IETE WELCOMES YOU

SENSOR WORKSHOP

2018

WHY DO WE NEED SENSORS?

Arduino → Brain

Sensors → Method of communicating

All electronics project require some sort of physical translation device.

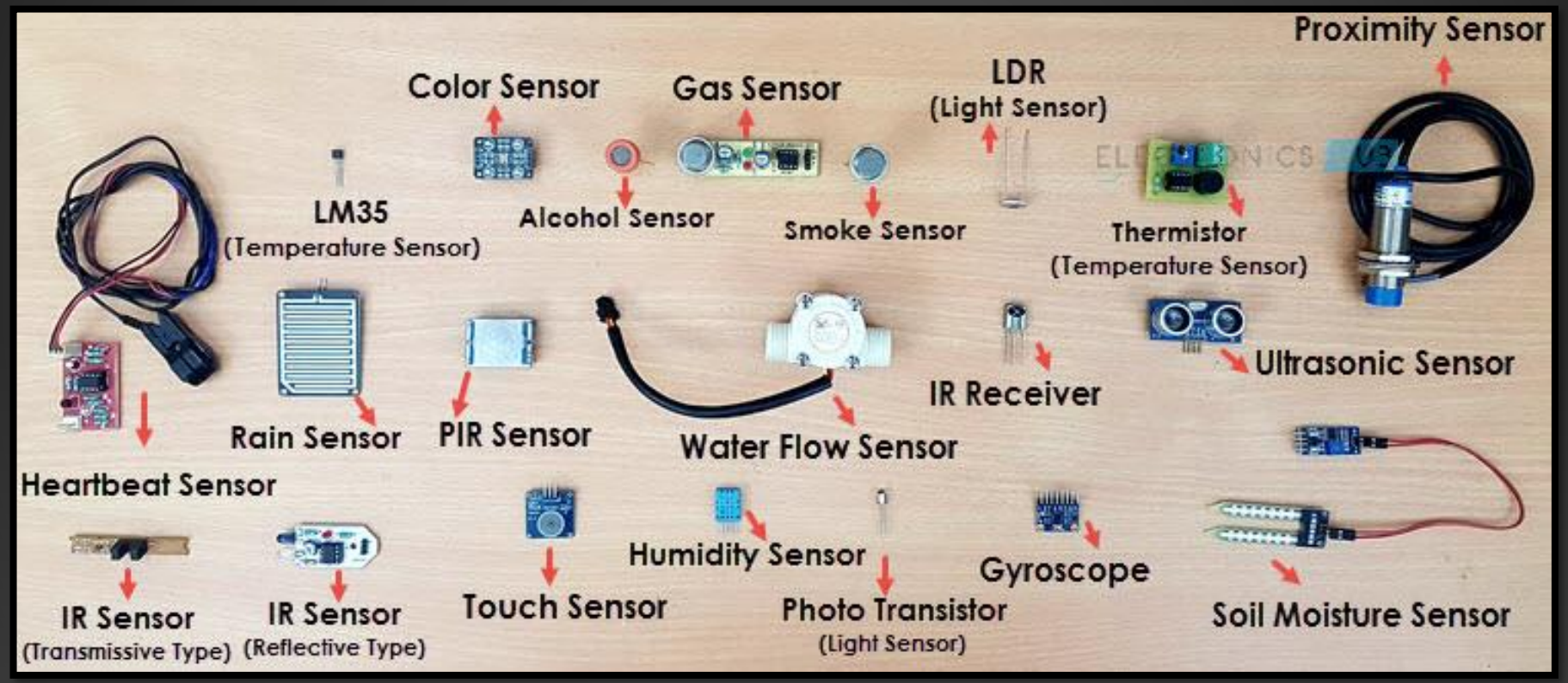
Whether to convert the real world to data (e.g. Motion Detection)

or

data to real world (e.g. speakers)

HOW DO WE USE SENSORS?

Sensors are attached to Arduino via the Breadboard



WHAT SENSORS WILL BE TAUGHT?

