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/Arduino Development/ Program Files/ Color Recognition/ Color_Detect/ Color_Detect.ino”

```
void loop() {
  if (ColorDetect()) {
    float color_num = 0.0;
    for (int i = 0; i < 5; i++) {
      color_num += ColorDetect();
      delay(80);
    }
    color_num = color_num / 5.0;
    if (color_num == 1.0) {
      Serial.println("Red");
      ultrasound.Color(255, 0, 0, 255, 0, 0);
    }
    else if (color_num == 2.0) {
      Serial.println("Green");
      ultrasound.Color(0, 255, 0, 0, 255, 0);
    }
    else if (color_num == 3.0) {
      Serial.println("Blue");
      ultrasound.Color(0, 0, 255, 0, 0, 255);
    }
    else {
      ultrasound.Color(255, 255, 255, 255, 255, 255);
    }
  }
```

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

2.1 Hardware

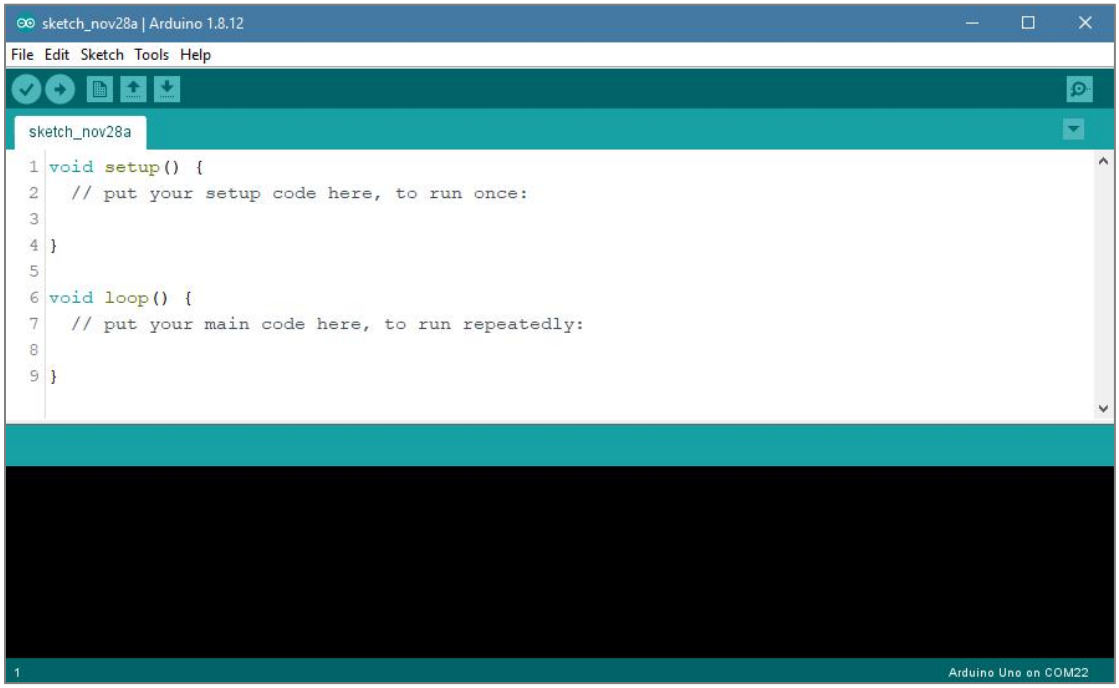
Please assemble the color sensor and ultrasonic sensor to the corresponding position on MaxArm according to the tutorial in folder “Lesson 1 Sensor Assembly” under the same directory.

2.2 Software

Please connect MaxArm to Arduino editor according to the tutorial in folder “4. Underlying Program Learning/Arduino Development/Lesson 1 Set Development Environment”.

