""  #Remove the password
            sleep_ms(1000)
        else:              #If the password is wrong
            lcd.clear()
            lcd.putstr("error")
            pwm.duty(25)  #Close the door
            sleep_ms(2000)
            lcd.clear()
            lcd.putstr("enter again")
            password = ""  #Remove the password
```

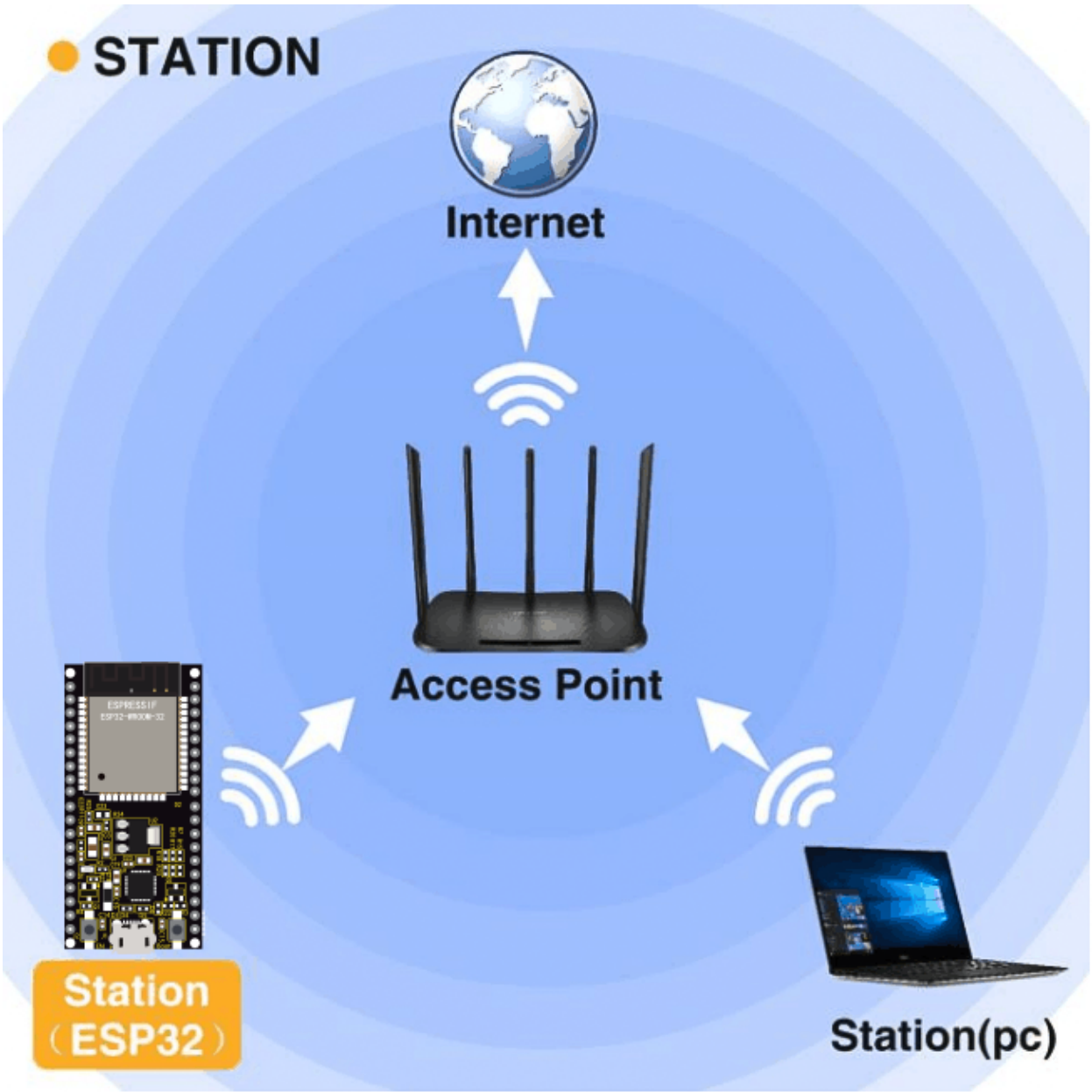
Test Result

At first, the LCD1602 displays “Enter password”, then click or long press button 1 to tap the password. If we input the correct password “-.-”, then click button 2, the door will open, and the LCD1602 will display “open”.

If other incorrect passwords are entered, the door will be closed and the LCD1602 will display error, which shows “enter again” 2s later.

6.2.30 Project 12: WiFi

The easiest way to access the Internet is to use a WiFi to connect. The ESP32 main control board comes with a WiFi module, making our smart home accessible to the Internet easily.



6.2.31 Project 12.1 Smart Home

1. Description

We connect the smart home to a LAN, which is the WiFi in your home or the hot spot of your phone. After the connection is successful, an address will be assigned. We will print the assigned address in the shell.

2. Test Code

Note: ssiD and password in the code should be filled with your own WiFi name and password.