- IR Sensor (Line follower)
- Passive Infrared Sensor (Home Security)
- Sound Wave Sensor (Project Showcase)
- Temperature Sensor
- Ultrasonic Sensor (Collision dist. measurement)
- Keypad

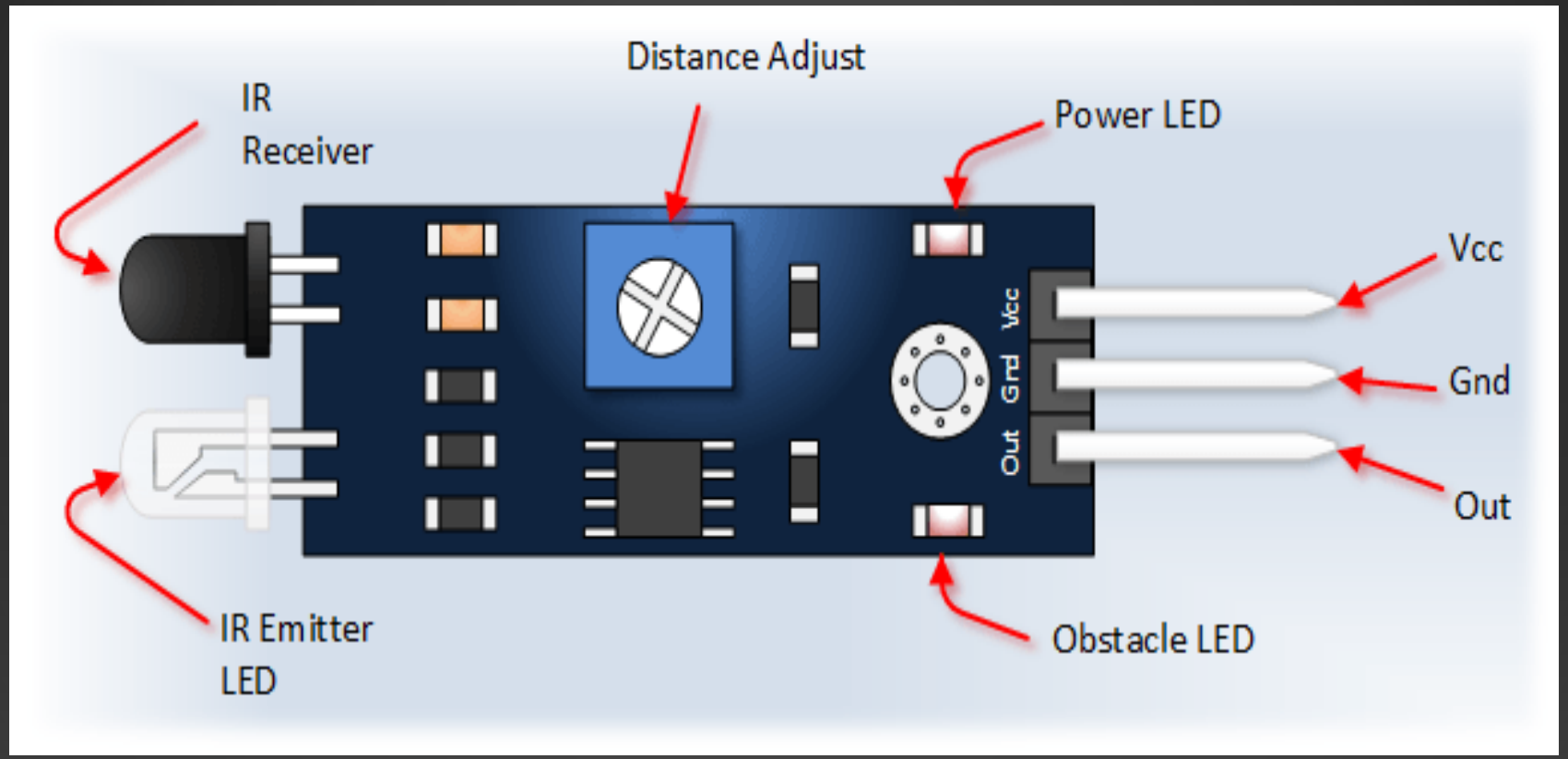
A COMMON QUESTION

Why not just embed the sensors into Arduino?