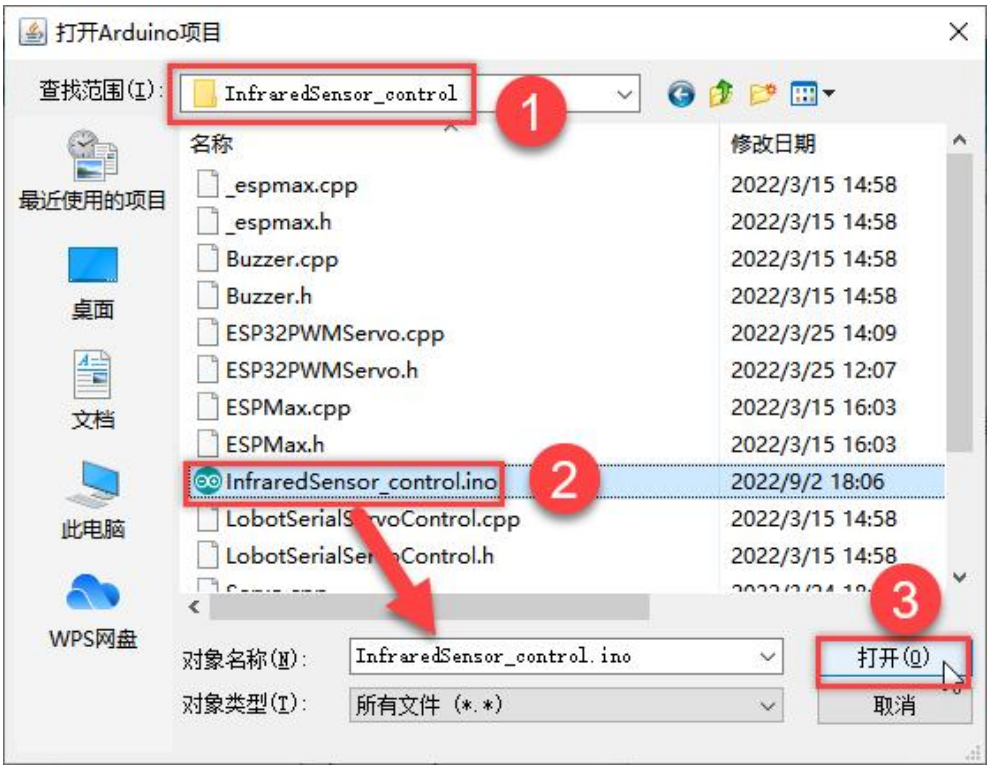
3. Program Download

1) Click on  icon to open Arduino IDE.

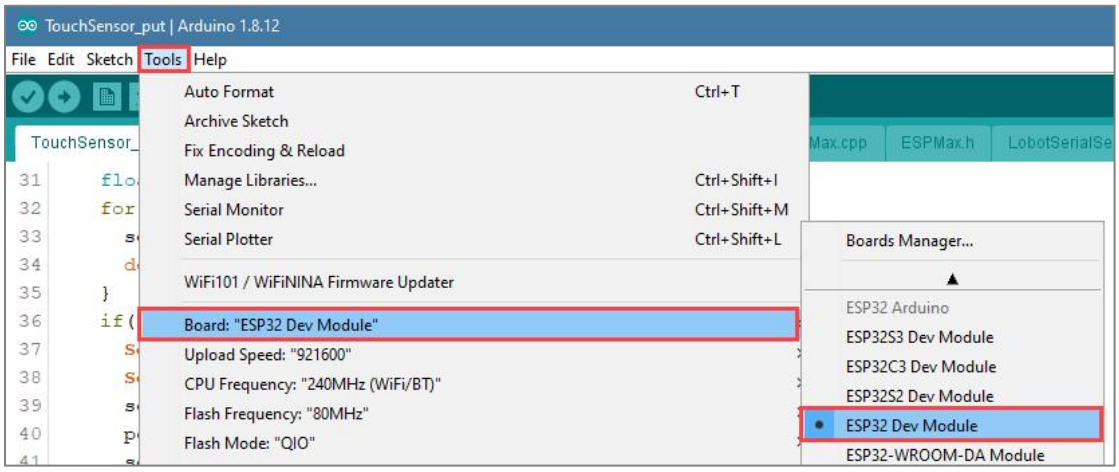


2) Click “File->Open” in turn.

