HC-SR501 Passive Infrared (PIR) Motion Sensor

This motion sensor module uses the LHI778 Passive Infrared Sensor and the BISS0001 IC to control how motion is detected. The module features adjustable sensitivity that allows for a motion detection range from 3 meters to 7 meters. The module also includes time delay adjustments and trigger selection that allow for fine tuning within your application. This user guide discusses the various functions and demonstrates how to integrate them to use with your Arduino boards.

SKU: SSR1005

Brief Data:

- Operating Voltage: 5~20Vdc.
- Power Consumption: 65mA.
- TTL Output: 3.3V/0V.
- Delay Time Adjustment: 0.3 ~ 5 mins.
- Lock Time: 0.2sec.
- Trigger Method: L = Disable repeat trigger; H = enable repeat trigger.
- Sensing Range: < 120° within 7 meter.
- Temperature: -15℃ ~ +70°C.
- Dimension: 32 x 23 mm.
- Mounting Screw pitch: 28mm, M2 screw.
- Fresnel lens size: Ø23mm.

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. 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.

PIR Sensor Operation Theory:

The PIR motion sensor consists of two or more elements that output a voltage proportional to the amount of incident infrared radiation. Each pair of pyroelectric elements are connected in series such that if the voltage generated by each element is equal, as in the case of IR due to ambient room temperature or no motion, then the overall voltage of the sensor elements is 0 V. Figure 4 shows an illustration of the PIR motion sensor construction.

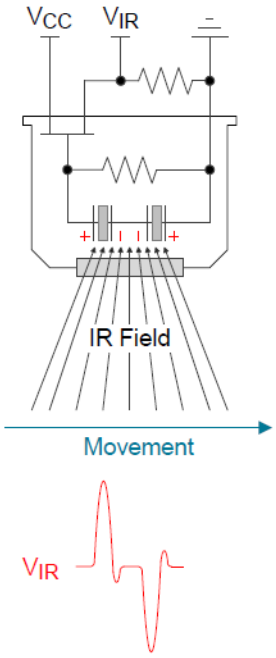


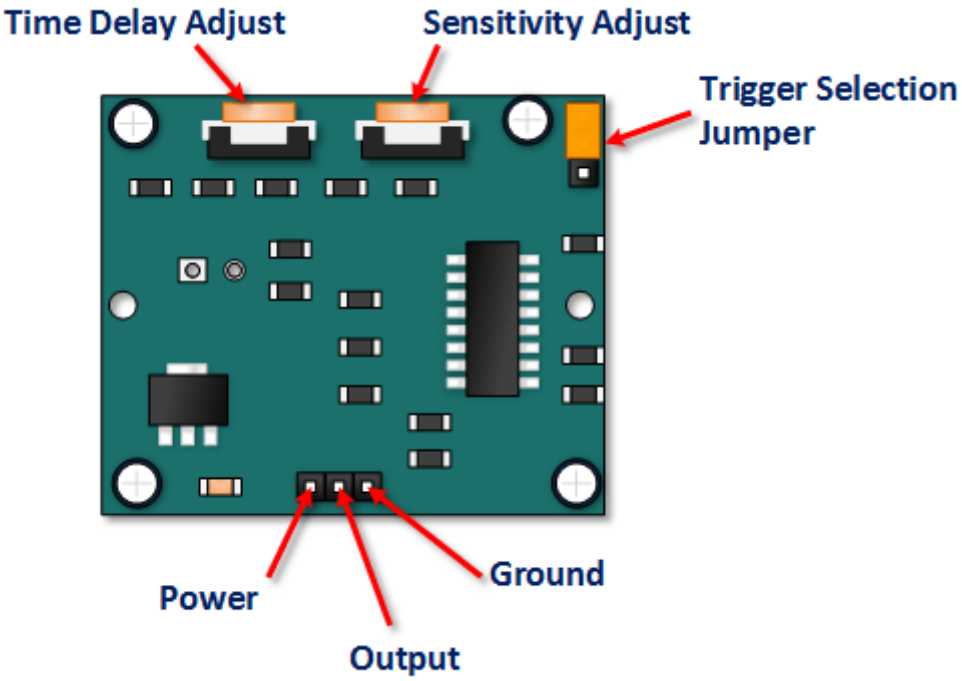
Figure-1. PIR Motion Sensor Illustration

