Lesson 24 HC-SR501 PIR Sensor

Introduction

In this lesson, you will learn how to use a PIR movement detector with a UNO R3.

Hardware Required

- ✓ 1 * RuiiGuu UNO R3
- ✓ 1 * HC-SR501 PIR motion sensor
- ✓ 3 * F-M Jumper Wires
- ✓ 1 * 5mm RED LED

Principle

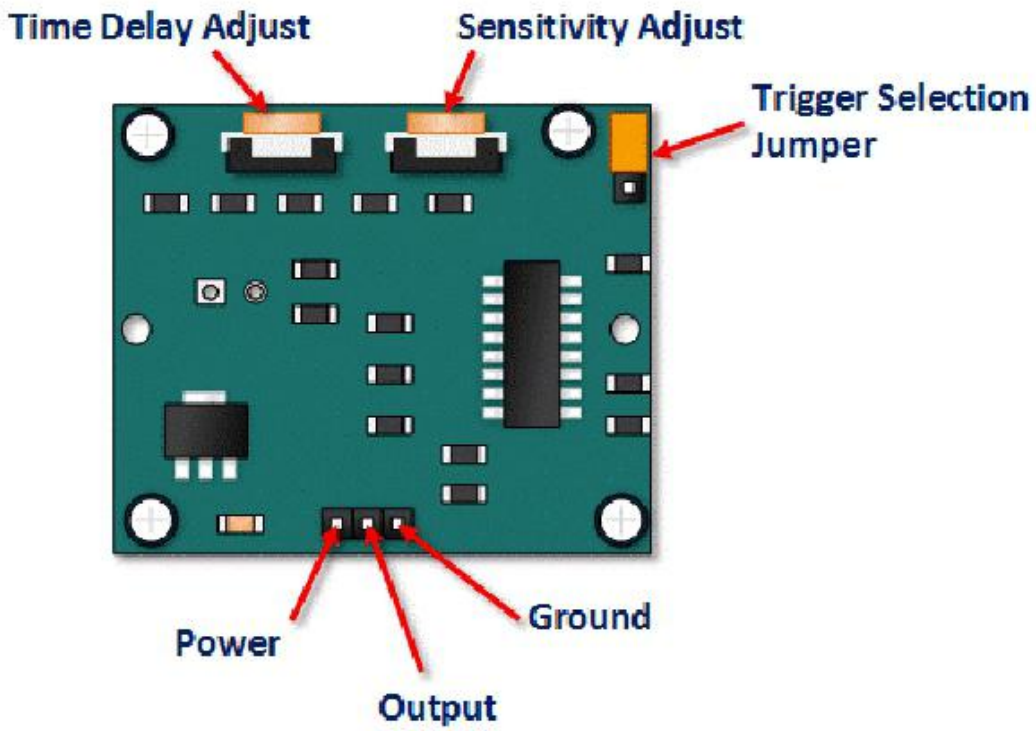
PIR SENSOR:

PIR sensors are more complicated than many of the other sensors explained in this tutorial (like photocells, FSRs and tilt switches) because there are multiple variables that affect the sensors input and output.

The PIR sensor itself has two slots. Each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor).

When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or an animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the

warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.



Pin or Control	Function
Time Delay Adjust	Sets how long the output remains high after detecting motion... Anywhere from 5 seconds to 5 minutes.
Sensitivity Adjust	Sets the detection range....from 3 meters to 7 meters
Trigger Selection Jumper	Set for single or repeatable triggers.
Ground pin	Ground input
Output Pin	Low when no motion is detected...High when motion is detected. High is 3.3V
Power Pin	5 to 20 VDC Supply input