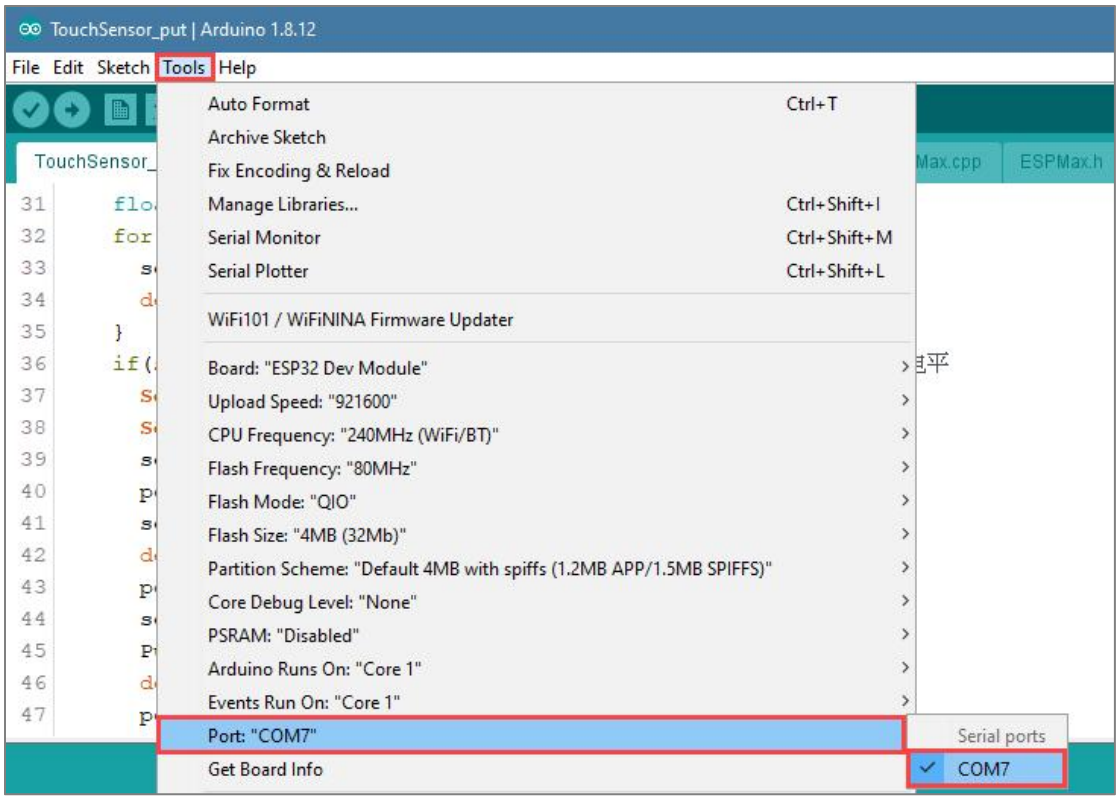
3) Select the program “InfraredSensor_control.ino” in the folder “6.Secondary Development / Sensor-extension Game/Arduino Development/Program Files/Infrared Detection and Control/InfraredSensor_control”.



