EE592P- Selected Topics on IoT
Assignment 3

<u>Sensor comparison and calibration</u>

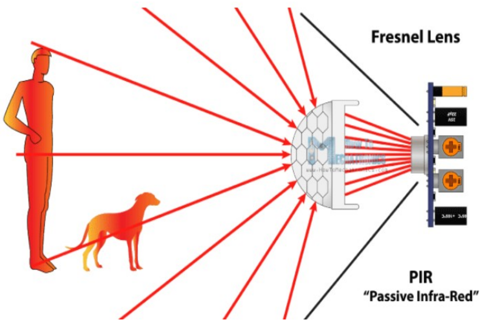
Group Members:
1. Joe Johnson
2. Vikanksh Nath
3. Manish Bansal

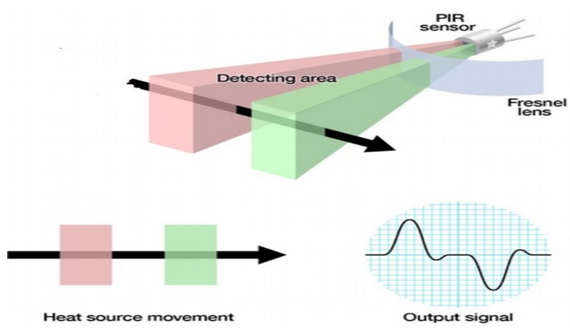
1) Compare and contrast the use of PIR and Ultrasonic sensors through practical demonstration. Find out the capabilities of each sensor and try to come up with an interesting application that uses both sensors

Apparatus Used:- Ultrasonic sensor, PIR sensor, Arduino, wires, breadboard

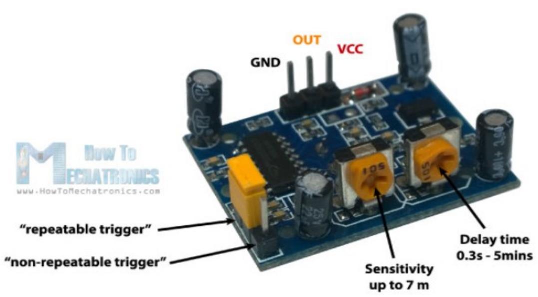
Theory:- As the working principle of Ultrasonic sensor has been discussed, here the working principle of only PIR sensor has been described. PIRs are basically made of a pyroelectric sensor (which is shown in fig1 below as the round metal can with a rectangular crystal in the centre), which can detect levels of infrared radiation. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves 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.

Working of PIR sensor: The module actually consists of a Pyroelectric sensor which generates energy when exposed to heat. That means when a human or animal body will get in the range of the sensor it will detect a movement because the human or animal body emits heat energy in a form of infrared radiation. The module also consists a specially designed cover named Fresnel lens, which focuses the infrared signals onto the pyroelectric sensor.





The module has just three pins, a Ground and a VCC for powering the module and an output pin which gives high logic level if an object is detected. Also it has two potentiometers. One for adjusting the sensitivity of the sensor and the other for adjusting the time the output signal stays high when object is detected. This time can be adjusted from 0.3 seconds up to 5 minutes.



The module has three more pins with a jumper between two of them. These pins are for selecting the trigger modes. The first one is called "non-repeatable trigger" and works like this: when the sensor output is high and the delay time is over, the output will automatically change from high to low level. The other mode called "repeatable trigger" will keep the output high all the time until the detected object is present in sensor's range. Note that after powering the sensor module it needs about 20 – 60 seconds to "warm-up" in order to function properly.