HC SR501 PIR Functional Description

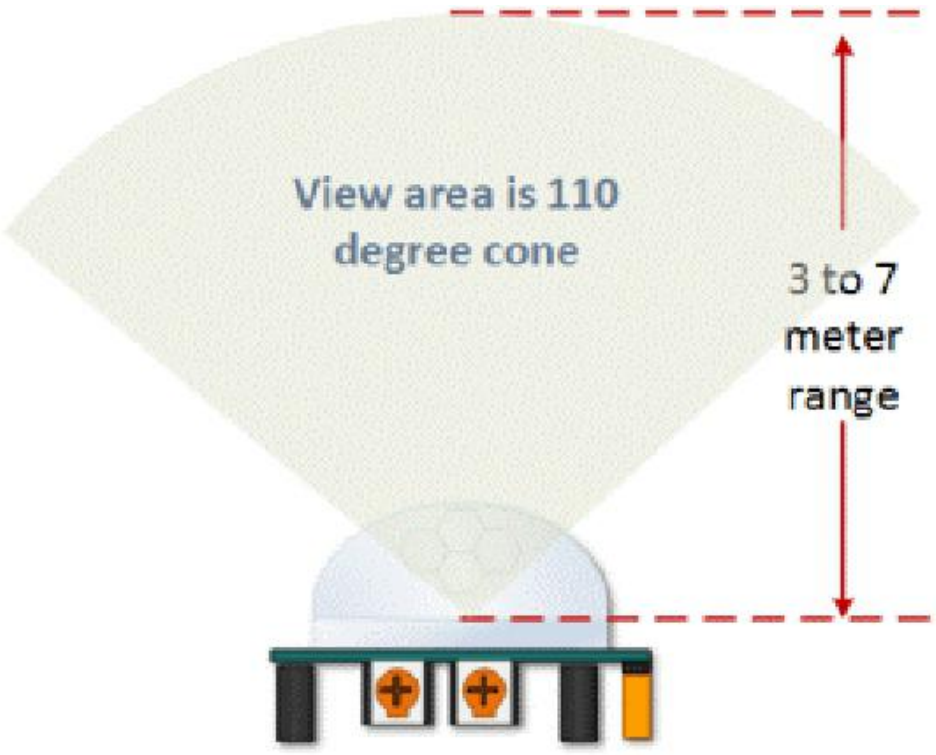
The SR501 will detect infrared changes and if interpreted as motion, will set its output low. What is or is not interpreted as motion is largely dependent on user settings and adjustments.

Device Initialization

The device requires nearly a minute to initialize. During this period, it can and often will output false detection signals. Circuit or controller logic needs to take this initialization period into consideration.

Device Area of Detection

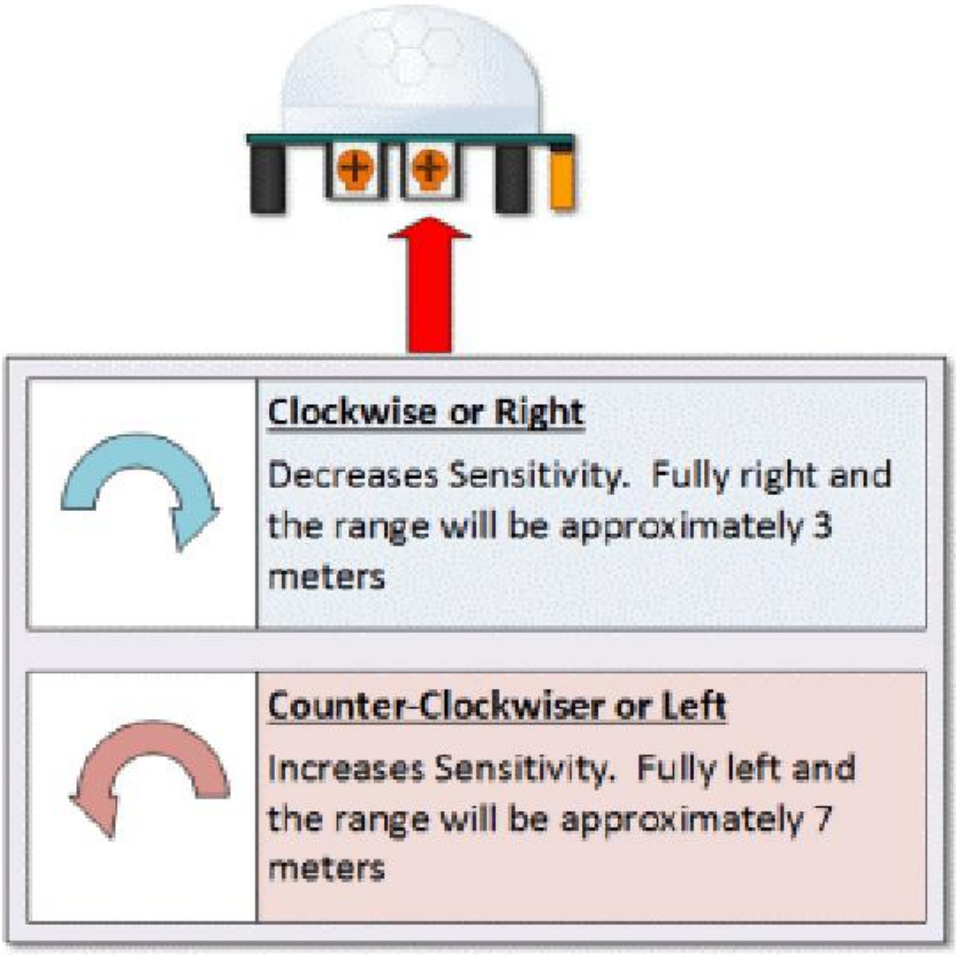
The device will detect motion inside a 110-degree cone with a range of 3 to 7 meters.



HC SR501 View Area

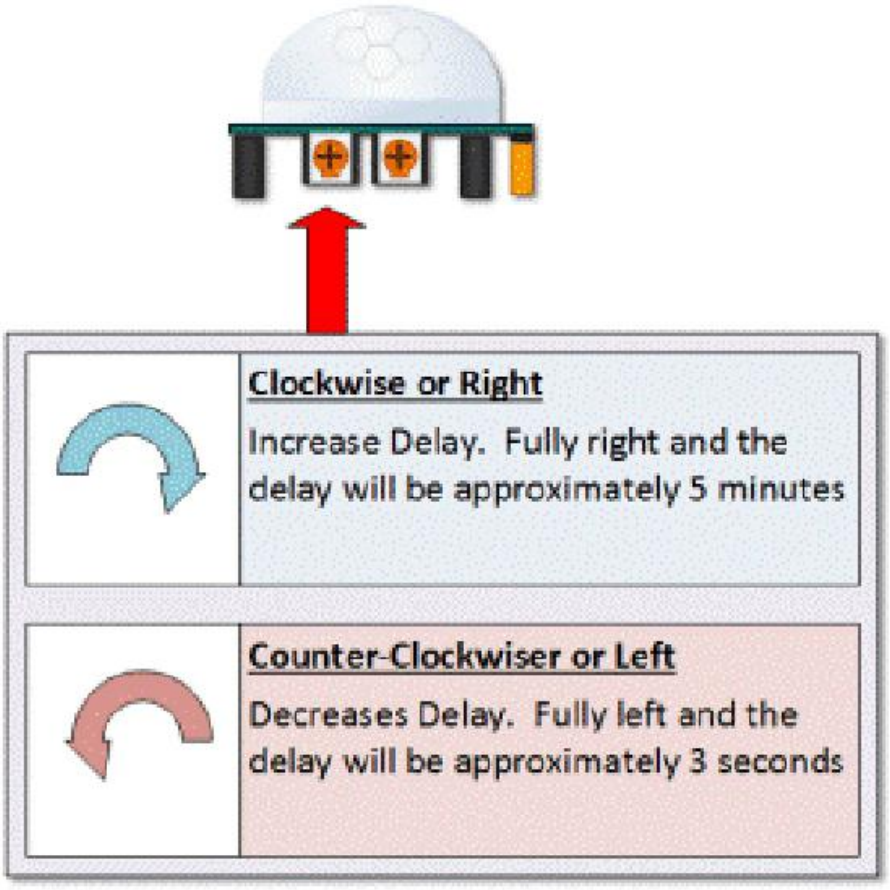
PIR Range (Sensitivity) Adjustment

As mentioned, the adjustable range is from approximately 3 to 7 meters. The illustration below shows this adjustment.



HC SR501 Sensitivity Adjust Time Delay Adjustment

The time delay adjustment determines how long the output of the PIR sensor module will remain high after the detection motion. The range is from about 3 seconds to five minutes.



HC SR501 Time Delay Adjustment

3 Seconds Off After Time Delay Completes – IMPORTANT

The output of this device will go LOW (or Off) for approximately 3 seconds AFTER the time delay completes. In other words, ALL motion detection is blocked during this three second period.

For Example:

Imagine you’re in the single trigger mode and your time delay is set 5 seconds.

The PIR will detect motion and set it high for 5 seconds.

After five seconds, the PIR will set its output low for about 3 seconds.

During the three seconds, the PIR will not detect motion.

After three seconds, the PIR will detect motion again and detected motion will

once

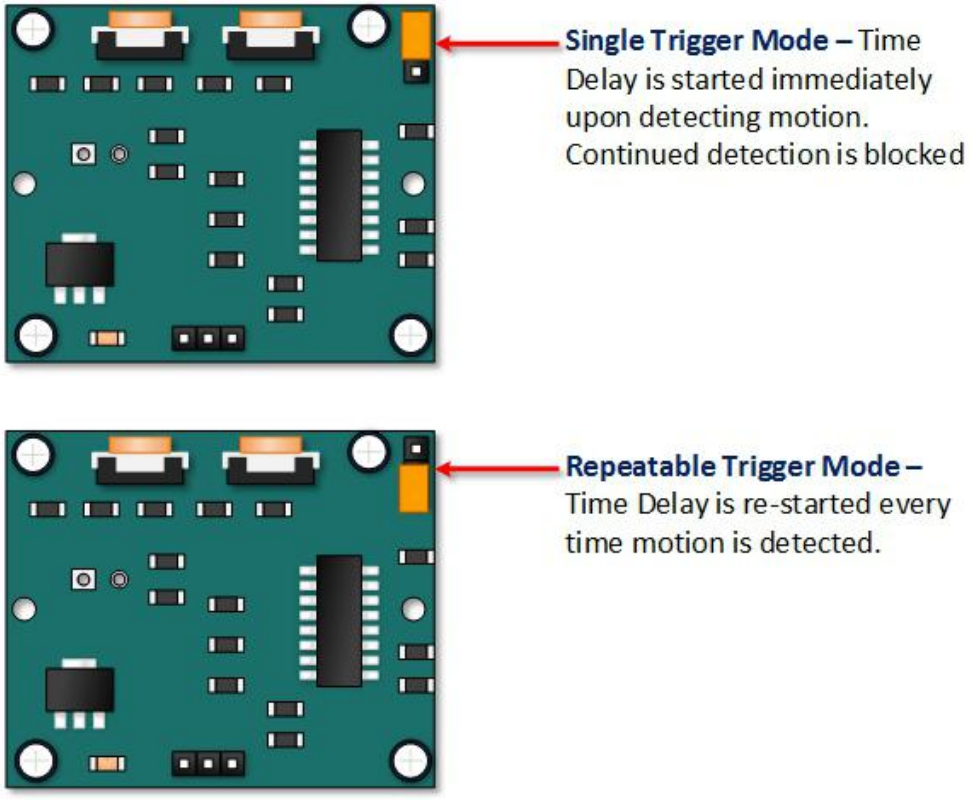
again set the output high.

Trigger Mode Selection Jumper

The trigger mode selection jumper allows you to select between single and repeatable triggers. The effect of this jumper setting is to determine when the time delay begins.

Application Examples

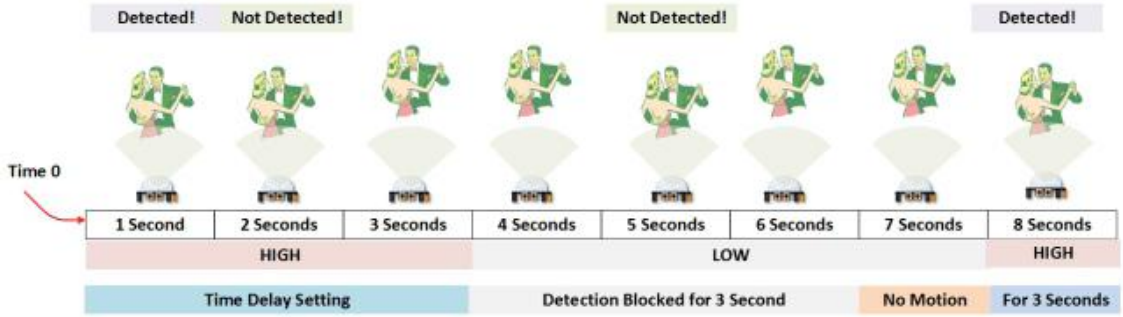
Imagine that you want to control lighting on a dance floor based upon where the dancers are dancing. Understanding how the time delay and trigger mode interact will be necessary to control that lighting in the manner that you want.



Example One

In this first example, the time delay is set to three seconds and the trigger mode is set to single. As you can see in the illustration below, the motion is not

always detected. In fact, there is a period of about six seconds where motion cannot be detected. Feel free to click on the image to enlarge.

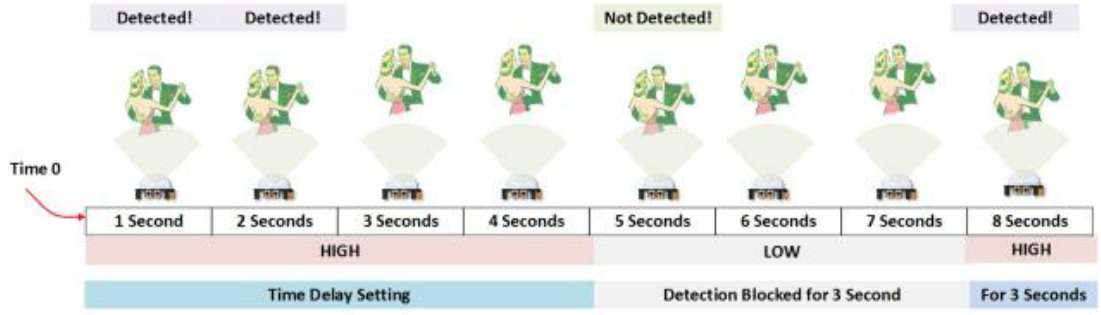


Example Two

In the next example, the time delay is still at three seconds and the trigger is set to repeatable. In the illustration below, you can see that the time delay period is restarted.

However, after that three seconds, detection will still be blocked for three seconds.

As I mentioned previously, you could override the 3 second blocking period with some creative code, but do give that consideration. Some of the electronics you use may not like an on and then off jolt. The three seconds allows for a little rest before starting back up.



Code interpretation

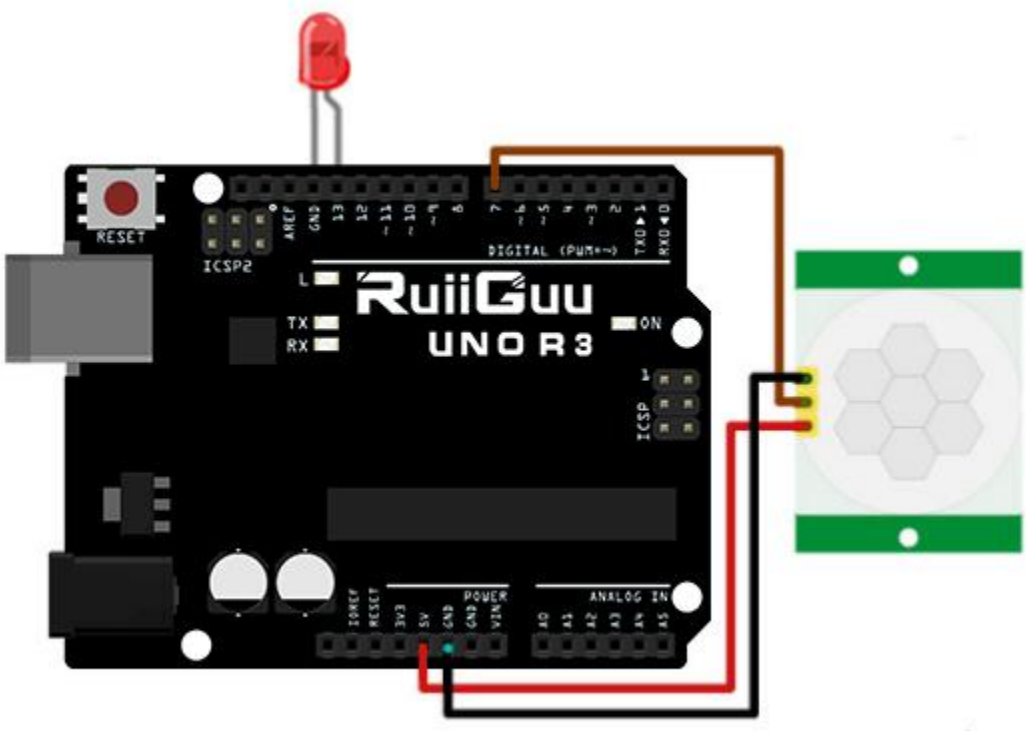
```
int led = 13;          // the pin that the LED is atteched to

int sensor = 7;        // the pin that the sensor is atteched to
```

```
int state = LOW;        // by default, no motion detected
int val = 0;            // variable to store the sensor status (value)

void setup() {
   pinMode(led, OUTPUT);        // initalize LED as an output
   pinMode(sensor, INPUT);      // initialize sensor as an input
   Serial.begin(9600);          // initialize serial
}

void loop(){
   val = digitalRead(sensor);   // read sensor value
   if (val == HIGH) {           // check if the sensor is HIGH
      digitalWrite(led, HIGH);  // turn LED ON
      delay(100);               // delay 100 milliseconds

      if (state == LOW) {
         Serial.println("Motion detected!");
         state = HIGH;          // update variable state to HIGH
      }
   }
   else {
         digitalWrite(led, LOW); // turn LED OFF
```