IR MODULE

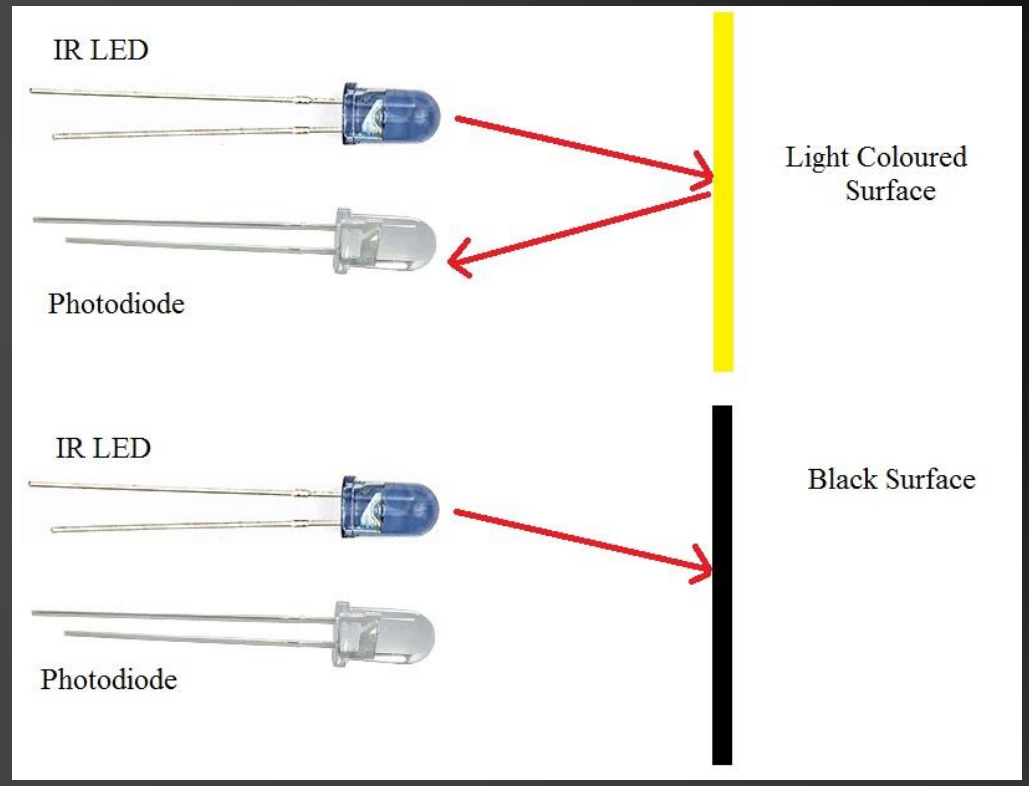
Used extensively in line followers, table top fighter etc.

PINS


Distance Adjust
IR
Receiver
Power LED
Vcc
Gnd
Out
Vcc
Gnd
Out
IR Emitter
LED
Obstacle LED

INTRODUCTION

- IR pair give off infrared radiation
- Radiation is reflected by nearby surfaces
- Darker color surfaces absorb the radiation
- Intensity of absorbed radiation is conveyed as output voltage
- Arduino receives input in range 1:1024, corresponding to the brightness of light received by the receiver



CODE:

```
int LED = 13;
int obstaclePin = 7;
int hasObstacle = HIGH;

void setup( ) {
  pinMode(LED, OUTPUT);
  pinMode(obstaclePin, INPUT);
  Serial.begin(9600);
}
```

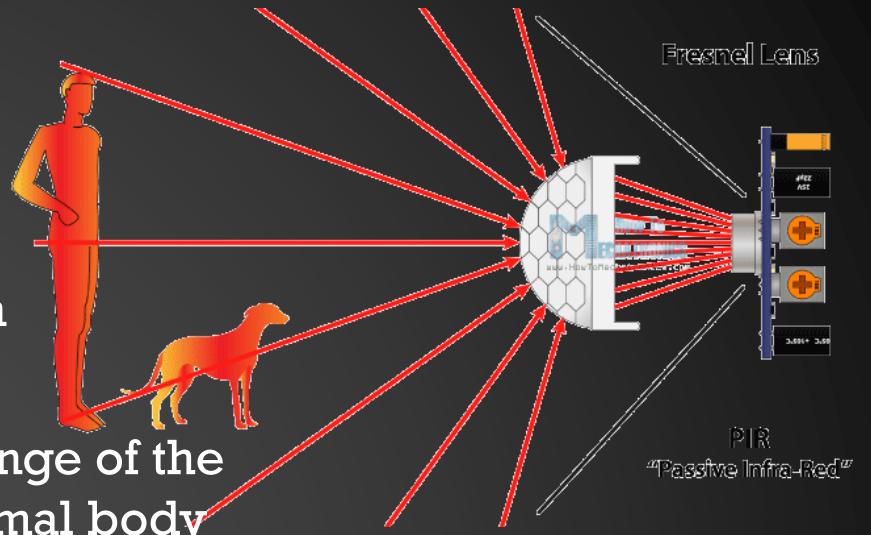
```
void loop( ) {
  hasObstacle = digitalRead(obstaclePin);
  if (hasObstacle == HIGH)   {
    Serial.println("Stop");
    digitalWrite(LED, HIGH);
  }
  else   {
    Serial.println("Path is clear");
    digitalWrite(LED, LOW);
  }
  delay(200);
}
```

