Lesson 2 Color Recognition

1. Working Principle

The color sensor is a sensor with various functions such as recognizing the color of objects, detecting the brightness of the surrounding environment, realizing object proximity detection and non-contact gesture detection, etc.

This lesson will use the color sensor for recognizing and comparing the RGB value of object. These sensors generally determine whether the detected color is consistent with the set one by using RGB (red, green, and blue) LED light sources and the ratio of R, G, and B wavelengths in the reflected light of an object.

The path of the program file: "6. Secondary Development /Sensor-extension Game/Python Development/Color Recognition/Program Files/Color Recognition/main.py".

```
1  import time
2  from machine import Pin, I2C
3  from Ultrasonic import ULTRASONIC
4  from Color_sensor import COLOR
5  from Buzzer import Buzzer
6  from espmax import ESPMax
7  from PWMServo import PWMServo
8  from BusServo import BusServo
9  from RobotControl import RobotControl
10 from SuctionNozzle import SuctionNozzle
11
12
13
14 pwm = PWMServo()
15 buzzer = Buzzer()
16 bus_servo = BusServo()
17 arm = ESPMax(bus_servo)
18 robot = RobotControl()
19 nozzle = SuctionNozzle()
```

Firstly, import the corresponding libraries and initialize ultrasonic sensor and color sensor.

Then read and calculate the RGB value of the object, and print out the color result.

Finally, the ultrasonic sensor emits light of the corresponding color.

2. Preparation

1.1 Hardware

Please assemble the color sensor and ultrasonic sensor to the corresponding position on MaxArm according to the tutorial in folder "Lesson 1 Sensor Assembly" under the same directory.
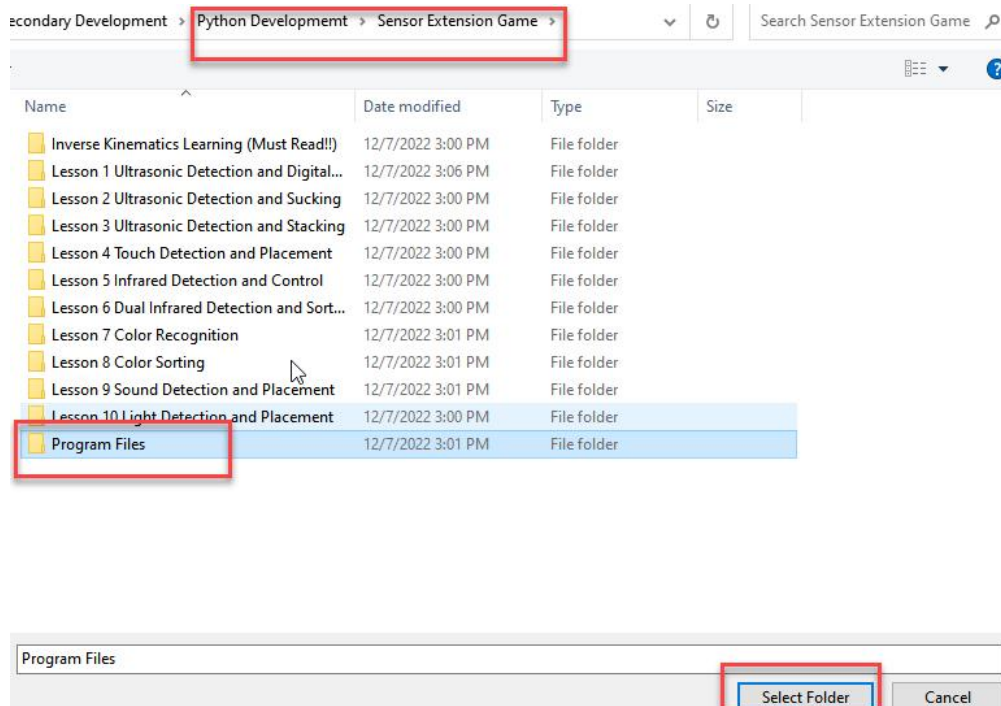
1.2 Software

Please connect MaxArm to Python editor according to the tutorial in folder "4. Underlying Program Learning/Python Development/Lesson 1 Set Development Environment".
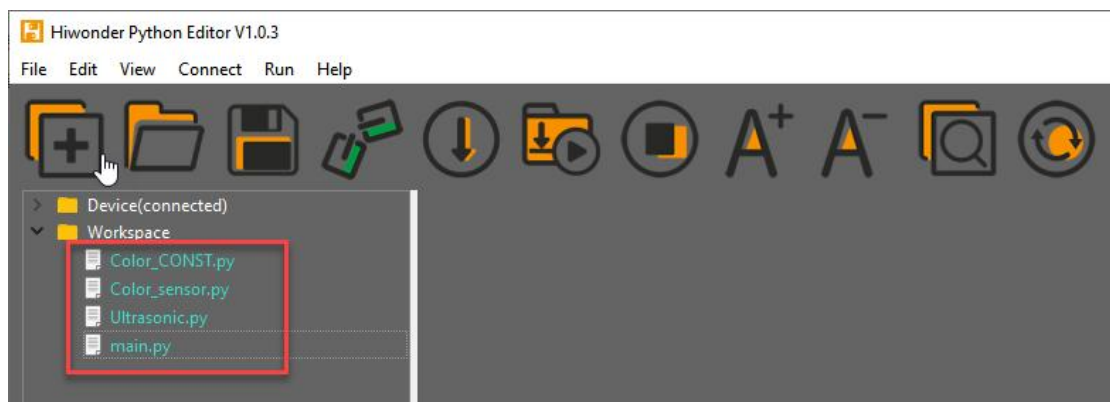
3. Program Download

1) After connecting, change the path of Workspace to "6. Secondary Development /Sensor-extension Game/Python Development/", and select "Program Files".
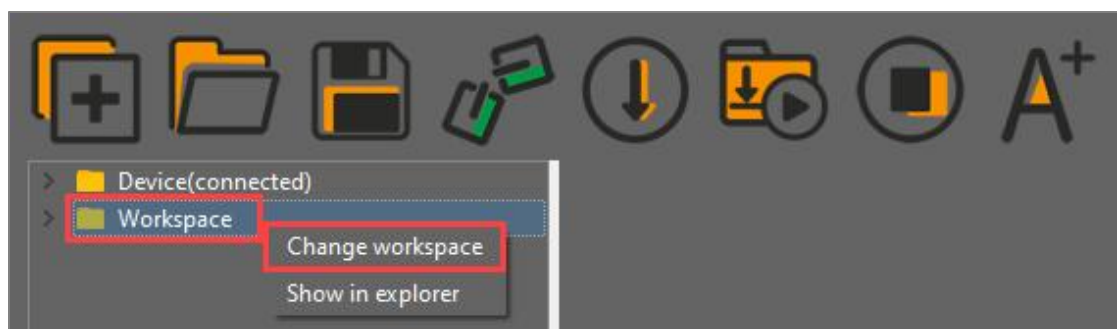
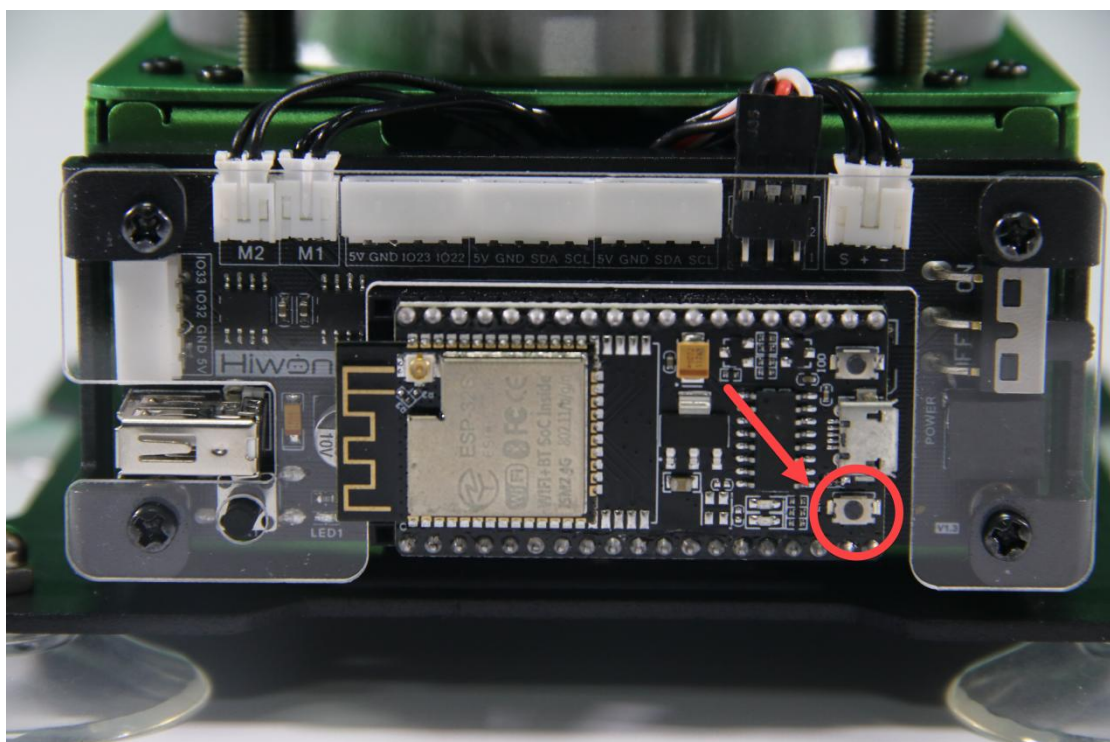2) Click the folder "Color Recognition", and then select all the program files in the folder.

3) Then right click to download all the program files to the controller.

When the terminal prints the prompt as shown in the image below, it means download completed.

4) After downloading, click on the reset icon or press the reset button on ESP32 controller to run program.

4. Project Outcome

After the colored block is detected by the color sensor, the glowing ultrasonic sensor will emit the corresponding color light.

5. Program Instruction

5.1 Import Function Library

Before executing the program, the I2C protocol, ultrasonic sensor, color sensor, buzzer, PWM servo, bus servo, infrared sensor and air pump and other related Python function libraries need to be imported.

The path of the program file "6. Secondary Development/Python Development/Color Recognition/Program Files/Color Recognition/main.py".

```python
1  import time
2  from machine import Pin, I2C
3  from Ultrasonic import ULTRASONIC
4  from Color_sensor import COLOR
5  from Buzzer import Buzzer
6  from espmax import ESPMax
7  from PWMServo import PWMServo
8  from BusServo import BusServo
9  from RobotControl import RobotControl
10 from SuctionNozzle import SuctionNozzle
```

5.2 Color Detection

Use apds.readRedLight(), apds.readGreenLight() and apds.readBlueLight() functions to detect the value of RGB channel of object, and calculate.

```
52        c = apds.readAmbientLight()
53        r = apds.readRedLight()
54        g = apds.readGreenLight()
55        b = apds.readBlueLight()
56        r = int(255 * (r - r_f) / (R_F - r_f))
57        g = int(255 * (g - g_f) / (G_F - g_f))
58        b = int(255 * (b - b_f) / (B_F - b_f))
```

5.3 Control the LED of Ultrasonic Sensor

After calculating the value of RGB channel of object color, determine the color of the object.

```
59     if r > 25 and r > g and r > b: #

60        color = RED
61        print('color: red')
```

Then, the ultrasonic sensor will emit the corresponding light.

```
60        color = RED
61        print('color: red')
62        hwsr06.setRGBValue(bytes([255,0,0, 255,0,0]))
63     elif g > 25 and g > r and g > b:
64        color = GREEN
65        print('color: green')
66        hwsr06.setRGBValue(bytes([0,255,0, 0,255,0]))
67     elif b > 25 and b > g and b > r:
68        color = BLUE
69        print('color: blue')
70        hwsr06.setRGBValue(bytes([0,0,255, 0,0,255]))
71     else:
72        color = 0
73        print('')
74        hwsr06.setRGBValue(bytes([255,255,255, 255,255,255]))
```

Use hwsr06.setRGBValue(bytes()) function to control the LED of the ultrasonic sensor. Take the code "**hwsr06.setRGBValue(bytes([255,0,0, 255,0,0]))**" as example.

The first three parameters "255,0,0" are the color thresholds for the LED on the right side of the senor.

The last three parameters "255,0,0" are the color thresholds for the left LED of the sensor.

At this time, the LED emits red light.