

NIELIT, Gorakhpur

Course Name: A-level (1st Sem.)

Subject:IoT

Topic: PIR Sensor Interfacing with Arduino UNO Date: 27.03.2020

Introduction



PIR Sensor

All living objects, whose body temperature is more than 0⁰C, emit the heat in form of infrared radiation through their body, also called as thermal radiations. This Radiated energy is invisible to human eye. These Signals can be detected by using PIR sensor which is specially designed for such purpose.



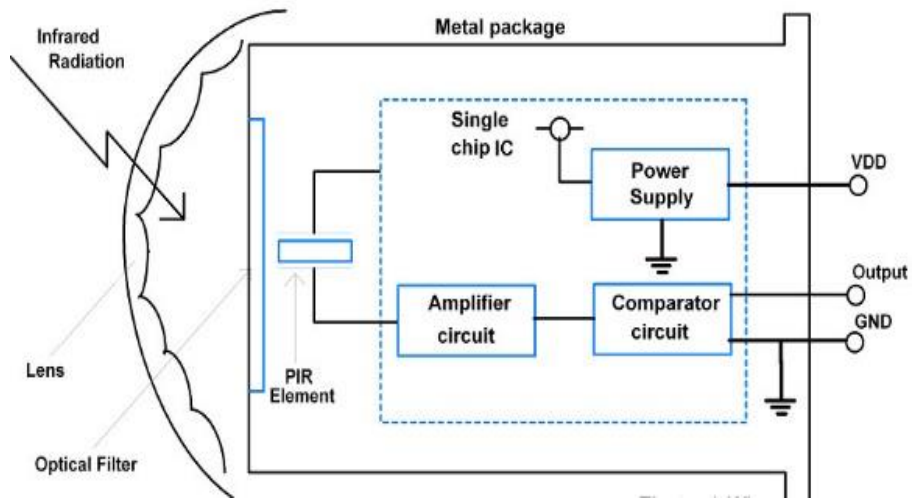
Grid eye illusion

In Passive Infrared (PIR) Sensor, passive word indicates PIR Sensor does not generate or radiate any energy for detection purposes.

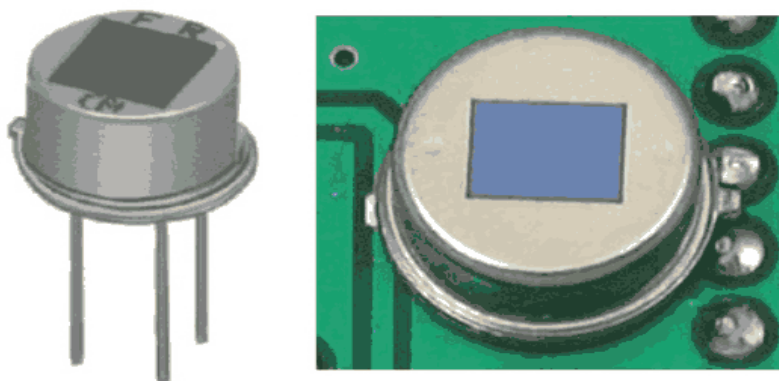
PIR Sensors don't detect or measure "HEAT"; they detect the infrared radiation emitted or reflected from objects.

They are small, inexpensive, low power and easy to use. They are commonly found at home, medical, factories etc. areas.

