

Lesson 9 Surprise Gift Box

Background Knowledge

Light Sensor

Project Making

Project Description:

Write Program:

Task 1: Achieve rainbow and breathing light effect in light strip

Task 2: Add optical switch function

Appearance Design

On your friend's birthday, do you want to give her/him a special birthday present without spending money? It can be realized through our existing modules. In this lesson, we are going to make a surprise gift box for our friends. What kind of surprise will appear when we open the box? What kind of modules do you need to complete such a surprise gift box? Let's start with questions.

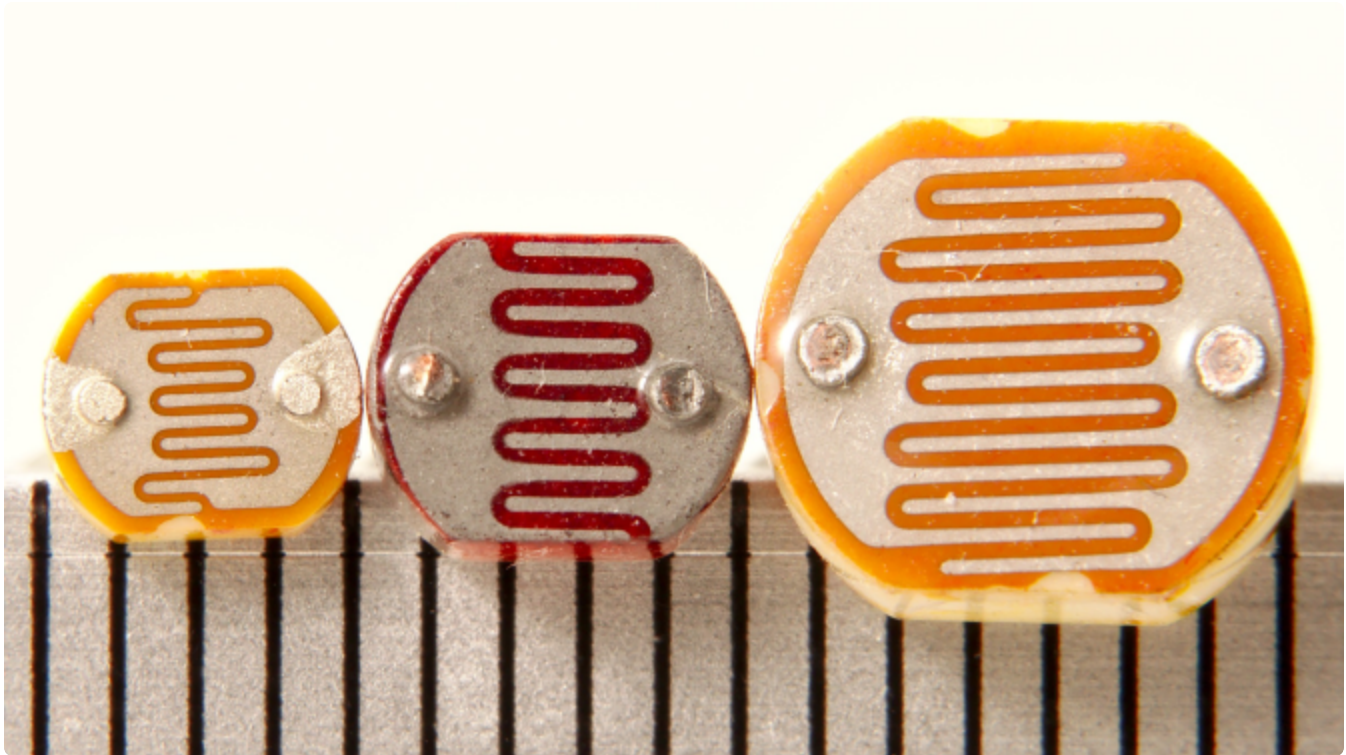
Background Knowledge

Light Sensor

A light sensor detects the intensity of light in the surrounding environment and converts the detected light energy into electrical energy. Light sensors are classified into photoresistance types, photodiode types and phototransistor types. Photoresistance and photodiode types are common in light sensors and will be briefly introduced in the lesson.