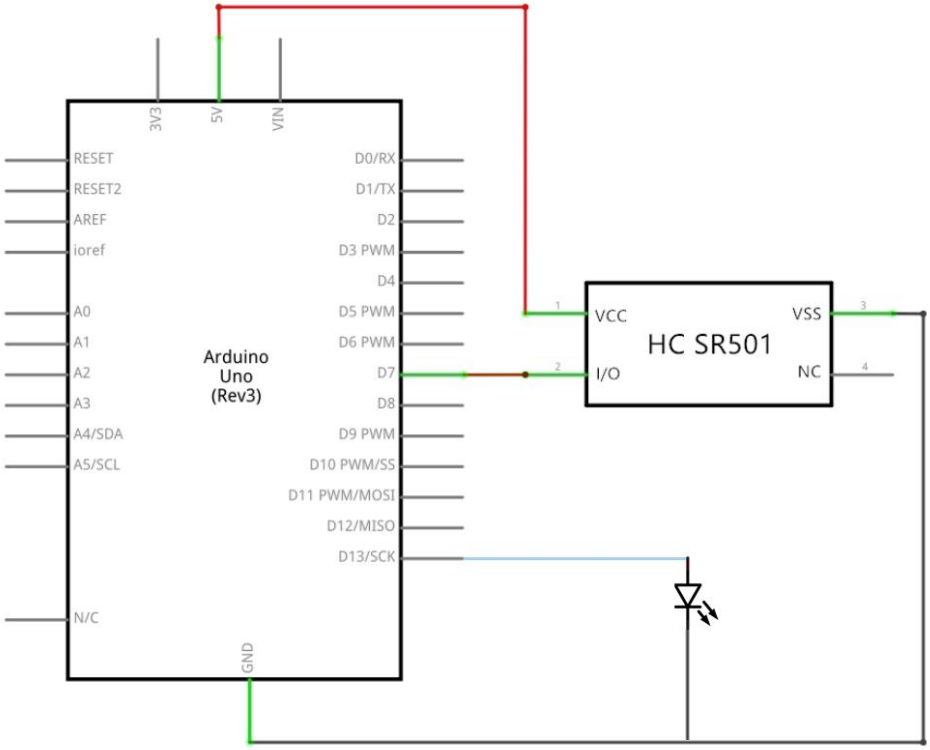
```
        delay(200);                    // delay 200 milliseconds


        if (state == HIGH){
           Serial.println("Motion stopped!");
           state = LOW;                // update variable state to LOW
      }
   }
}
```