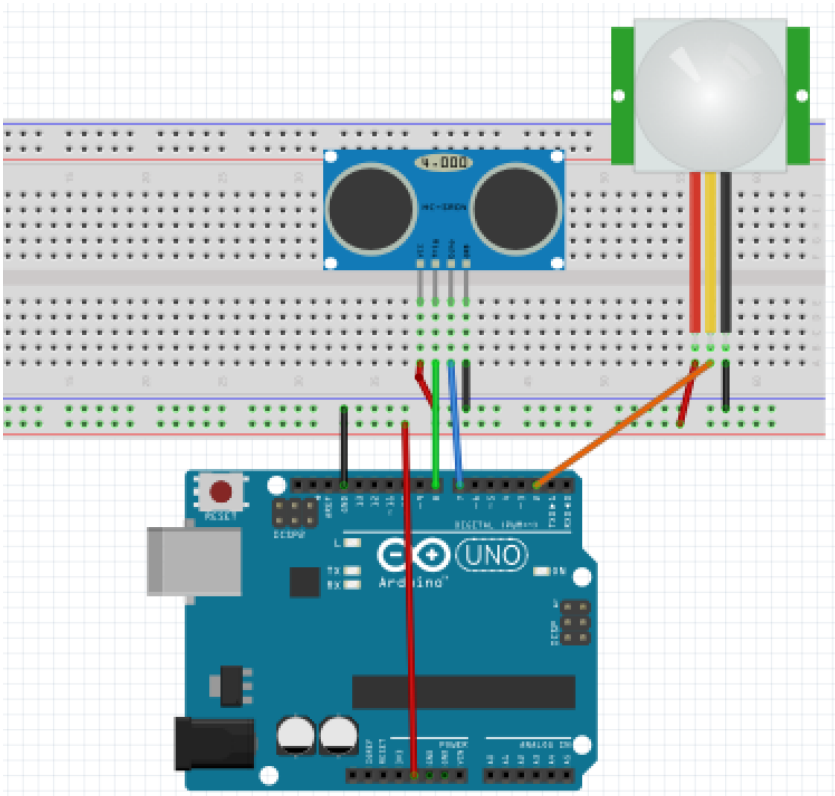
Changing Timeout Length:

"**Tx**" timeout: how long the LED is lit after it detects movement - this is easy to adjust on Adafruit PIR's because there's a potentiometer. On Adafruit PIR sensors, there's a little trim potentiometer labeled **TIME.** This is a 1 Megaohm adjustable resistor which is added to a 10K series resistor. And **C6** is 0.01uF so
Tx = 24576 x (10K + Rtime) x 0.01uF
If the Rtime potentiometer is turned all the way down counter-clockwise (to 0 ohms) then
Tx = 24576 x (10K) x 0.01uF = 2.5 seconds (approx)
If the Rtime potentiometer is turned all the way up clockwise to 1 Megaohm then
Tx = 24576 x (1010K) x 0.01uF = 250 seconds (approx)
If RTime is in the middle, that'd be about 120 seconds (two minutes) so you can tweak it as necessary. For example if you want motion from someone to turn on a fan for a minimum of 1 minute, set the Rtime potentiometer to about 1/4 the way around.

Comparison:

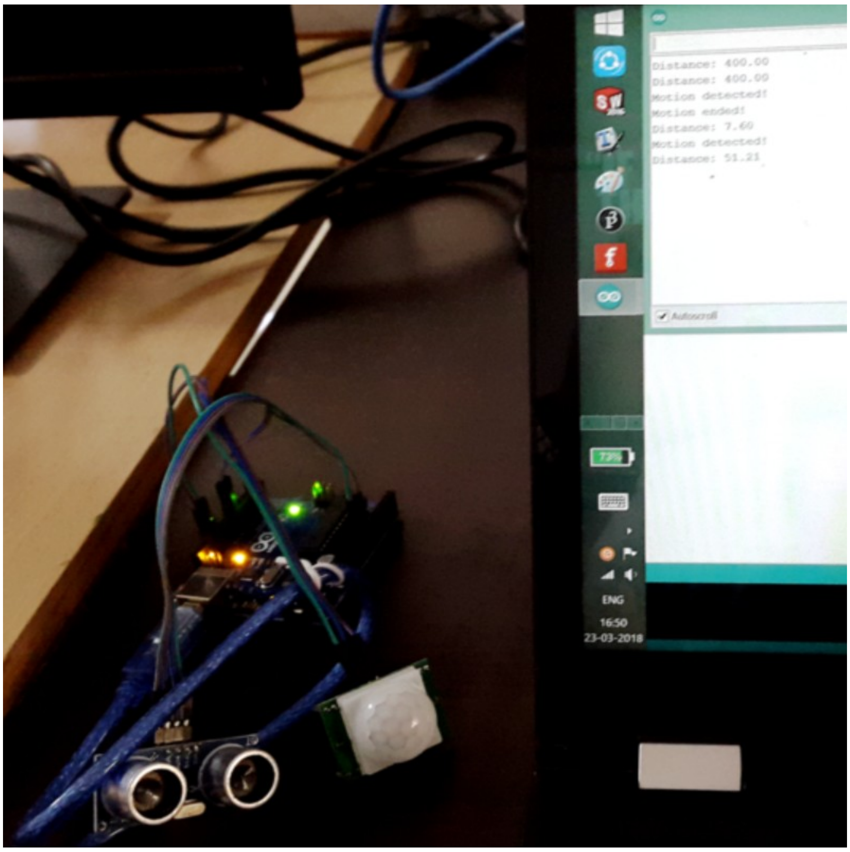
Parameter	PIR	Ultrasonic
Operating Voltage	3 to 10 V at Rs = 47 kΩ	DC 5 V
Range	Up to 10 meters (30 feet),	2cm – 4 m
Measuring Angle	69 degree(x axis) 62.5 degree(y axis)	15 Degree
supply current	0.2 mA (max 0.5 mA)	15mA
Terminals	Three(Vcc, Out, Gnd)	Four(Vcc,Trig,Echo,Gnd)
Application Areas	• Alarm systems • Consumer electronics • Human body detection • Automatic switches	• Robotics barrier • Object distance measurement • Level detection • Public security • Parking detection