The lower part of Figure 1 shows the output voltage signal resulting from movement of a body with a different temperature than the ambient parallel to the surface of the sensor and through the field of view of both sensor elements. The amplitude of this signal is proportional to the speed and distance of the object relative to the sensor and is in a range of low millivolts peak to peak to a few hundred microvolts peak to peak or less. A JFET transistor is used as a voltage buffer and provides a DC offset at the sensor output. Because of the small physical size of the sensor elements, a Fresnel lens is typically placed in front of the PIR sensor to extend the range as well as expanding the field of view by multiplying and focusing the IR energy onto the small sensor elements. In this manner, the shape and size of the lens determine the overall detection angle and viewing area. The style of lens is typically chosen based on the application and choice of sensor placement in the environment. Based on this information, for best results, the sensor should be placed so that movement is across the sensor instead of straight into the sensor and away from sources of high or variable heat such as AC vents and lamps.

Also note that on initial power up of the sensor, it takes up to 30s or more for the sensor output to stabilize. During this "warm up" time, the sensor elements are adjusting themselves to the ambient background

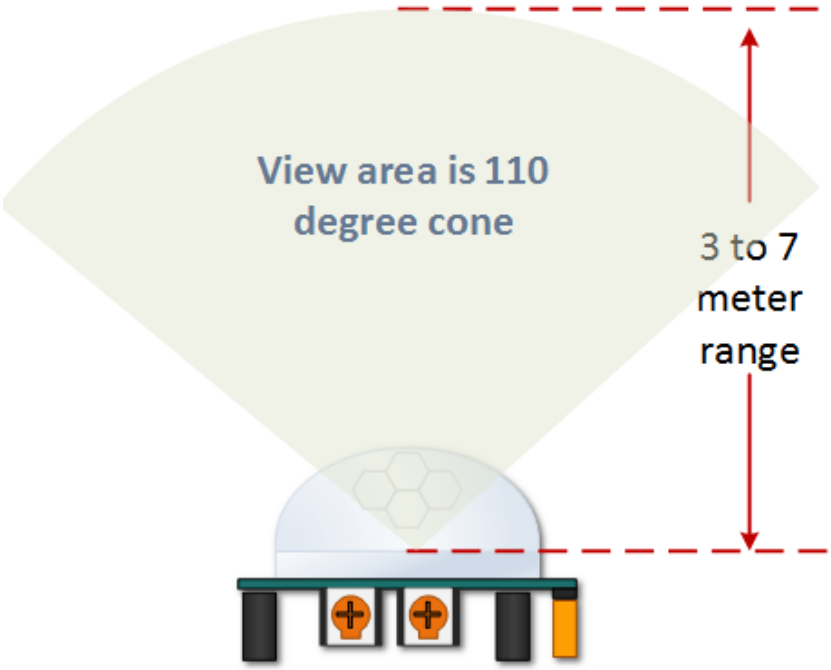
conditions. This is a key realization in designing this subsystem for maximum battery life in that the sensor itself must be continuously powered for proper operation, which means power cycling techniques applied to either the sensor or the analog signal path itself cannot be applied for proper operation and reliable detection of motion.

HC-SR501 Pin Outs and Controls:



Pin or Control	Function
Time Delay Adjustment	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 Supply Pin	5 to 20 VDC Supply input