Experimental Procedures

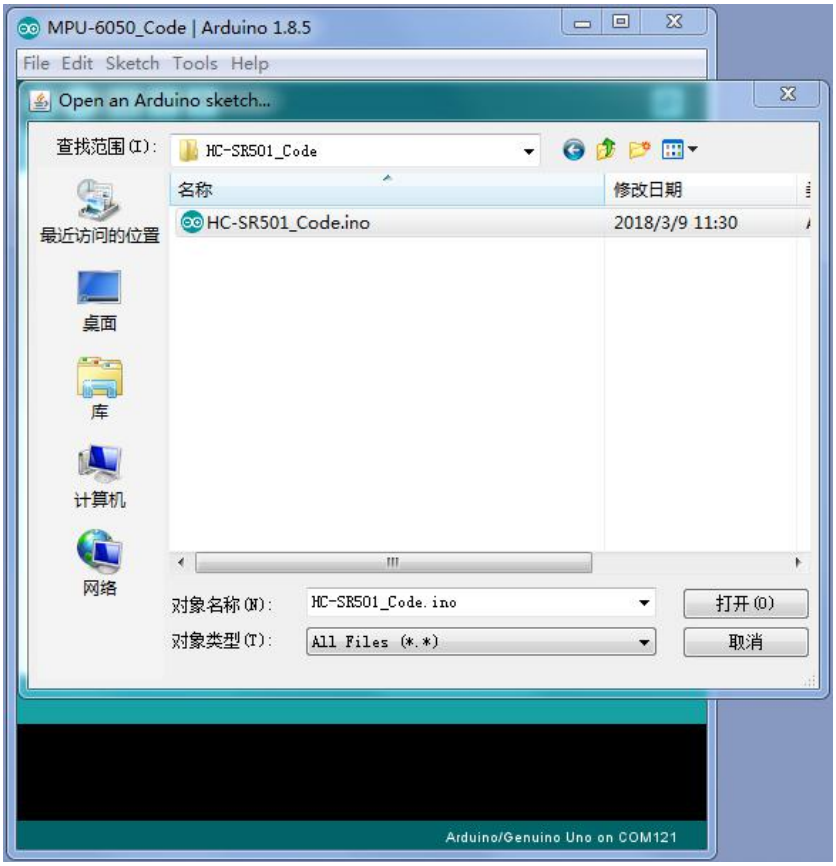
Step 1:Build the circuit



Schematic Diagram



Step 2: Open the code:HC-SR501_Code

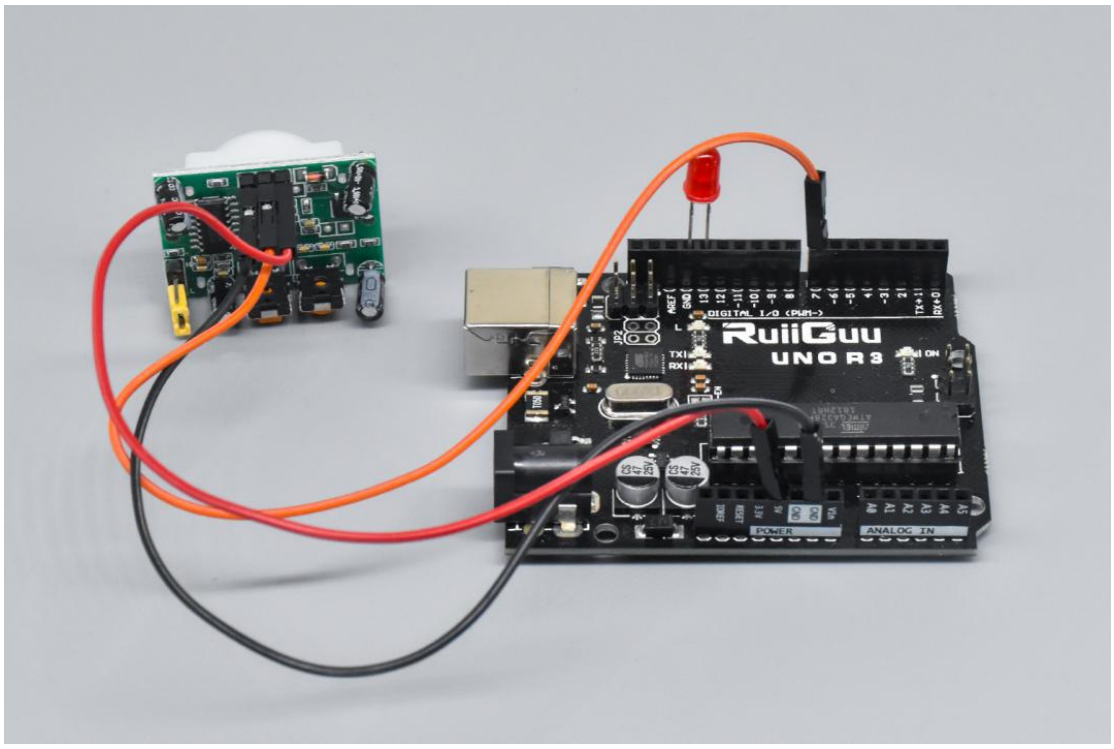


Step 3: Attach Arduino UNO R3 board to your computer via

USB cable and check that the 'Board Type' and 'Serial Port' are set correctly.

Step 4: Upload the code to the UNO R3 board.

Then, you can see that when you approach the PIR motion sensor, the LED will flash and the LED will not flash when you are not close to the PIR motion sensor.



If it isn’ t working, make sure you have assembled the circuit correctly, verified and uploaded the code to your board. For how to upload the code and install the library, check Lesson 0 Preface.