Fritzing Diagram:



Code: Refer pir_ultrasonic_joe.ino

Actual demonstration in class:



2) You have been given 2 temperature sensors, each of a different variety. Take readings from both these sensors for the whole week by setting it up in your hostel and record the data. Using the data, provide your best estimate of sensor accuracy, precision and drift. Which of the two sensors is more reliable?

Thermistor Sensor Module

•The comparator output, the signal is clean, the waveform, driving ability, more than 15mA
•Adjust the temperature distribution bit detection threshold Specification Operating voltage
•The output in the form: Digital switching outputs (0 and 1); A fixed bolt hole for easy installation
•Wide voltage LM393 comparator Application Temperature detection, temperature control sensors, the ambient temperature detection

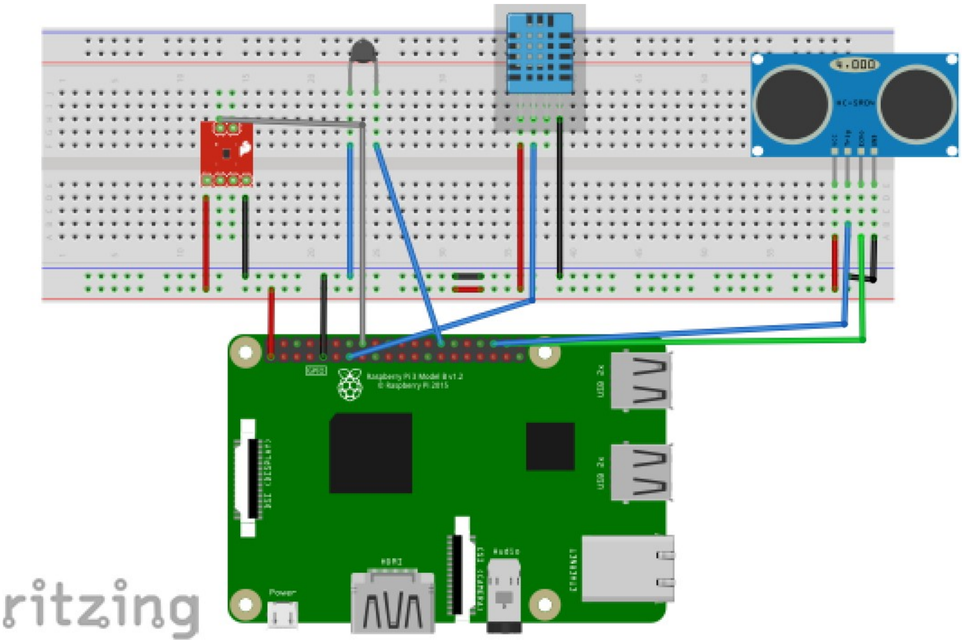
•Features
• NTC thermistor sensor
• LM393 voltage comparator
• Mounting hole for easy installation
• Adjustable threshold via potentiometer

Specifications
• Operating Voltage: 3.3 V to 5 V
• Output Current: 15 mA
• Output Type: Digital
• PCB Size: 32 mm x 14 mm

Code: Refer- iot_temp_us_joe.py

Data stored: Refer – iot4_temp_joe.txt

Fritzing Diagram:



Actual demonstration in class