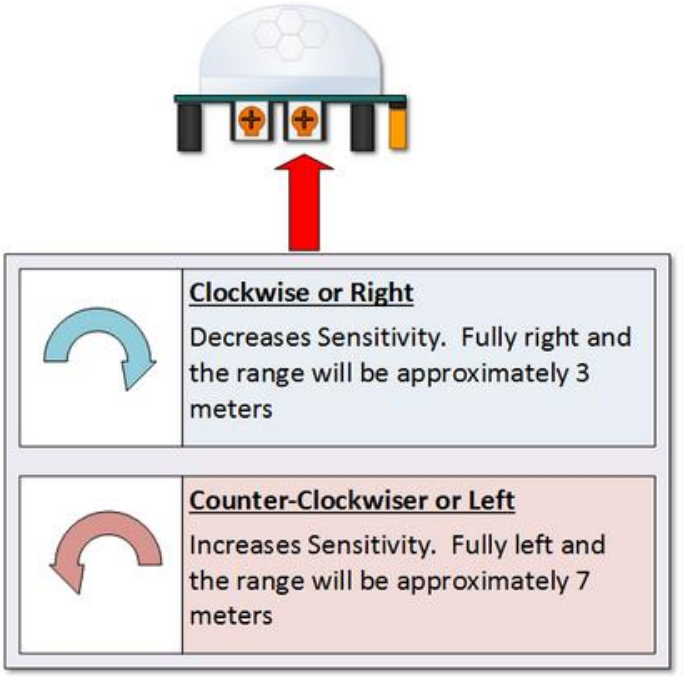
Device Area of Detection:



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

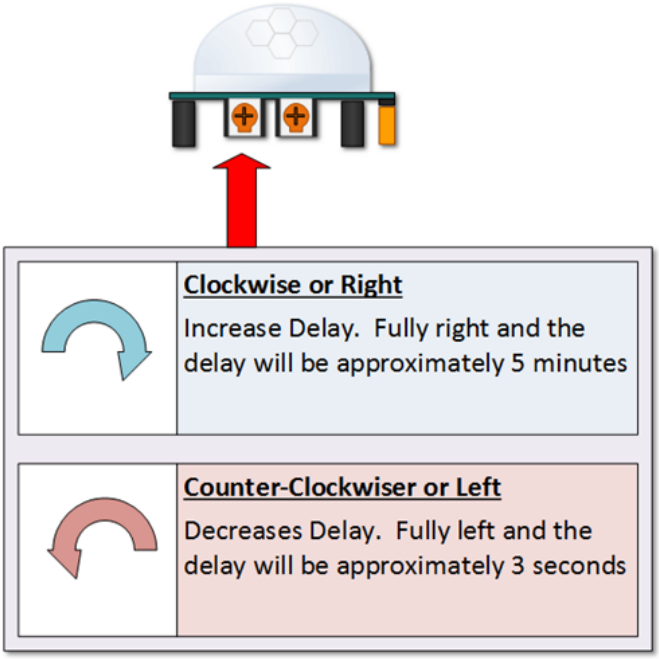
PIR Range (Sensitivity) Adjustment:

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



Time Delay Adjustment:

The time delay adjustment determines how long the output of the PIR sensor module will remain high after detection motion. The range is from about 3 seconds to five minutes. The illustration below shows this 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 (see below) 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 and the output will remain on as dictated by the Time Delay adjustment and trigger mode selection.

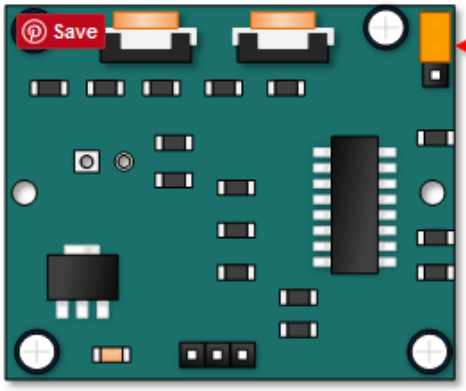
OVERRIDING THE TIME DELAY –If you're connecting your HC-SR501 to an Arduino, it is likely that you are going to take some sort of action when motion is detected. For example, you may wish to brighten lights when motion is detected and dim the lights when motion is no longer connected

Simply delay dimming within your sketch.

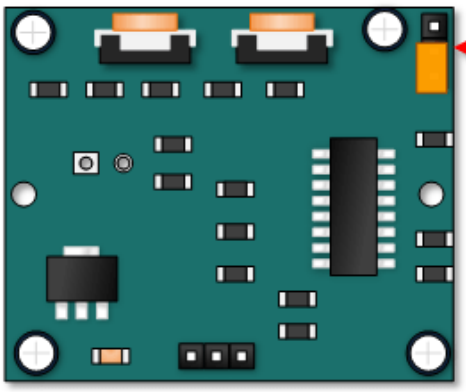
Trigger Mode Selection Jumper:

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.