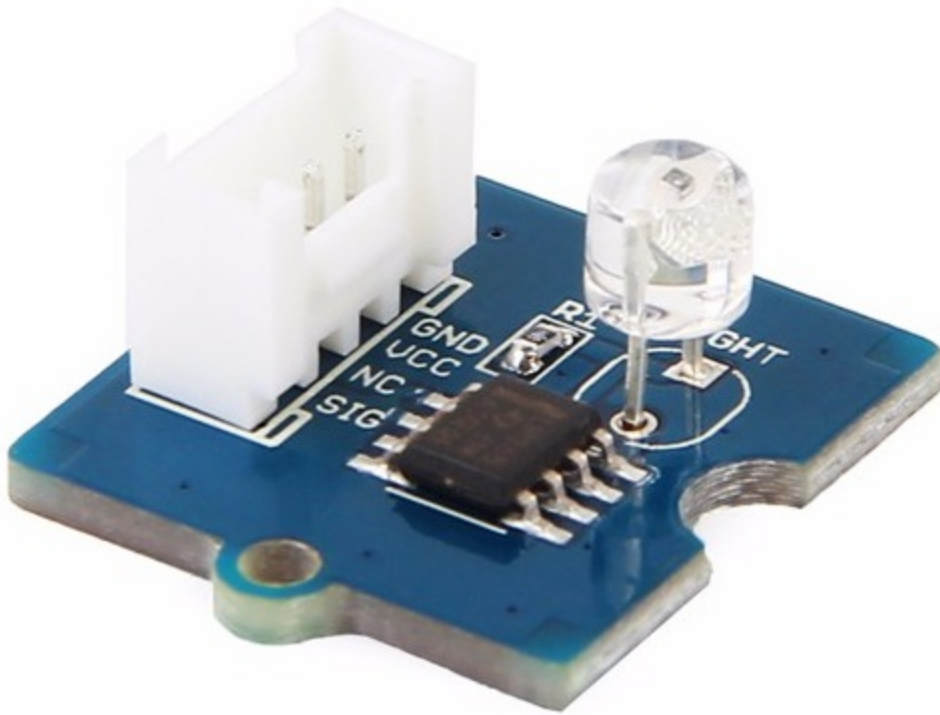
Photoresistance Type

A photoresistor is used in a photoresistor light sensor. As shown in the figure below, a photoresistor is a material whose electrical resistance changes with the intensity of light that it is exposed to. High-intensity light reduces its resistance value, while low-intensity light increases the resistance value. The resistance value of the photoresistor then affects the voltage across other elements in the circuit, such as an LED. In this way, the light intensity of the LED can be controlled.



Photodiode type

Photodiodes are also called photoelectric sensors and photodetectors. When a beam of light hits the diode, the electrons in the tube will quickly disperse to form electron holes, which will lead to greater electrical conductivity, allowing current to pass through. The stronger the light, the more holes are created and the stronger the current. Because the current generated by the photodiode is proportional to the intensity of the light, it is very useful for light detection to change lighting response quickly. The light sensor we are going to use in this lesson is photodiode type.



We can construct the light control switch through the light sensor, for example, control the lights on and off, turn off the lights during the daytime, and turn on the lights at night. The main purpose of light control equipment is to save energy, automatically improve efficiency, light control lamp is the best example, such as light control desk lamp, light control street lamp, road tunnel lighting, etc., which brings convenience to our life at the same time also contribute to environmental protection and energy saving.

RGB LED Strip



Light sensor and RGB LED strips are used together because the light belt is integrated with multiple colored beads. Compared to a single LED, it can achieve more lighting effects and is very suitable for surprise. RGB LED lamps are available in several styles and models, we need WS2813, 30 lamp bead model. The program controls the RGB LED strip to achieve rich lighting effects. Let's learn about its library together.

Open the "simple" example by following the path: **File→Example→Adafruit NeoPixel→simple.**

After opening the sample program, we can see the program as shown below. The program implements that the light strip illuminates 30 beads in turn (green light). This is a simple light strip example and we need to modify some parameters:

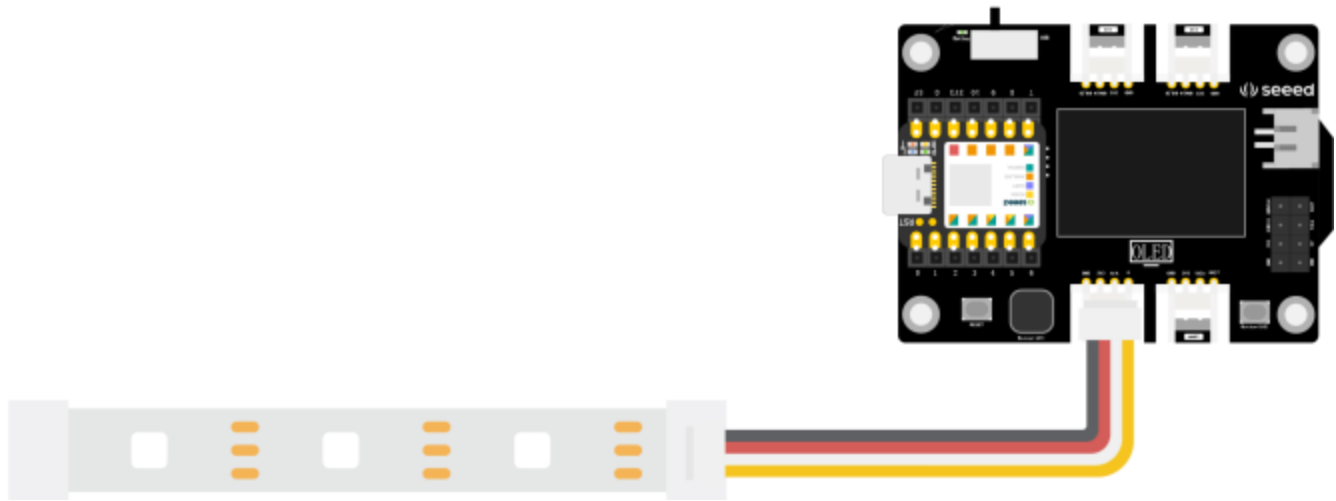
#define PIN 0, we need to modify the pin of the light band connection according to the actual situation, and connect to the A0 interface of XIAO expansion board, so it is PIN 0.

#define NUMPIXELS 30, defines the number of LED lights on the lamp strip, because the number of integrated beads varies with the type of lamp. We use a 30-bead strip, so it is **NUMPIXELS 30**.

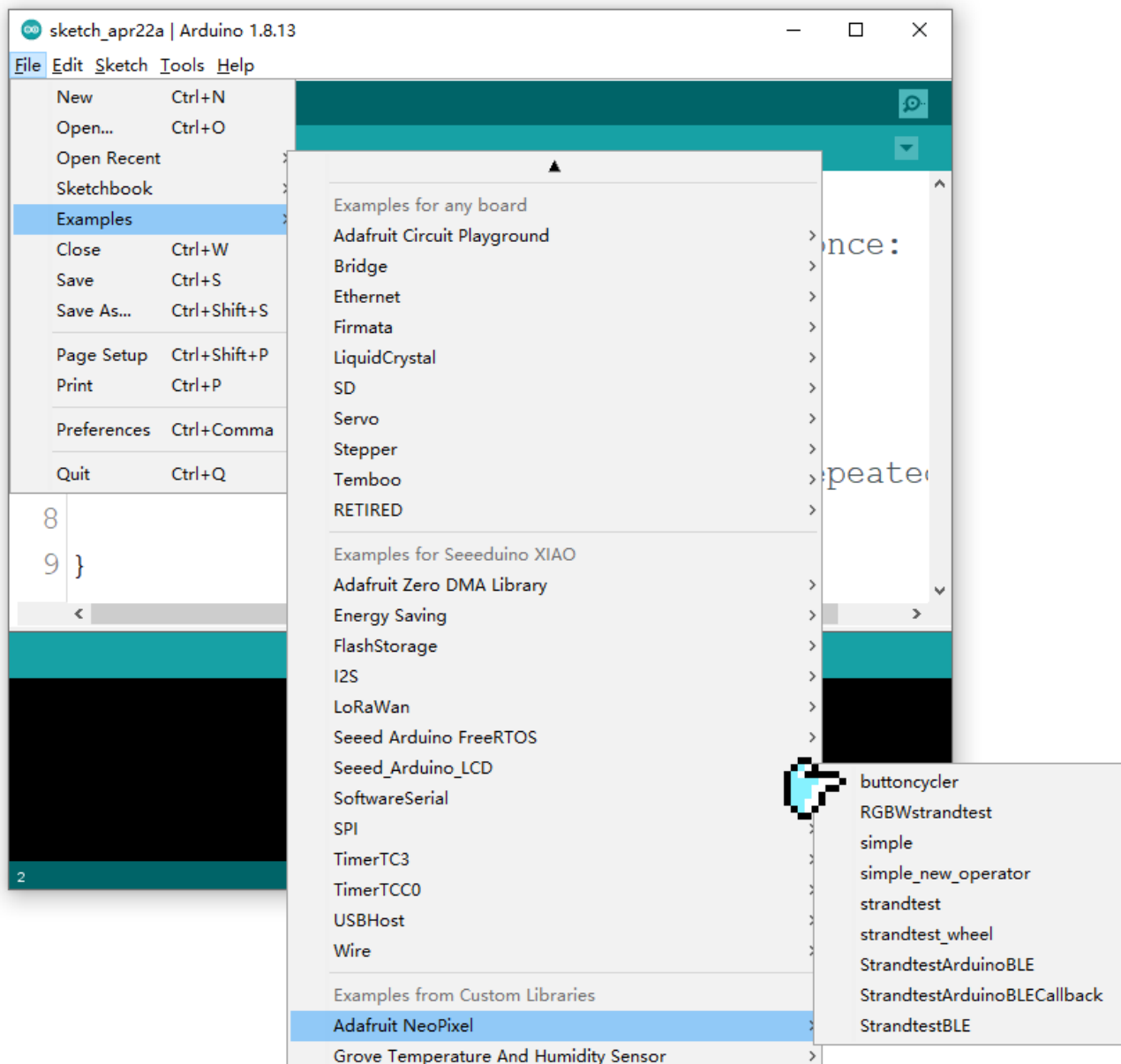
After modifying the parameters, in order to see the code more clearly, we can delete the comment, which occupies a very large space.

```
1  #include <Adafruit_NeoPixel.h>
2  #ifdef __AVR__
3    #include <avr/power.h>
4  #endif
5
6  #define PIN 0 //light strip connect to Pin A0, if you use XIAO RP2040,
   please change 0 to A0
7  #define NUMPIXELS 30 //number of Led on the light strip
8  Adafruit_NeoPixel pixels(NUMPIXELS, PIN, NEO_GRB + NEO_KHZ800); //create a
   new light strip object to define the data pattern
9  #define DELAYVAL 500 //time (in milliseconds) to pause between pixels
10
11 void setup() {
12   #if defined(__AVR_ATtiny85__) && (F_CPU == 16000000)
13     clock_prescale_set(clock_div_1);
14   #endif
15   pixels.begin(); // initialize NeoPixel strip object
16
17 void loop() {
18   pixels.clear(); //Set all pixel colors to 'off'
19   //The first NeoPixel in a strand is #0, second is 1, all the way up to
   the count of pixels minus one.
20   for(int i=0; i<NUMPIXELS; i++) {
21     pixels.setPixelColor(i, pixels.Color(0, 150, 0)); //here we're using a
   moderately bright green color
22     pixels.show(); //send the updated pixel colors to the hardware.
23     delay(DELAYVAL); //pause before next pass through loop
24   }
25 }
```