PIR Sensor Working



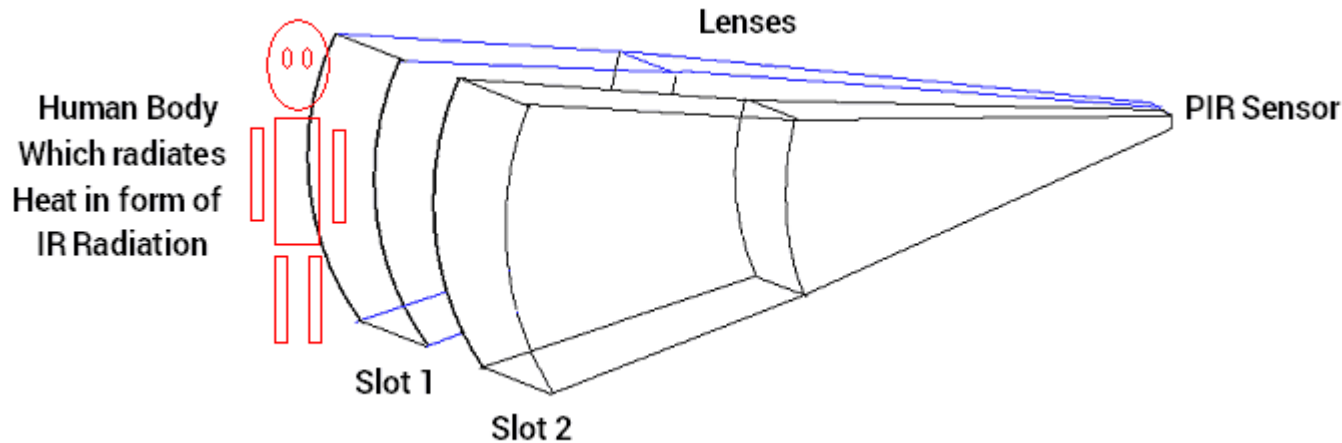
PIR Sensor Blocks



PIR Element

- PIRs are basically made of a [pyroelectric](#) sensor, which can detect levels of infrared radiation.

- Above figure of PIR element shows the round metal can with a rectangular crystal in the centre.
- Every object emits some low-level radiation, and the hotter objects emits more radiations.



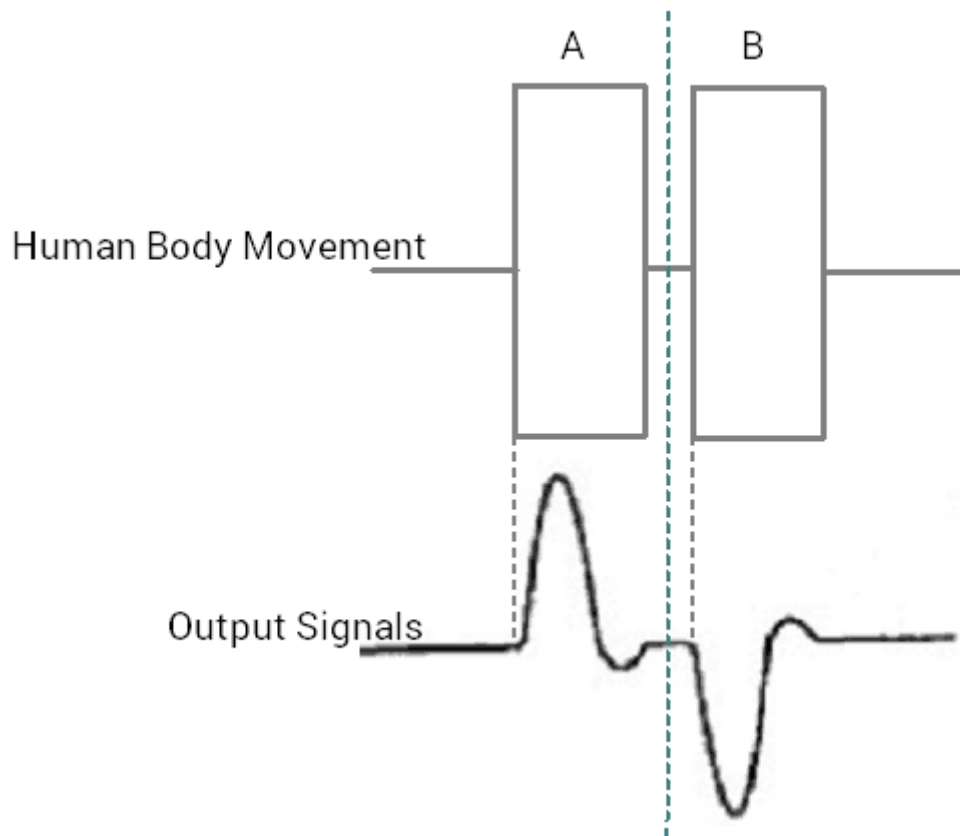
- The sensor is split in two slots, which are wired up so that they cancel each other out.
- If one half sees more or less IR radiation than the other, the output will swing high or low.
- Input signals from both terminals of PIR element are amplified using amplifier circuit and compared using comparator circuit.
- The PIR element is covered by lens to increase range of operation.