PASSIVE INFRARED SENSOR (PIR)

INTRO

- As we Know All objects with Temperature above absolute zero ,even Human body, emits heat energy in form of Infrared Radiation
- These IR radiation can not be detected by Human eye
- It is an electronic Sensor that detects infrared radiation emitted by any object within its Range of view
- This Sensor is often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.
- PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range
- Being small, inexpensive, low-power, easy to use, IT is widely used in Security and Surveillance Systems for Motion detection

WORKING



- 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 Term "passive" means that sensor does not generate or radiate energy for Detection purposes , it just works by detecting the energy given off by the other objects.
- Its do not measure How much heat given by object But only it detects them
- It uses a specially designed cover named Fresnel lens, which focuses the infrared signals onto the pyroelectric sensor.

APPLICATIONS

- Automatic Street/Garage/Warehouse or Garden Lights
- Burglar Alarms
- Security cams as motion detectors
- Industrial / Home Automation Control

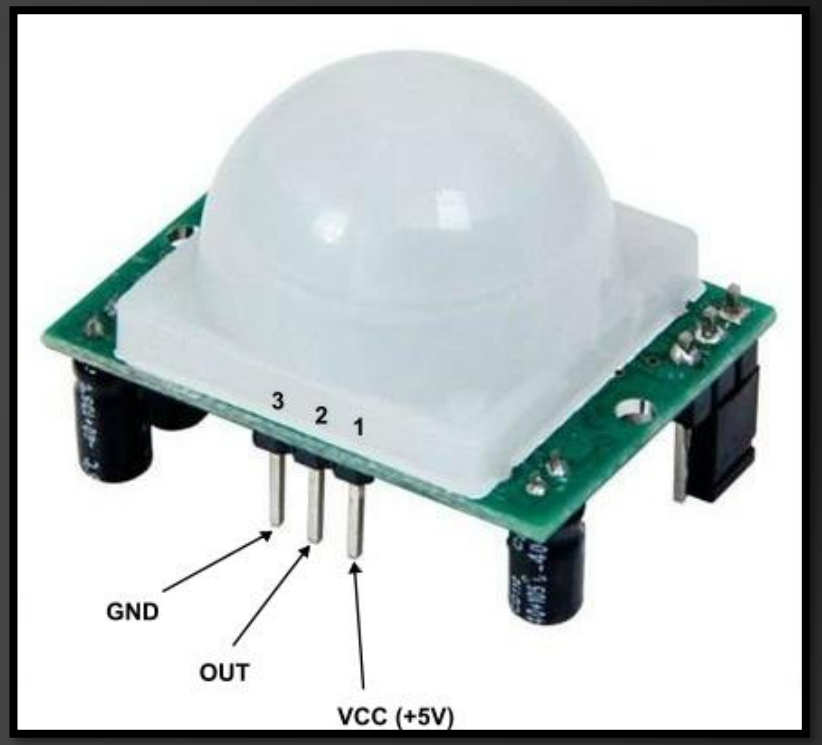
PIN DIAGRAM

This sensor has three output pins:-

- VCC
- OUTPUT
- GROUND

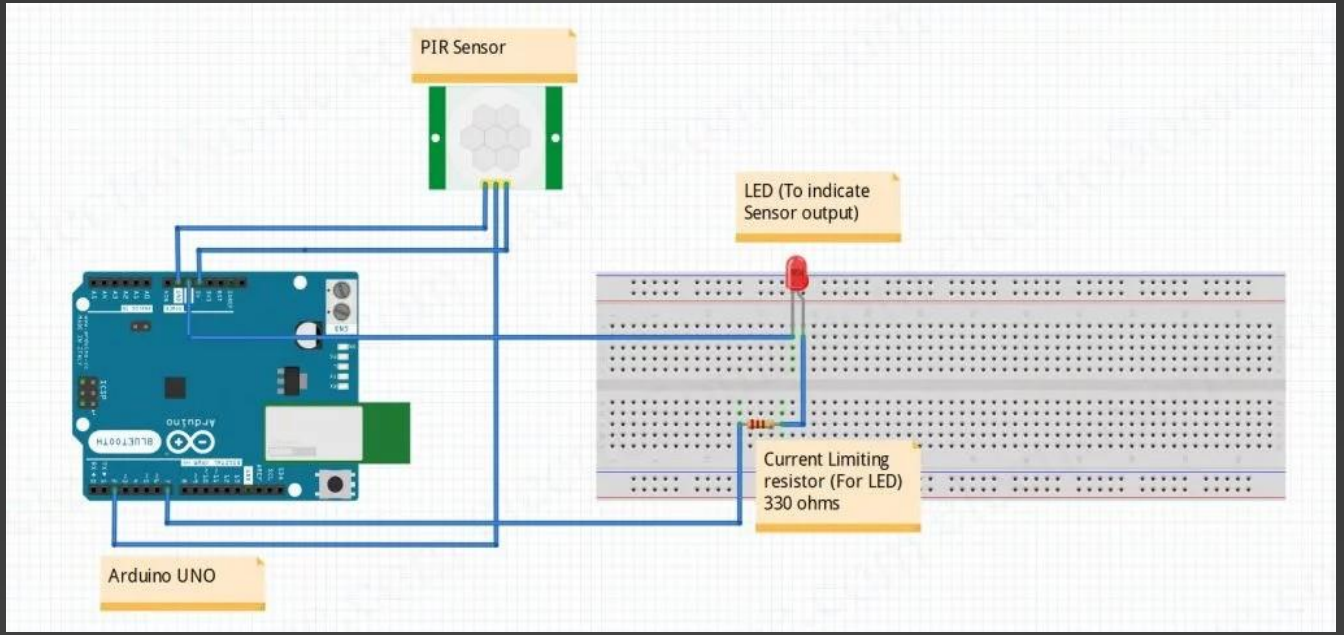
This sensor has Two Potentiometers:

- One - for sensitivity of range of Sensors
- Other - for Time delay Adjust



SCHEMATIC

- Connect positive terminal of LED to one lead of the Resistor
- Connect other lead of the resistor to digital pin 7 of Arduino
- Connect negative terminal of LED to GND pin of Arduino