In the above code, `pixels.Color(0,150,0)` is a function of setting the LED lamp color, the numbers in parentheses respectively represent the three primary colors (red, green, and blue). If it is (0,150,0), it means that the red brightness is 0, the green brightness is 150, and the blue brightness is 0. The whole lamp strips will present the effect of green. The larger the number, the greater the brightness, the maximum is 255. Next, connect the strip to the XIAO expansion board A0 interface as shown in the following figure:



Connect the XIAO **main board** to the computer with a data cable and upload the program to the motherboard. After successful upload, observe the effect of the lamp strips. The light strips can be toned, blinking, breathing and other light effects, we can refer to the library of sample programs. For example, buttoncycler, in the example program, buttons are used to switch the lamp strips to different lamp effects, and we can find codes for various lamp effects in the programs, such as flashing, rainbow lamp, and chasing.



Project Making

Project Description:

Surprise gift box program steps: the light sensor can control the RGB LED strip on and off, just like the light control lamp, but the opposite effect will appear, when the value detected by the light sensor is less than a fixed value, which will turn off RGB LED in a dim environment, when the value detected by the light sensor is greater than a fixed value, which will light up RGB LED strip with rainbow color in a bright environment.

Write Program:

The programming ideas are as follows:

- Declare the files that will be used, create a new light strip object, and define the number of sensor pins and light strip LED lights
- Initialize the light strip and set the light sensor pin mode
- Read the light value, if the light value is greater than 100, the led strip shows rainbow and breathing light effect, otherwise the led strip go out

The program is divided into two tasks:

Task 1: Achieve rainbow and breathing light effect in light strip

Step 1: Declare the files that will be used, create a new light strip object, and define the number of sensor pins and light strip LED lights.