```
import time
import network #Import network module

#Enter correct router name and password
ssidRouter     = 'ChinaNet-2.4G-0DF0' #Enter the router name
passwordRouter = 'ChinaNet@233' #Enter the router password

def STA_Setup(ssidRouter,passwordRouter):
    print("Setup start")
    sta_if = network.WLAN(network.STA_IF) #Set ESP32 in Station mode
    if not sta_if.isconnected():
        print('connecting to',ssidRouter)
#Activate ESP32's Station mode, initiate a connection request to the router
#and enter the password to connect.
```

```
import time
import network #Import network module

#Enter correct router name and password
ssidRouter     = 'ChinaNet-2.4G-0DF0' #Enter the router name
passwordRouter = 'ChinaNet@233' #Enter the router password

def STA_Setup(ssidRouter,passwordRouter):
    print("Setup start")
    sta_if = network.WLAN(network.STA_IF) #Set ESP32 in Station mode
    if not sta_if.isconnected():
        print('connecting to',ssidRouter)
#Activate ESP32's Station mode, initiate a connection request to the router and enter␣
↪the password to connect.
        sta_if.active(True)
        sta_if.connect(ssidRouter,passwordRouter)
#Wait for ESP32 to connect to router until they connect to each other successfully.
        while not sta_if.isconnected():
            pass
#Print the IP address assigned to ESP32 in "Shell".
    print('Connected, IP address:', sta_if.ifconfig())
    print("Setup End")

try:
    STA_Setup(ssidRouter,passwordRouter)
```

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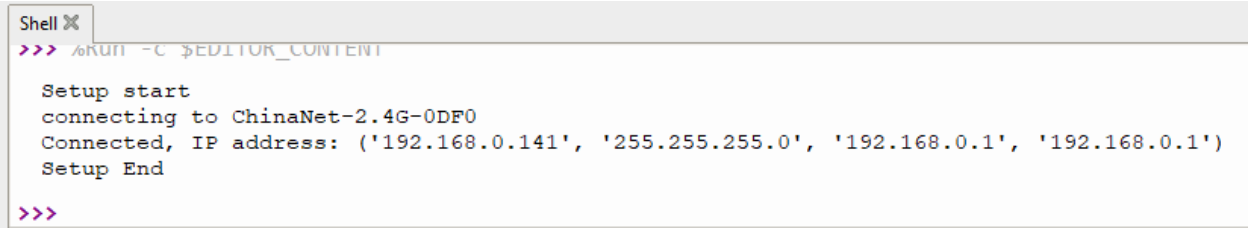
```
except:
    sta_if.disconnect()
```

3. Test Result

If the WiFi is connected successfully, the serial monitor will print out the connected WiFi name and assigned IP address.



6.3 Resources

Download code, libraries and more details, please refer to the following link:

https://fs.keyestudio.com/KS5009