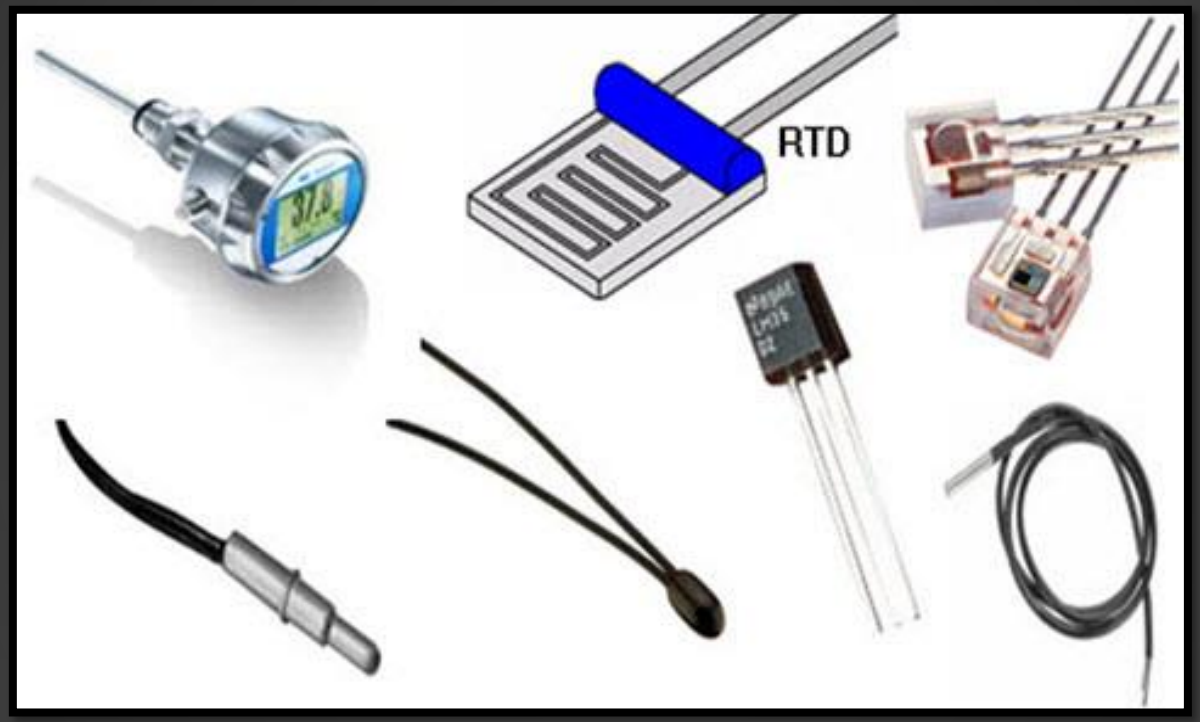


CODE:

```
void setup( )  {
pinMode (7,OUTPUT);
pinMode (2,INPUT);
Serial.begin(9600);
}
```

```
void loop( )  {
int i=digitalRead(2);
if (i==1)  {
digitalWrite(7, HIGH);