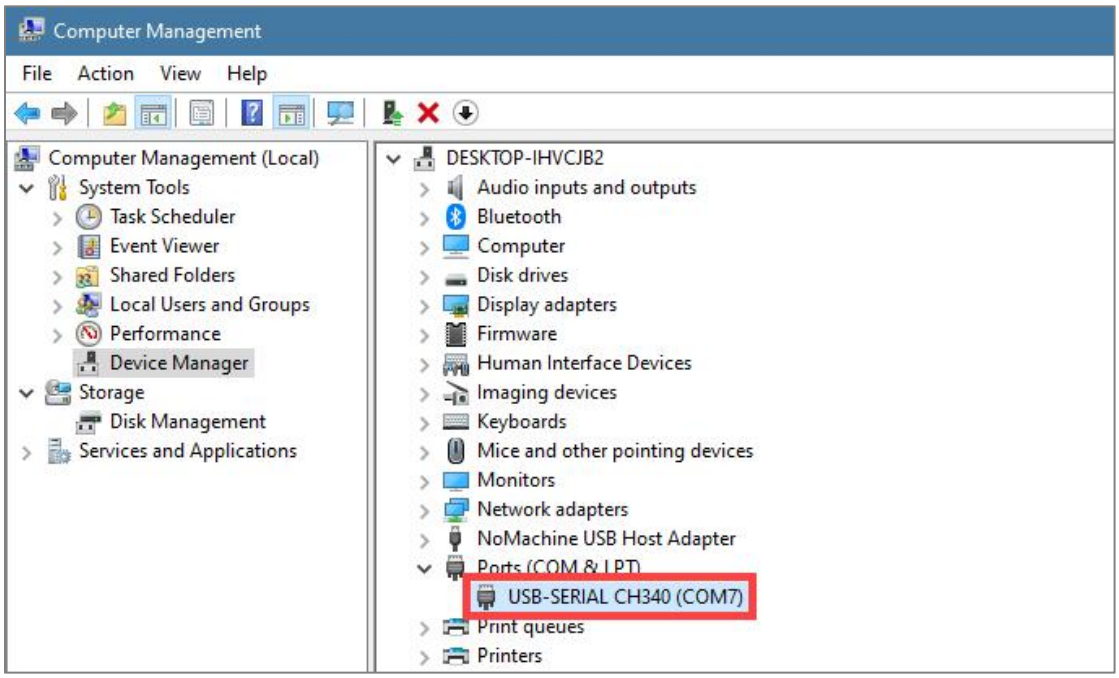
4) Select the model of the development board. Click “Tools-> Board” and select “ESP 32 Dev Module” (If the model of the development board has been configured when setting the development environment, you can skip this step).



5) Select the corresponding port of Arduino controller in “Tools->Port”. (Here take the port “COM5” as example. Please select the port based on your computer. If COM1 appears, please do not select because it is the system communication port but not the actual port of the development port.)

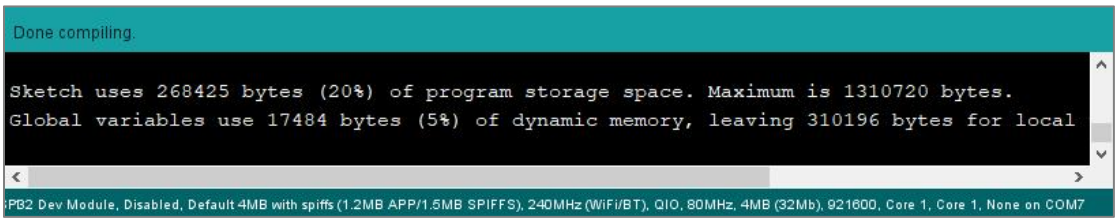


6) If you're not sure about the port number, please open the "This PC" and click "Properties->Device Manger" in turns to check the corresponding port number (the device is with CH340). Then select the correct port on Arduino editor.