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```

1  #include <Adafruit_NeoPixel.h>
2  #ifdef __AVR__
3  #include <avr/power.h>
4  #endif
5
6  #define PIXEL_PIN 0 //RGB LED strip connect to Pin 0, if you use XIAO
   RP2040, please change 0 to A0
7  #define PIXEL_COUNT 30 //number of NeoPixels
8  Adafruit_NeoPixel strip(PIXEL_COUNT, PIXEL_PIN, NEO_GRB + NEO_KHZ800);
9  //declare our NeoPixel strip object:

```

Step 2: Initialize the light strip.

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```

1  void setup() {
2      strip.begin(); //initialize NeoPixel strip object
3  }

```

Step 3: The light strip now shows the rainbow and breathing light effects. This part uses the for() loop to present the effect of breathing. For example for(i = 0; i<5; i++){} indicates that the initial value i is 0. When i is less than 5, the statement in the loop body {} is run. Each loop is made up of 1, and the loop is made up of 5 times.

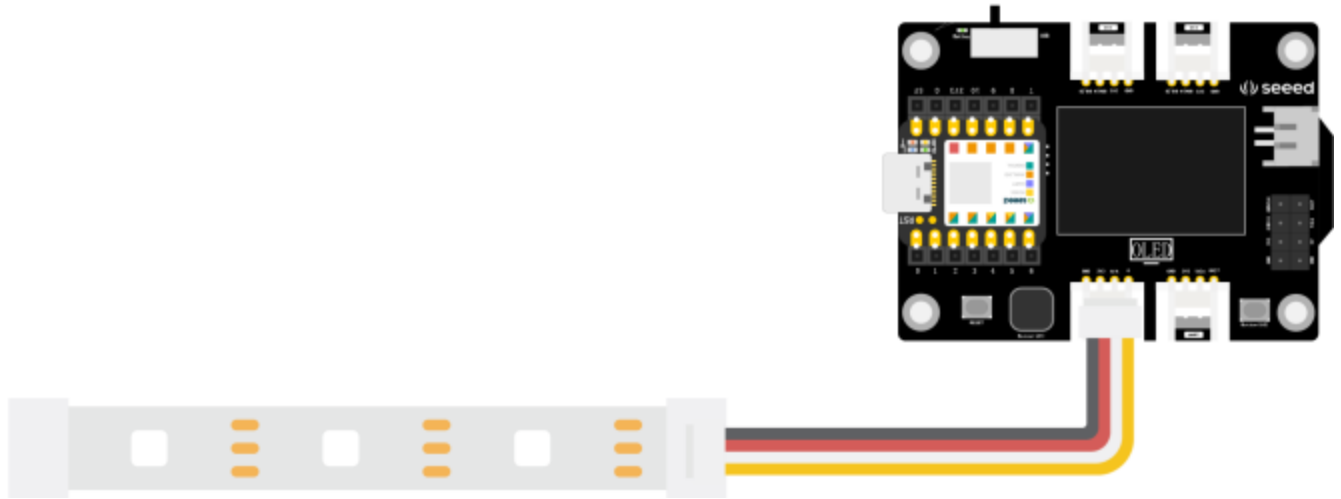

```
1 void loop() {
2     strip.clear();//set all pixels in RAM to 0 (off)
3     rainbow(10);//The light strip show the rainbow light effect, the number
    in brackets represents the speed of the rainbow light flow, when the
    number is smaller, the flow speed is faster
4 }
5 //The following is the rainbow light effect code,
6 //rendering breathing light effect, the code can be found in the example
    program buttoncycler
7 void rainbow(int wait) {
8     for(long firstPixelHue = 0; firstPixelHue < 3*65536; firstPixelHue +=
        256) {
9         for(int i=0; i<strip.numPixels(); i++) {
10             int pixelHue = firstPixelHue + (i * 65536L / strip.numPixels());
11             strip.setPixelColor(i, strip.gamma32(strip.ColorHSV(pixelHue)));
12         }
13         strip.show(); /update strip with new contents
14         delay(wait); // pause for a moment
15     }
16 }
```

Please see details on entire program:

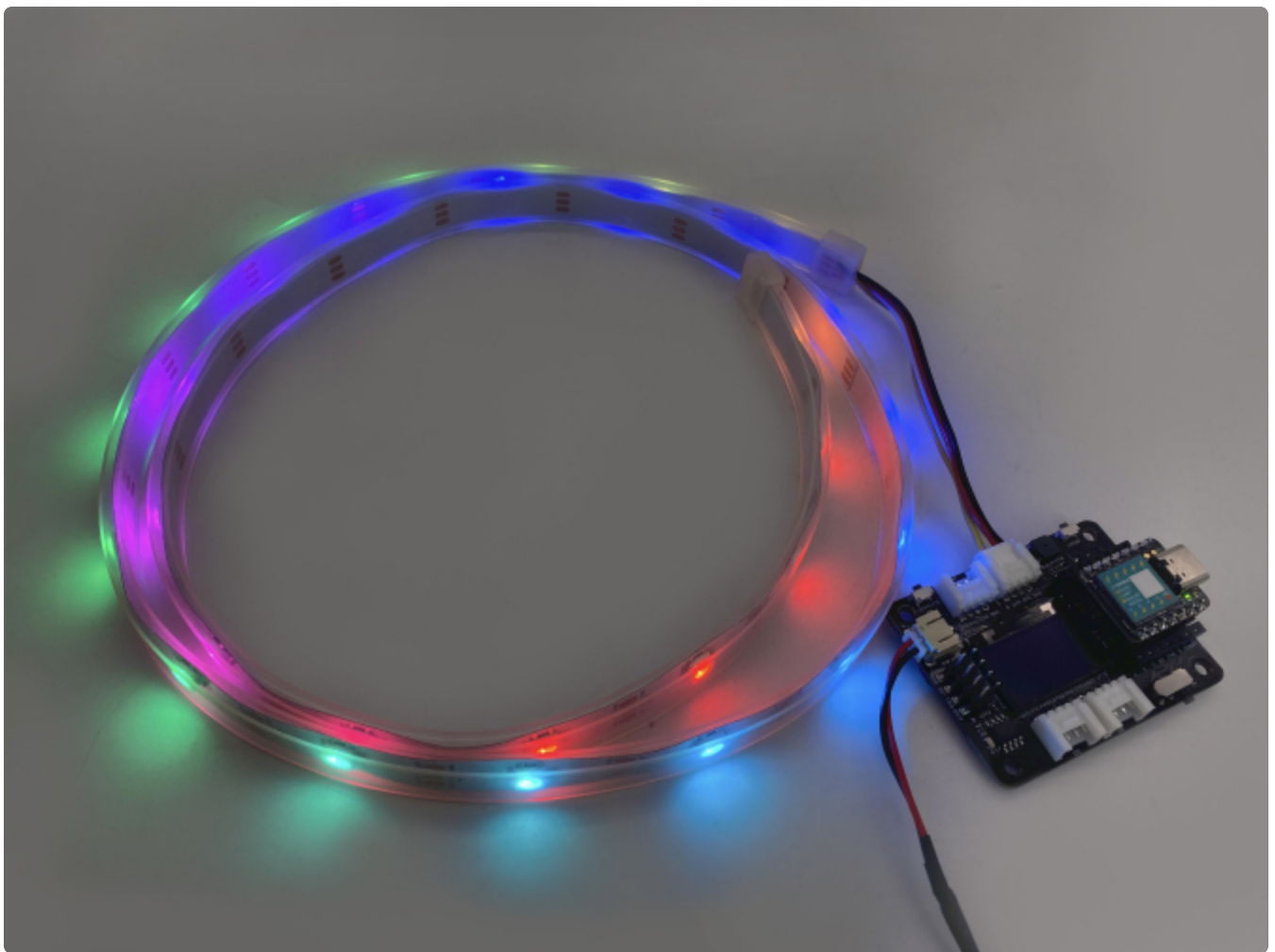


L9-Rainbow.ino

Step 4: Connect the hardware and upload the program. First connect the RGB LED strip to A0/D0 interface of XIAO expansion board, as shown in the figure:



Connect XIAO to the computer with the data cable, and click the "Upload" button to upload the program to the hardware. when "Done uploading" is displayed in the debugging area, observe the lighting effect of the light strip.



Task 2: Add optical switch function

Step1 add code.Read the light value detected by the light sensor, and judge the light value with the statement "If ... else ..." When it is greater than 100 (the value can be adjusted according to the actual environment), the RGB LED strip shows the rainbow breathing light effect.

Added program part:

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```
1 //partial program, do not run
2 #define LIGHT_PIN 7//the number of light pin, If you use XIAO RP2040,
  please change 7 to A3, if you use XIAO BLE, please change 7 to 5.
3 #define PIXEL_PIN 0//define the light strip, if you use XIAO RP2040,
  please change 0 to A0
4 int readValue = 0;//define the variable readValue and store the light
  value
5 void setup() {
6     pinMode(LIGHT_PIN , INPUT); //set the pin of the light sensor as the
  input state
7 }
8 void loop() {
9     readValue = analogRead(A7);//read the ray analog value at pin A7 and
  stores it in the readValue variable.If you use XIAO RP2040, please change
  A7 to A3, if you use XIAO BLE, please change A7 to A5.
10    if(readValue > 100){ //judging by the condition, if the light value
  is greater than 100, the rgb led strip exhibits rainbow lamp effect;
  otherwise, the lamp strip is extinguished
11        rainbow(10);
12    }else {
13        strip.clear();
14        strip.show();
15    }
16 }
```

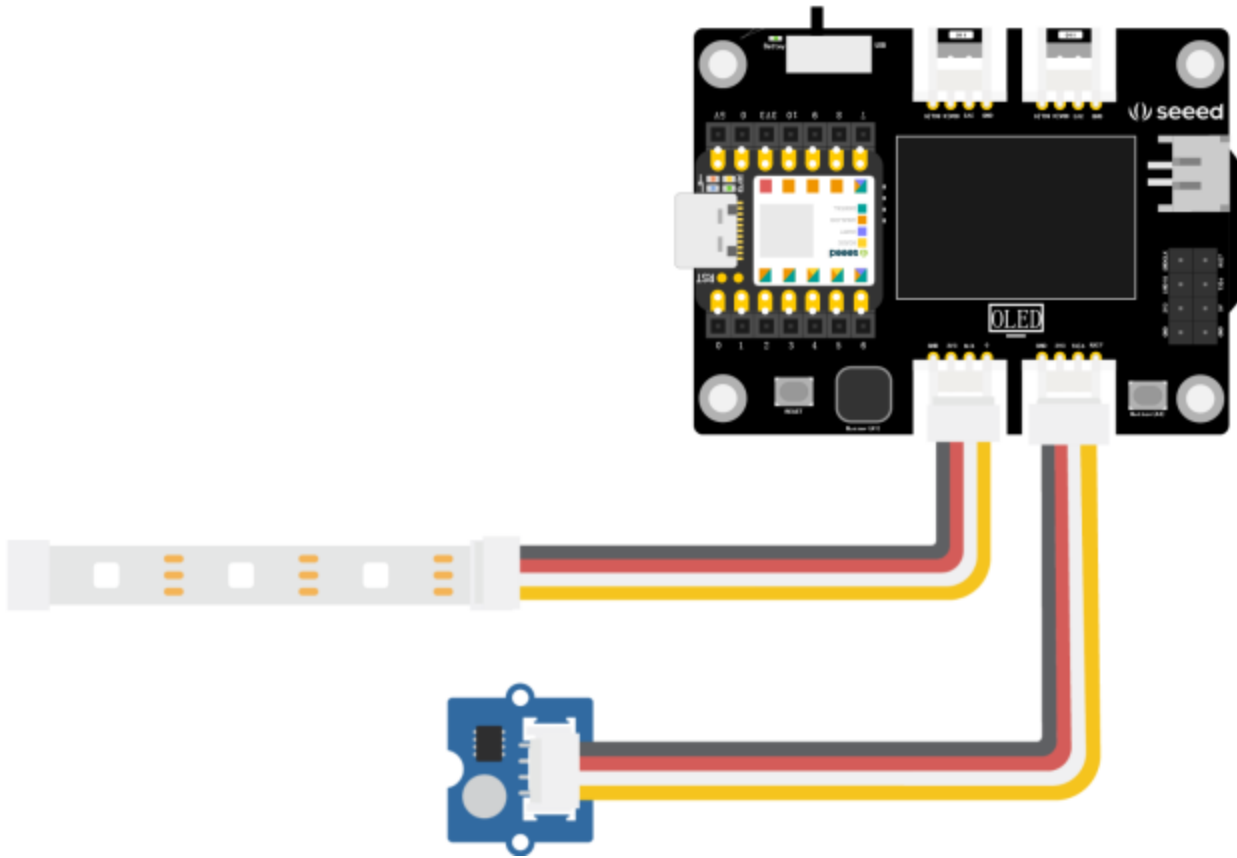
We place the added statement in the corresponding position of the task-one program,Please see details on entire program.



L9-StripLight.in



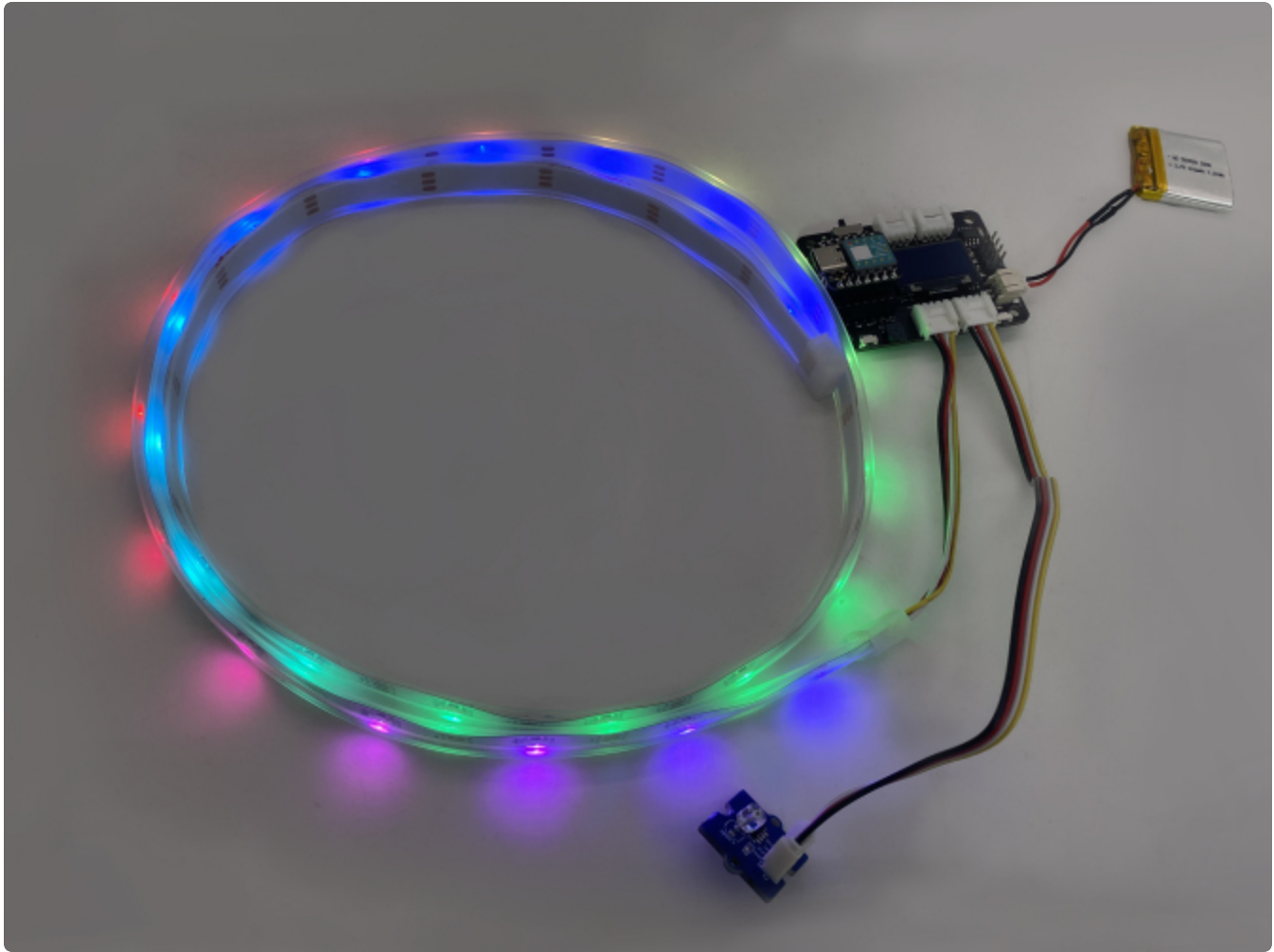
Step2:Connect the hardware and upload the program.Connect the RGB LED strip to the A0/D0 interface of the XIAO expansion board and connect the light sensor to the A7 interface, as shown in the figure:



If you are using XIAO BLE, please connect the light sensor to the I2C interface of the expansion board.

If you use XIAO RP2040, you need to connect the SIG pins of the light sensor and A3 pins of XIAO RP2040 by yourself using cable because of the limited pinout.

Next, XIAO is connected to the computer by the data cable, and then click the "Upload" button to upload the program to the hardware. when "Done uploading" is displayed in the debugging area, we can cover the light sensor with our hands, and then release the light sensor to observe the changes of the light strip. Because the strip takes time to show the light effect, it will not go out immediately when you cover the light sensor.



Appearance Design

It might be helpful to visualise how your surprise gift box will behave. For example, you might want your RGB LED lights to go out when your light sensor is in a dark environment, and for rainbow lights to go on once it is in a bright environment. This mirrors your electronics being placed in a dark, closed box; the lights should turn on only when it is open and exposed to surrounding light! Of course, your creativity might lead you to develop other designs!

Product name	Surprise Gift Box
Product characteristics	Cool lighting, light control, surprise, birthday
Product characteristics	Controlling the On/Off of RGB LED strip with Light Sensor
Product function	

References:

