

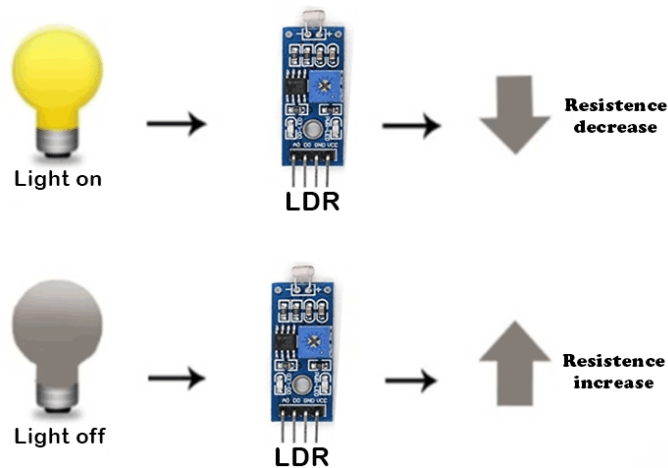


## Sensors(part2)

**3- Light Sensor LDR (Light Dependent Resistor):** Also called photoresistor, Is a light-controlled variable resistor. Works by sensing the intensity of light in its environment. This sensor has an Integrated circuit which contains a built in potentiometer and resistor.

### How does it Work:

The LDR gives out an analog voltage when connected to VCC (5V), which varies in magnitude in direct proportion to the input light intensity on it. That is, the greater the intensity of light, the greater the corresponding voltage from the LDR will be. Since the LDR gives out an analog voltage, it is connected to the analog input pin on the Arduino. The Arduino, with its built-in ADC (analog-to-digital converter), then converts the analog voltage (from 0-5V) into a digital value in the range of (0-1023). When there is sufficient light in its environment or on its surface, the converted digital values read from the LDR through the Arduino will be in the range of 800-1023.

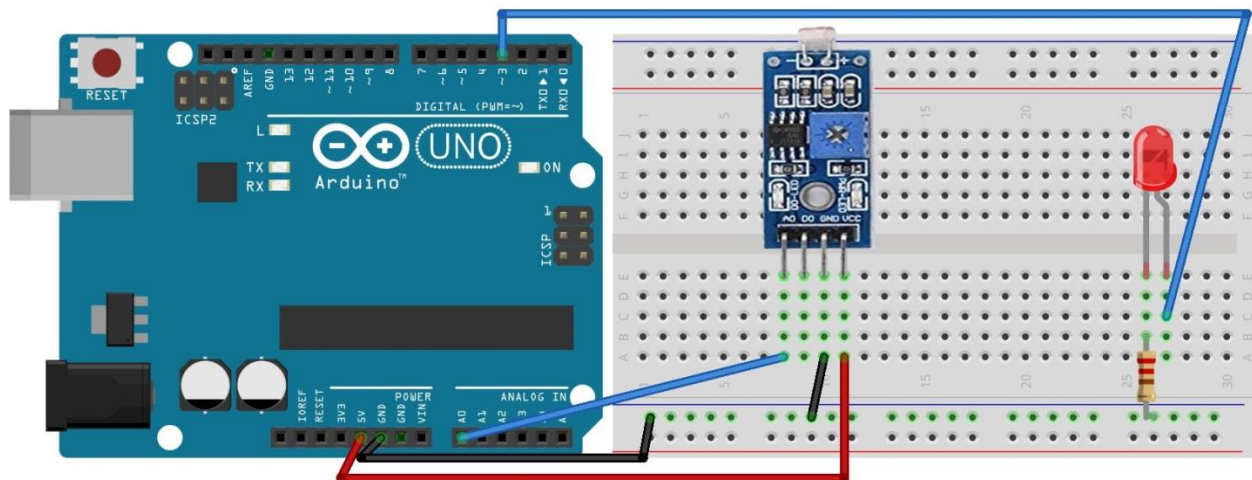


## Example

### (Measurement of intensity of light)

**Requirements:** Arduino, BreadBoard, Resistor, LDR Sensor, Led, wires.

**Connection map:**



**Code:**

```
int LDR =A0;
void setup(){
  pinMode(LDR,INPUT);
  pinMode(3,OUTPUT);
  Serial.begin(9600);
}
void loop(){
  int LDRvalue=analogRead(LDR);
  Serial.println(LDRvalue);
  if(LDRvalue >= 900){
    digitalWrite(3,HIGH);
  }else{
    digitalWrite(3,LOW);
  }
}
```