At Idle Position

- PIR motion sensor uses element RE200B for infrared detection. Both slots of this sensor are connected to differential amplifier.
- When the sensor is idle, both slots detect same amount of IR.
- So, there is no error signal between differential inputs. The output of comparator circuit is zero.

Object in Motion

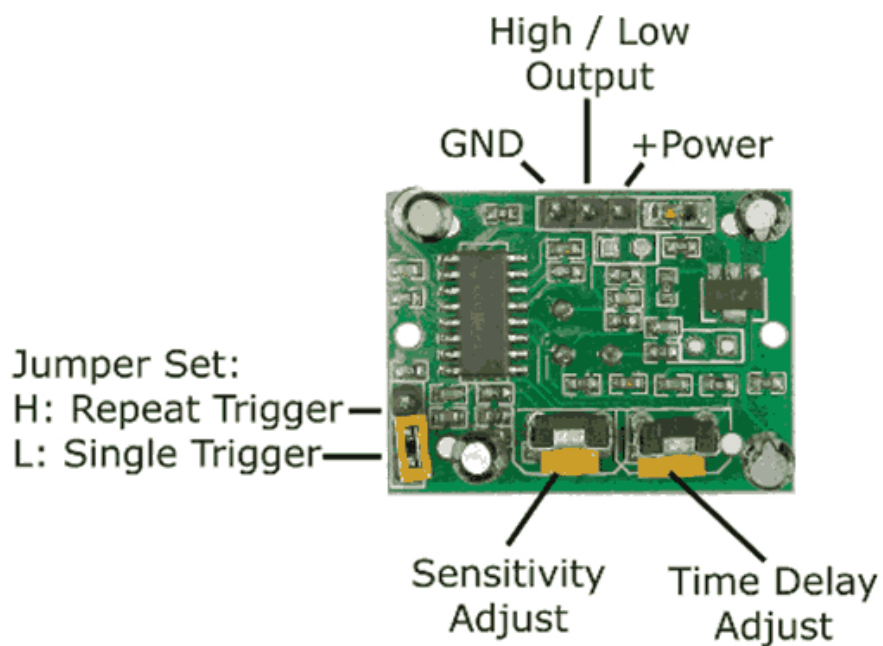
- When any warm object passes in front of the sensor, it intercepts one slot of the PIR sensor. This causes a positive differential change between the two slots. This change is indicated by Part A in below figure.
- When the warm body leaves the sensing area, the sensor generates negative differential change. This change is indicated by Part B in below figure.



Differential changes between two slots

- Both these changes in pulse are the detection of warm body which radiate infrared signals.

Pin Description



Pin Diagram of PIR Sensor

Pin 1 – GND

We have to connect this pin to Ground.

Pin 2 – Output

This pin gives output (3.5V) when the motion is detected.

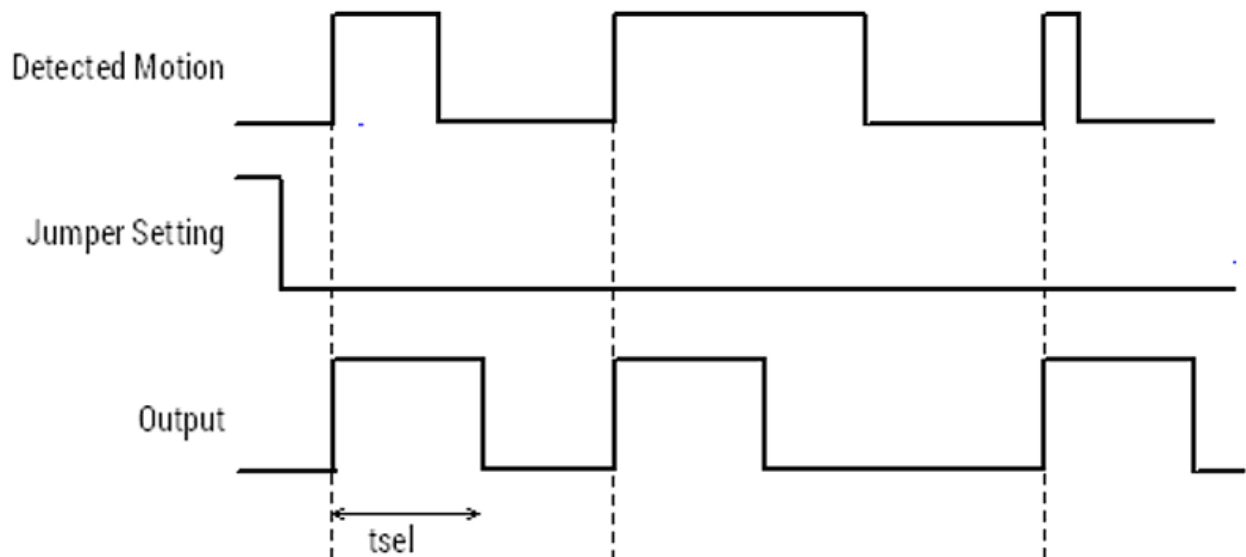
Pin 3 – VCC

This pin provides supply voltage(+5v) to PIR element and internal circuit.

Modes of Operations

This sensor has two modes of operations:

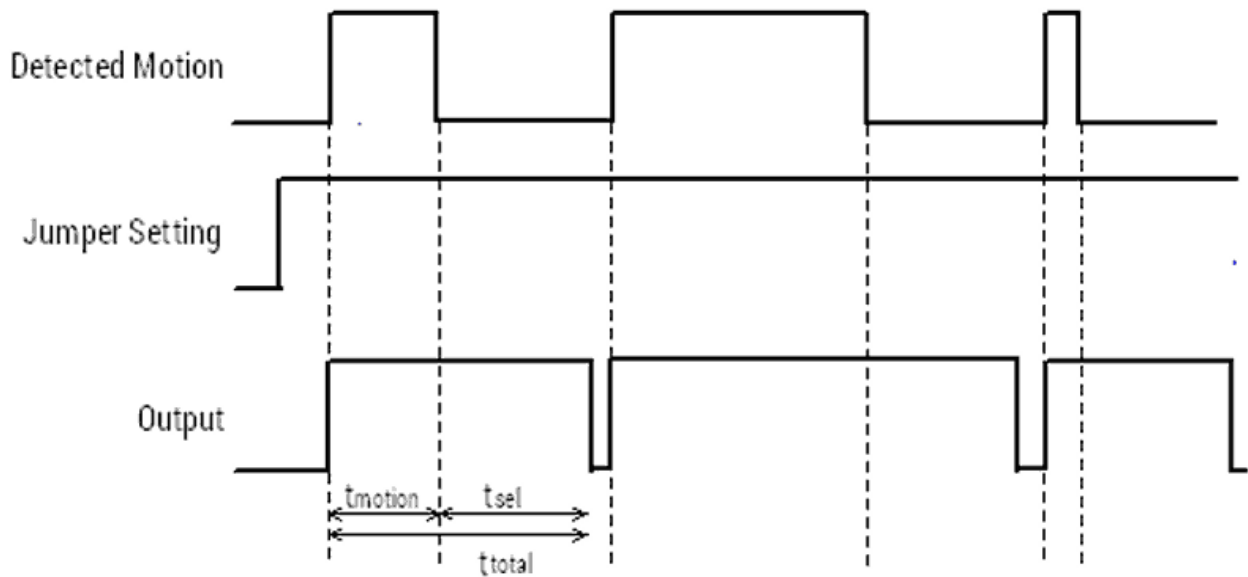
1. Single Trigger Mode



Single trigger mode timing diagram

- To select Single Trigger mode, the jumper setting on PIR sensor must be set on LOW.
- In case of Single Triggered Mode, Output goes HIGH when motion is detected.
- After specific delay (t_{sel}) the output goes to LOW even if the object is in motion.
- The output is LOW for some time and again goes HIGH if object remains in motion.
- This delay (t_{sel}) is provided by user using the potentiometer. This potentiometer is on board of PIR sensor module.
- In this way, the PIR sensor gives HIGH/LOW pulses if object is in continuous motion.

2. Repeat Trigger Mode



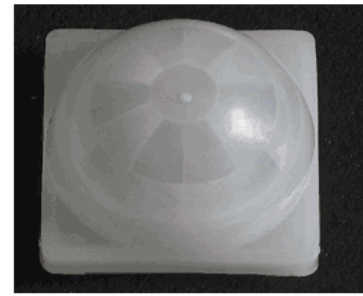
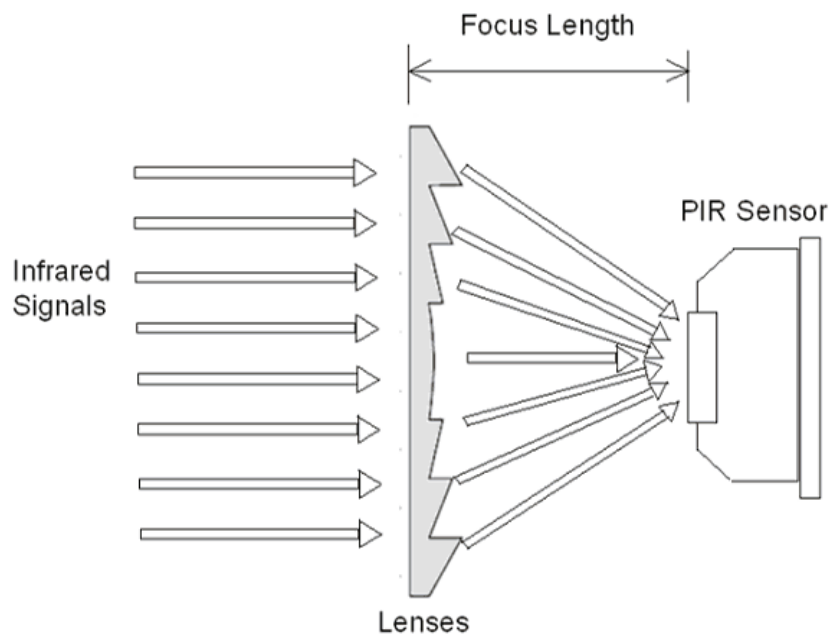
Repeat trigger mode timing diagram

- To select Repeat Trigger mode, the jumper setting on PIR sensor must be set on HIGH.
- In case of Repeat Triggered Mode, Output goes HIGH when motion is detected.
- The output of PIR sensor is HIGH until the object is in motion.
- When object stops motion, or disappears from the sensor area, the PIR continues its HIGH state up to some specified delay (t_{sel}).
- We can provide this delay (t_{sel}) by adjusting the potentiometer. This potentiometer is on board of PIR sensor module.
- In this way, the PIR sensor gives HIGH pulse if object is in continuous motion.

Changing Sensitivity and Delay time

- There are two potentiometers on PIR motion sensors board: Sensitivity Adjust and Time delay adjust.
- It is possible to make PIR more sensitive or Non-Sensitive Enough. The maximum sensitivity can be achieved up to 6 meters.
- Time Delay Adjust potentiometer is used to adjust the timestep shown in above timing diagrams.
- Clockwise Movement makes PIR more Sensitive.

Lenses



Top View

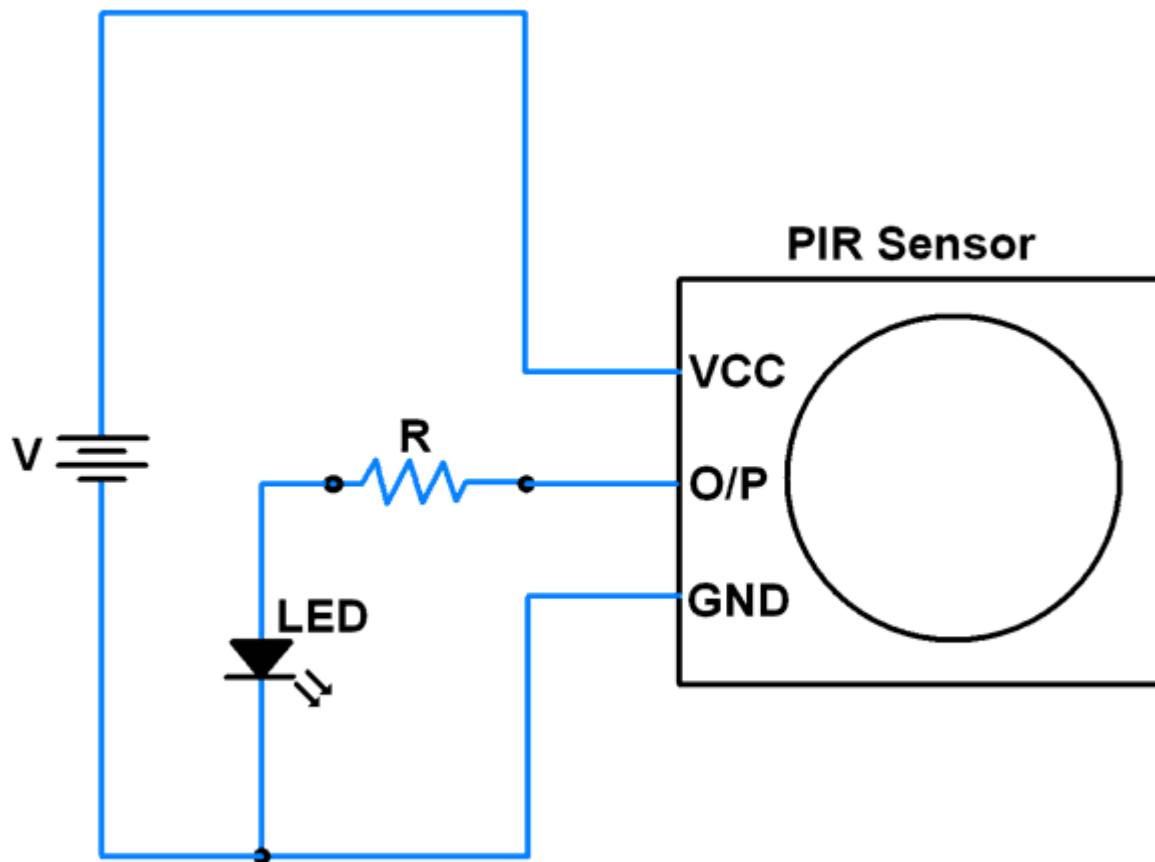


Bottom View

PIR Detector with Fresnel Lenses

- Two things are important while manufacturing PIR sensor: Low cost and High Sensitivity.
- Both these things can be magically achieved by using Lens cap.
- The lenses increase range of operation; increases sensitivity and change pattern of Sensing vary easily.

PIR Sensor



Testing PIR Sensor

PIR sensor is used for detecting infrared heat radiations. This makes them useful in applications involving detection of moving living objects that emit infrared heat radiations.

The output (in terms of voltage) of PIR sensor is high when it senses motion; whereas it is low when there is no motion (stationary object or no object).

Exercise:

1. What is a sensor? Explain its working with example.