- SINGLE TRIGGER – The time delay begins immediately when motion is first detected.
- REPEATABLE TRIGGER – Each detected motion resets the time delay. Thus the time delay begins with the last motion detected.



Single Trigger Mode – Time Delay is started immediately upon detecting motion. Continued detection is blocked

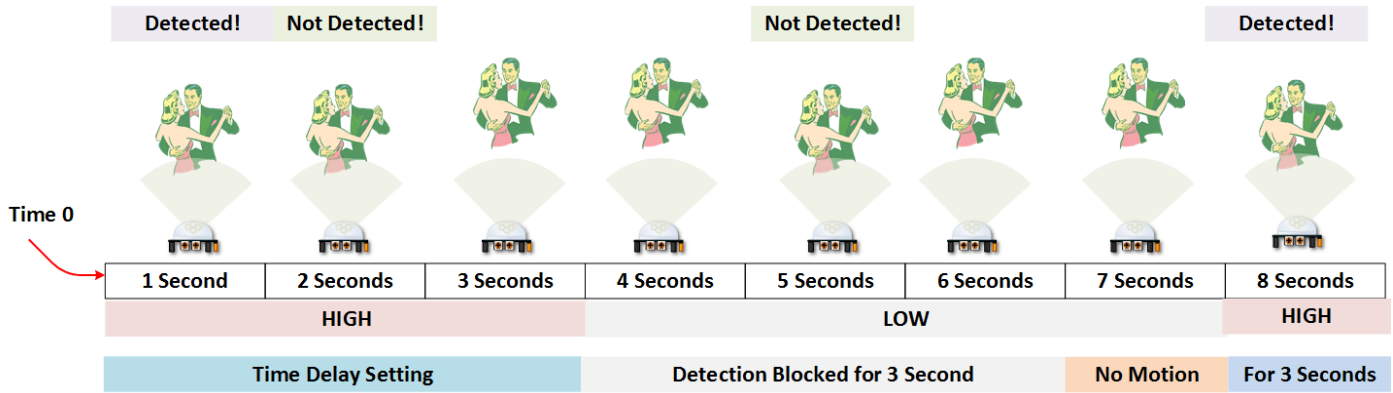


Repeatable Trigger Mode – Time Delay is re-started every time motion is detected.

HC-SR501 Dance Floor Application Examples:

Example 1:

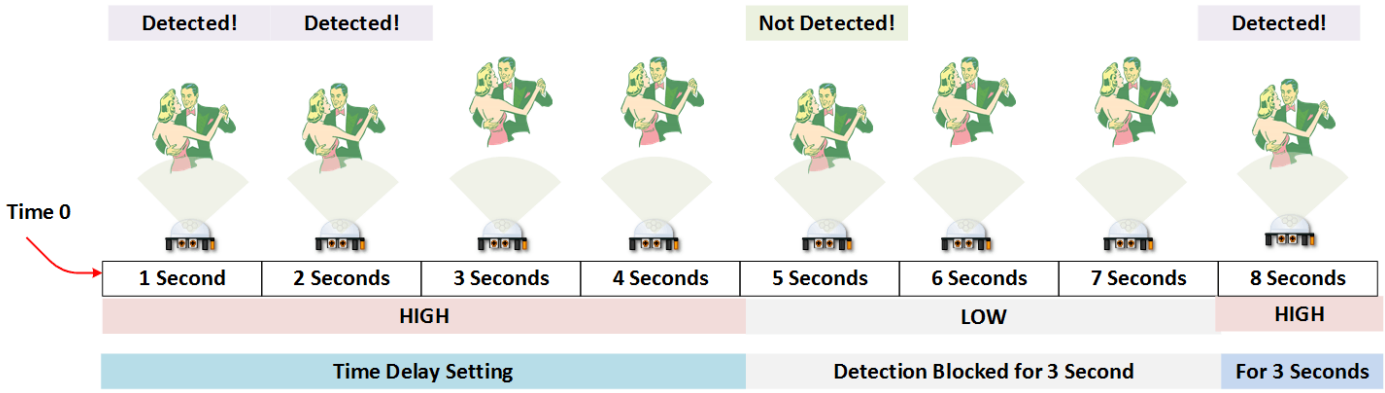
In this first example, the time delay is set to 3 seconds and the trigger mode is set to single. As you can see in the illustration below, the motion is not always detected. In fact, there is a period of about 6 seconds where motion cannot be detected.