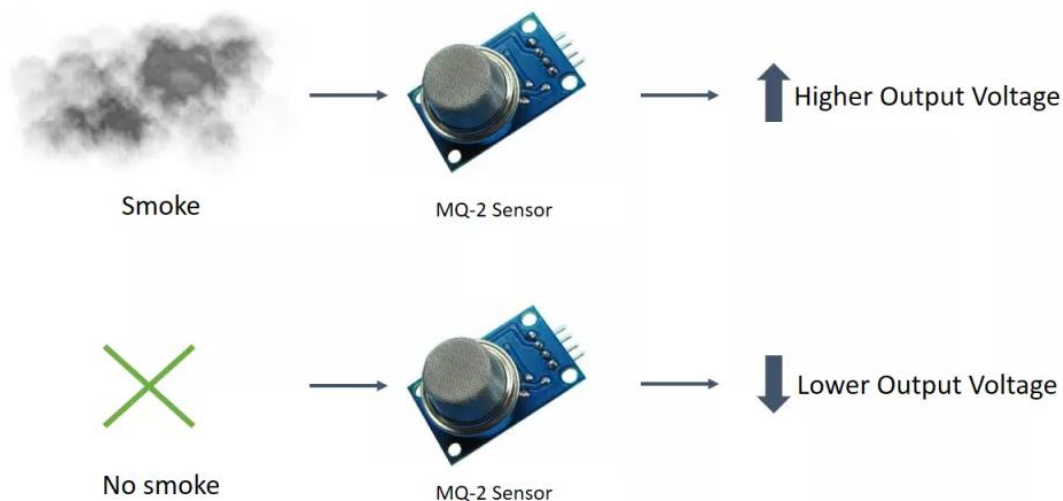


4- **MQ sensor:** is a gas sensor. There are different types of it such as **MQ2** for Combustible Gas and Smoke, **MQ3** for Alcohol Vapor, **MQ5** for LPG and Natural Gas and Town Gas, **MQ9** for Carbon Monoxide and Coal Gas and Liquefied Gas, and so on...

We will use the MQ2 type.

**How does it Work:**

Use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of the Arduino.

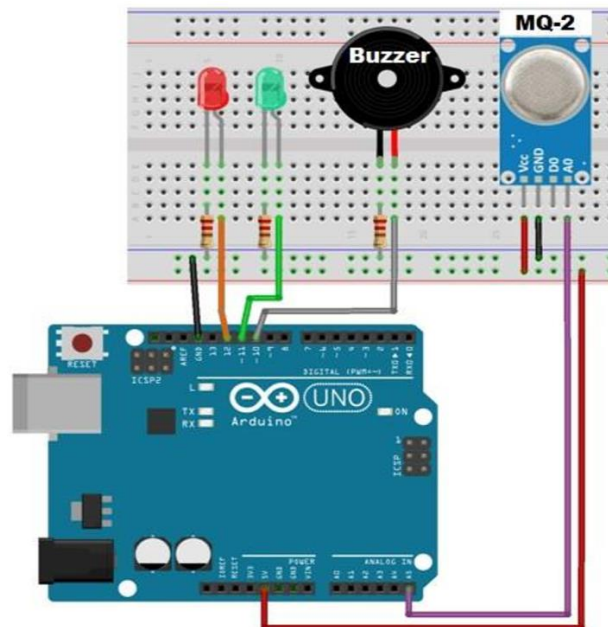


## Example

### (Measurement of qaz)

**Requirements:** Arduino, BreadBoard, Resistor, LDR Sensor, Led, wires.

**Connection map:**



**Code:**

```
int redLed = 12;
int greenLed = 11;
int buzzer = 10;
int smoke = A5;

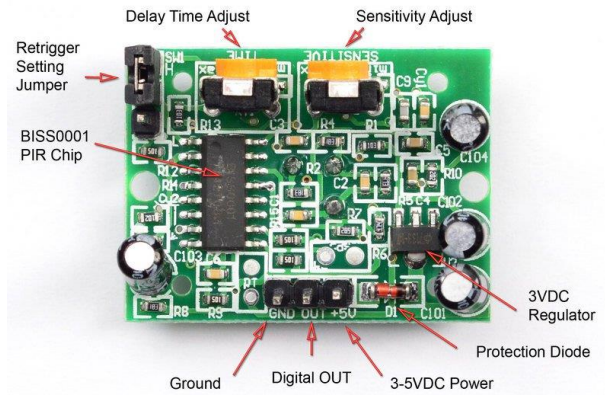
void setup() {
  pinMode(redLed, OUTPUT);
  pinMode(greenLed, OUTPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(smoke, INPUT);
  Serial.begin(9600);
}
```



```
void loop() {  
  int analogSensor = analogRead(smoke);  
  
  Serial.print("Qaz: ");  
  Serial.println(analogSensor);  
  if (analogSensor > 120)  
  {  
    digitalWrite(redLed, HIGH);  
    digitalWrite(greenLed, LOW);  
    tone(buzzer, 1000);  
  }  
  else  
  {  
    digitalWrite(redLed, LOW);  
    digitalWrite(greenLed, HIGH);  
    noTone(buzzer);  
  }  
  delay(100);  
}
```



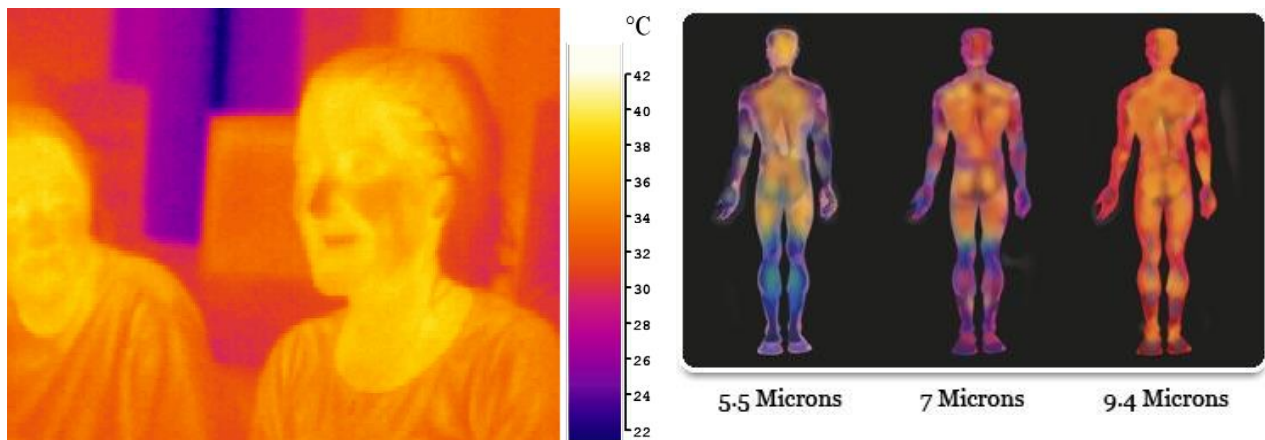
**5- PIR- Based motion sensor (passive infrared):** is a device that allow to sense motion, almost used to detect whether a human has moved in or out of the sensors range.



### How it works:

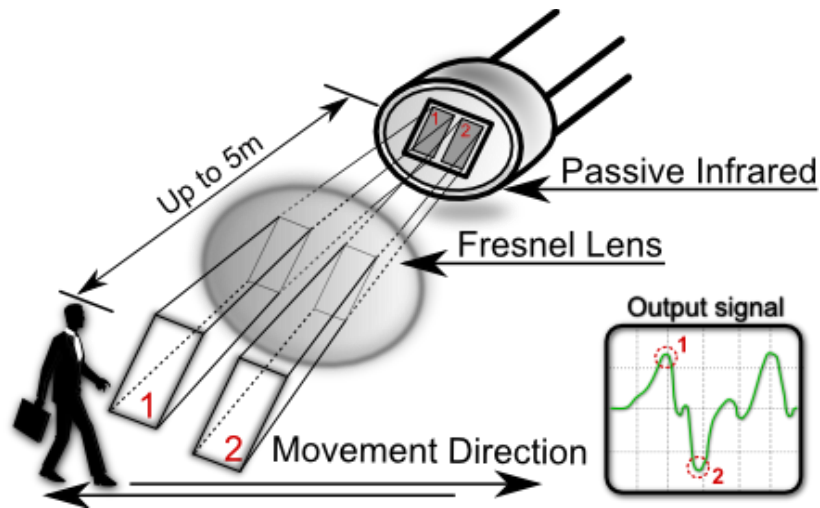
It used the infrared. Infrared is electromagnetic rays have all the basic properties of light, phenomena of diffusion, reflection, refraction, interference, diffraction and polarization. When analyze the light to its basic colors, and measure the temperature of the colored spectrum components using the thermometer. When the thermometer is moved from the violet field to the red field, the temperature is the greatest value in the dark part behind the red light.

Anybody have infrared; have a certain range of frequencies for the infrared spectrum. For example, a human has a range of infrared with a wavelength of 4 to 11 micrometers.





The sensor consists of a thermoelectric matrix of small size, where the matrix draws infrared radiation from the objects. As the change in the infrared level emitted from the observed objects, it works to change the resistance of the matrix, resulting in a voltage drop that produces a current that corresponds with Intensity of change in infrared.

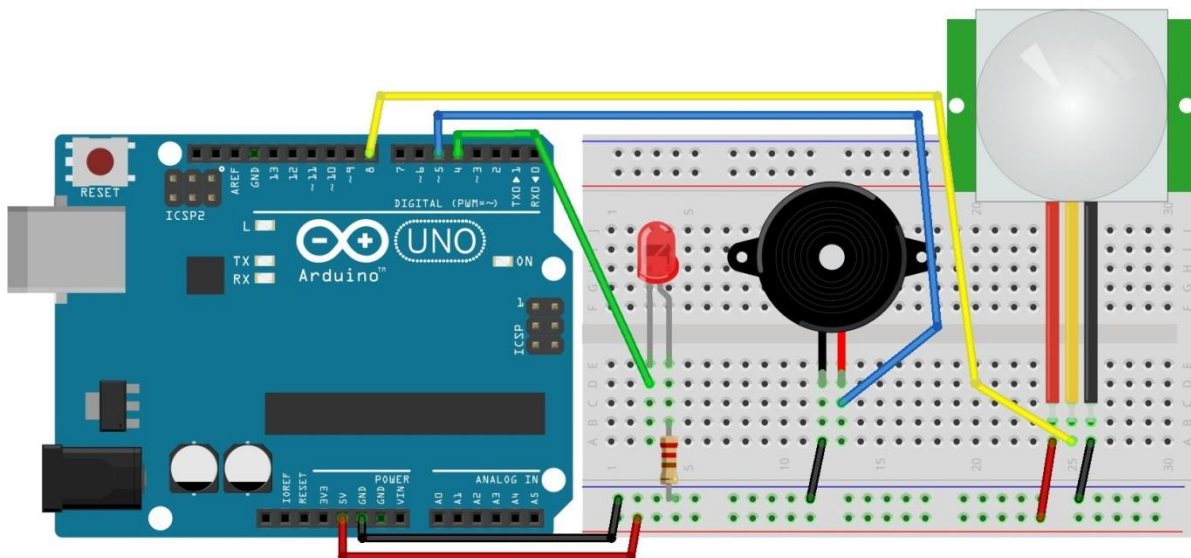


## Example

### (Measurement of qaz)

**Requirements:** Arduino, BreadBoard, Resistor, PIR Sensor, Led, Buzzer, wire.

**Connection map:**





**Code:**

```
int PIR=8;
int led=4;
int buzzer=5;

void setup() {
  pinMode(PIR, INPUT);
  pinMode(led, OUTPUT);
  pinMode(buzzer, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  if(digitalRead(PIR) == HIGH)
  {
    digitalWrite(led, HIGH);
    digitalWrite(buzzer, HIGH);
    Serial.println("motion detected");
  }
  else {
    digitalWrite(led, LOW);
    digitalWrite(buzzer, LOW);
    Serial.println("scanning");
  }
}
```





**6- Ultrasonic sensor:** The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package.

Work from 2cm to 400 cm or 1 to 13 feet. Its operation is not affected by sunlight or black material. It comes complete with ultrasonic transmitter and receiver module.



### How does it Work:

- a- The transmitter (trig pin) sends a signal: a high-frequency sound.
- b- When the signal finds an object, it is reflected and...
- c- ... The transmitter (echo pin) receives it.



The equation of distance is **distance = duration\* speed**

Here the speed is a speed of air 340µm in one second. But this sensor used cm, so we need to convert speed to cm to become 0.0340cm. The output distance represents the distance for Send & Receive, so we need to divide it on 2. The equation becomes:

$$\text{distance} = \text{duration} * 0.034/2$$

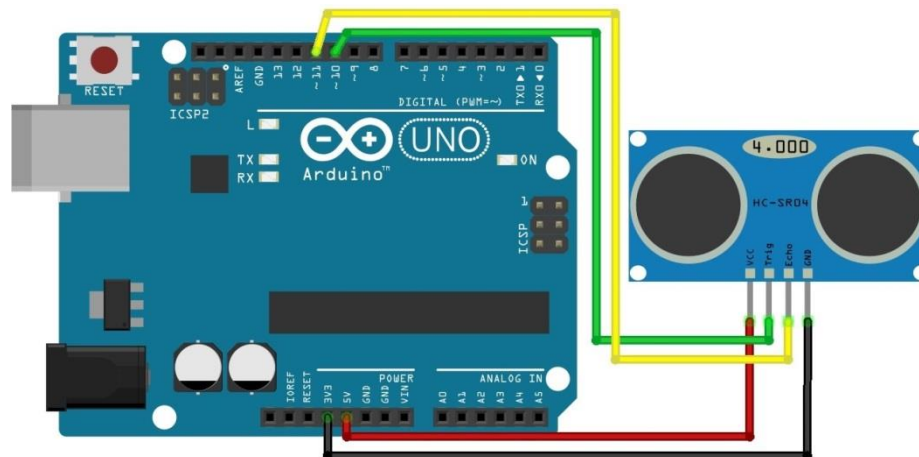


## Example

### (Measurement of distance)

**Requirements:** Arduino, Ultrasonic Sensor, wire.

**Connection map:**



**Code:**

```
int TRIG=10;
int ECHO=11;

void setup() {
  pinMode(TRIG, OUTPUT);
  pinMode(ECHO, INPUT);
  Serial.begin(9600);
}

void loop() {
  digitalWrite(TRIG, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG, LOW);
```



```
long duration= pulseIn(ECHO, HIGH);  
int distance= duration*0.034/2;  
if(duration==0){  
    Serial.println("Warning: no pulse from sensor");  
}  
else{  
    Serial.print("distance to nearest object:");  
    Serial.print(distance);  
    Serial.println(" cm");  
}  
delay(1000);  
}
```



## **Solution of H.W lab5**

### **1- Why do we need a sensor in our life (why it is important) with example?**

A sensor is who provides data to the system via its input. Suppose you set your air conditioning system to bring the room temperature to 15 degrees, considering it was previously off (and the current temperature of the room is different that 15 degrees), now the system starts pumping air to bring the room to the desired temperature, how does it know when the room temperature has been reached?

Here is where the sensor comes into play: there must be a sensor in the room to tell the air-conditioning system to stop pumping when the wanted temperature is attained.

We need sensor to feed data to the system and tell the controller when to take action.

If you are building an Arduino powered car that will avoid obstacle while cruising, you could for example make use of a collision crash sensor to tell the controller when an obstacle is ahead of the car, then the controller can tell the wheel to stop and move to a different direction.

### **2- Why some sensors have a built-in potentiometer?**

Sensors that deal with analog signals have values from 0 to 1023. To control the amount of this value, we use potentiometer to control the sensitivity of the sensor.

Previously the sensors were single and needed to be bonded to potentiometer so that we could deal with light sensitivity, but recently the potentiometer was added as built-in to the sensor circuit to facilitate handling.

## **H.W**

1- Why use array in a programming language?

2- What is a type of array? Explain each type with example?