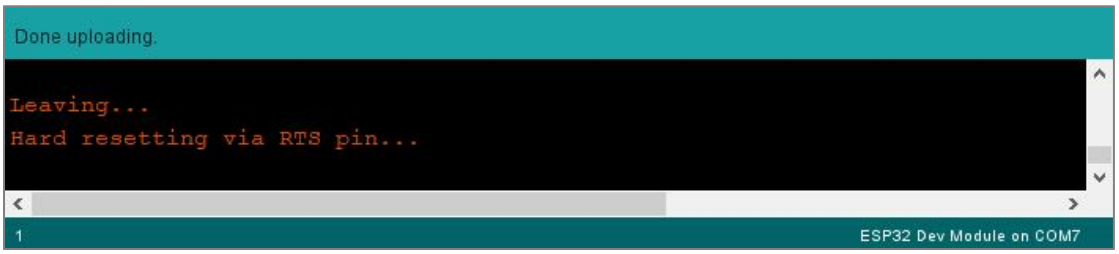


7) After selecting, confirm the board “ESP32 Dev Module” in the lower right corner and the port number “COM5” (it is an example here, please refer to the actual situation).

8) Then click on  icon to verify the program. If no error, the status area will display “Compiling->Compile complete” in turn. After compiling, the information such as the current used bytes, and occupied program storage space will be displayed.

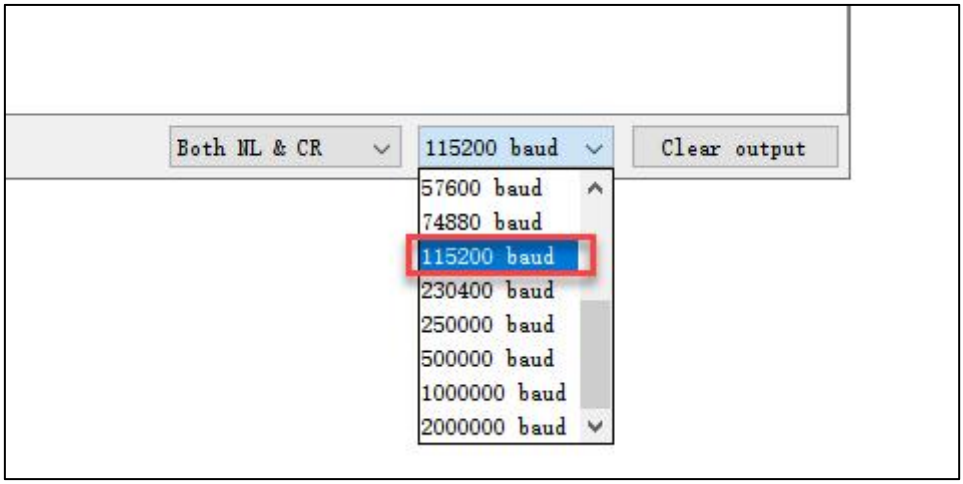


9) After compiling, click on  icon to upload the program to the development board. The status area will display “Compiling->Uploading->Complete” in turn. After uploading, the status area will stop printing the uploading information.



10) Then click on the serial port monitor icon in the upper right corner.

11) Select the baud rate to “115200” in the pop-up window.



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.

```
import time
from machine import Pin, I2C
from Ultrasonic import ULTRASONIC
from Color_sensor import COLOR
from Buzzer import Buzzer
from espmax import ESPMax
from PWMServo import PWMServo
from BusServo import BusServo
from RobotControl import RobotControl
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.

```
    c = apds.readAmbientLight()
    r = apds.readRedLight()
    g = apds.readGreenLight()
    b = apds.readBlueLight()
    r = int(255 * (r - r_f) / (R_F - r_f))
    g = int(255 * (g - g_f) / (G_F - g_f))
    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.

```
    if r > 25 and r > g and r > b: #
        color = RED
        print('color: red')
```

Then, the ultrasonic sensor will emit the corresponding light.

```
    color = RED
    print('color: red')
    hwsr06.setRGBValue(bytes([255,0,0, 255,0,0]))
  elif g > 25 and g > r and g > b:
    color = GREEN #
    print('color: green')
    hwsr06.setRGBValue(bytes([0,255,0, 0,255,0]))
  elif b > 25 and b > g and b > r:
    color = BLUE
    print('color: blue')
    hwsr06.setRGBValue(bytes([0,0,255, 0,0,255]))
  else:
    color = 0
    print('')
    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.