Example 2:

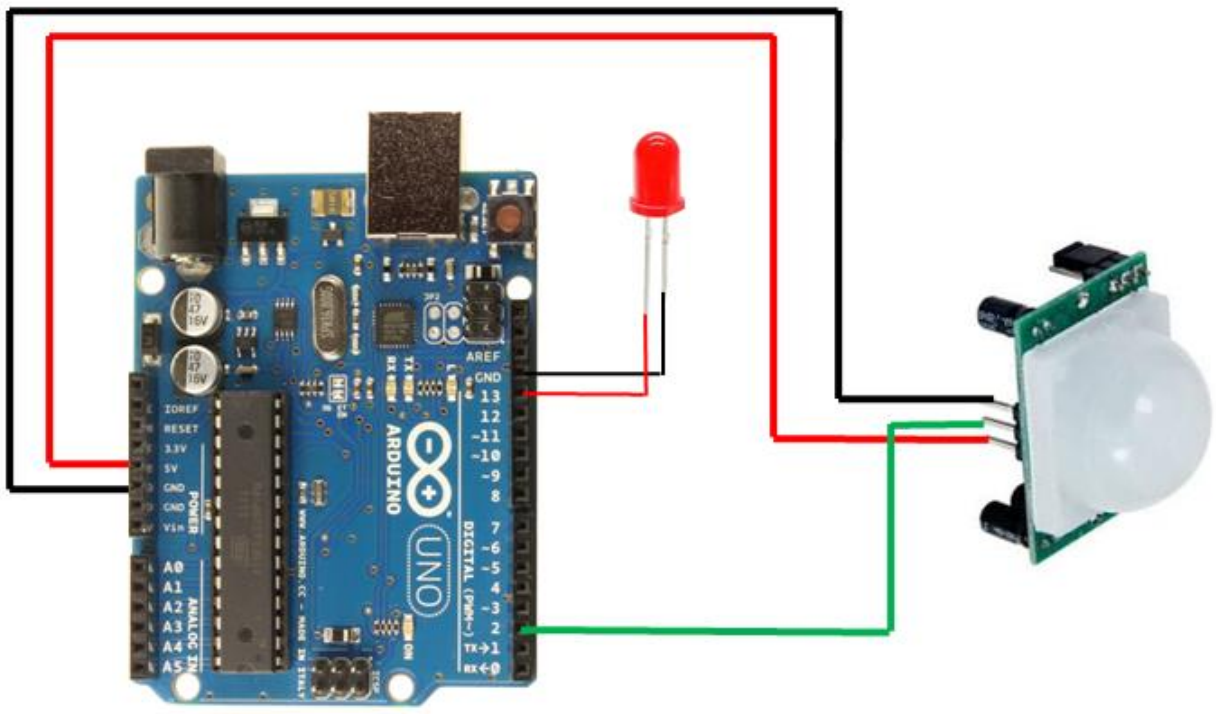
In the next example, the time delay is still at 3 seconds and the trigger is set to repeatable. In the illustration below, you can see that the time delay period is restarted. However, after that 3 seconds, detection will still be blocked for 3 seconds.

As 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 3 seconds allows for a little rest before starting back up.



Arduino HC-SR501 Motion Sensor Tutorial:

Connect Arduino Uno to the HC-SR501 as shown in below schematic. This only requires three wires.



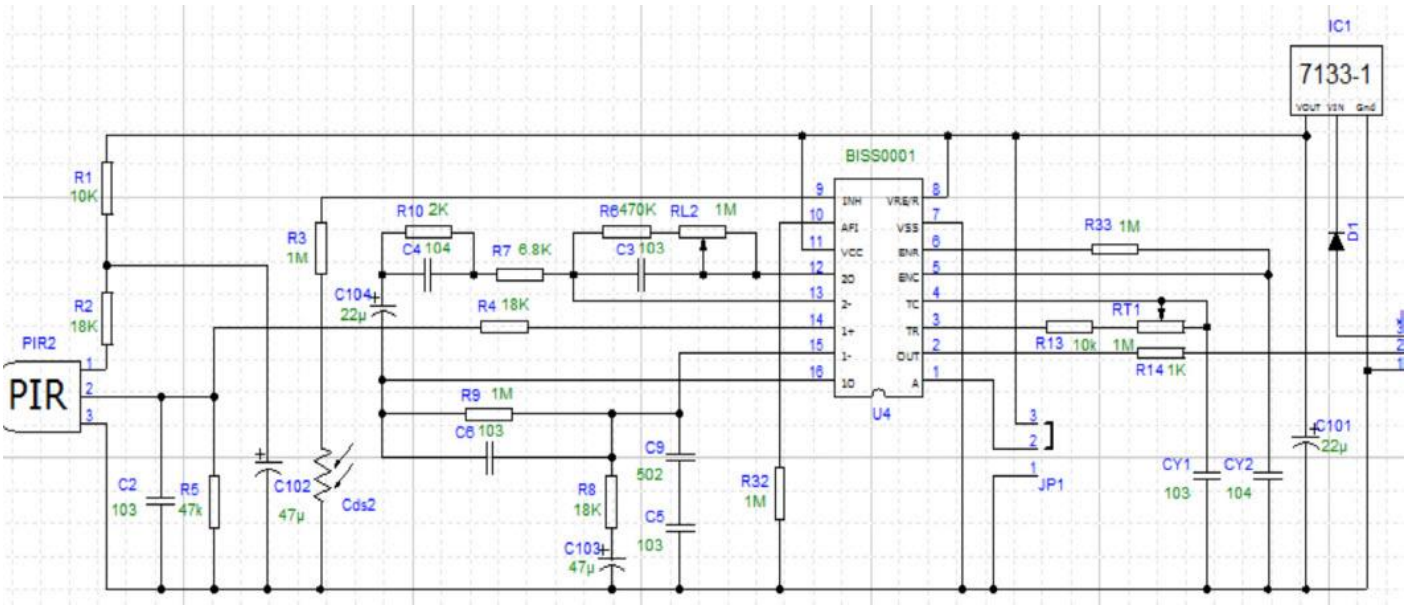
Copy, Paste and Upload the Tutorial Sketch:

The sketch simply turns on LED connected to Pin 13 on Arduino Uno board whenever motion is detected. Be sure to beware of and somehow handle the 1 minute initialization in whatever application you develop.

```
/*
   Arduino with PIR motion sensor
   For complete project details, visit: http://RandomNerdTutorials.com/pirsensor
   Modified by Rui Santos based on PIR sensor by Limor Fried
*/

int led = 13;                // the pin that the LED is attached to
int sensor = 2;              // the pin that the sensor is attached 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
    }
  }
}
```

Schematic Diagram:



HandsOn Technology provides a multimedia and interactive platform for everyone interested in electronics. From beginner to diehard, from student to lecturer. Information, education, inspiration and entertainment. Analog and digital, practical and theoretical; software and hardware.

open source hardware

HandsOn Technology support Open Source Hardware (OSHW) Development Platform.

Learn : Design : Share

handsontec.com

The Face behind our product quality…

In a world of constant change and continuous technological development, a new or replacement product is never far away – and they all need to be tested.
Many vendors simply import and sell wihtout checks and this cannot be the ultimate interests of anyone, particularly the customer. Every part sell on Handsotec is fully tested. So when buying from Handsontec products range, you can be confident you're getting outstanding quality and value.

We keep adding the new parts so that you can get rolling on your next project.

Breakout Boards & Modules

Connectors

Electro-Mechanical Parts

Engineering Material

Mechanical Hardware

Electronics Components

P

Power Supply

Arduino Board & Shield

Tools & Accessory