Serial.println("MOTION DETECTED");
}
else
        digitalWrite (7, LOW);
}
```

TEMPERATURE SENSOR

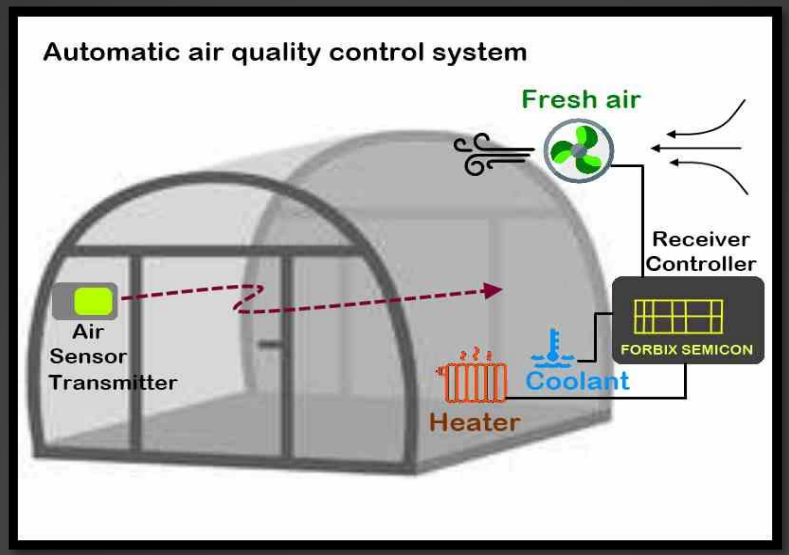


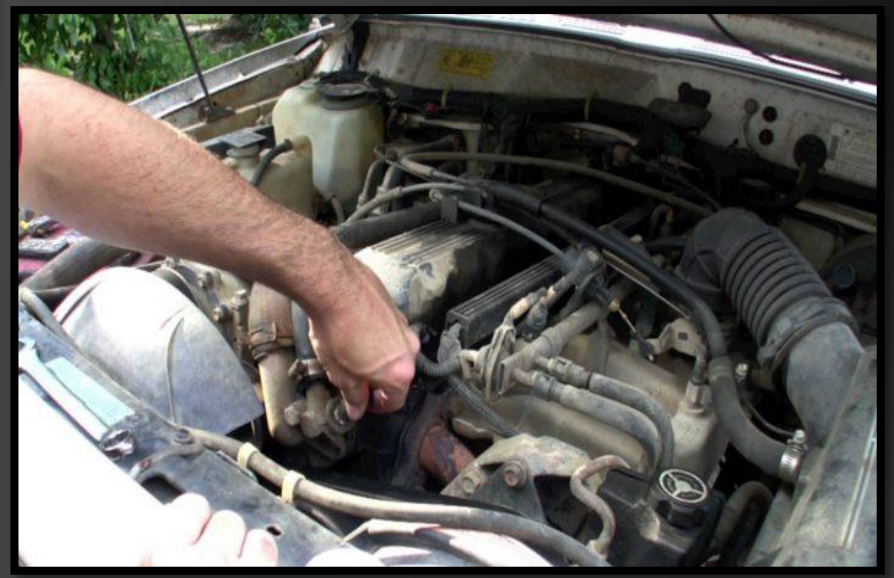
LM35

TEMPERATURE SENSOR

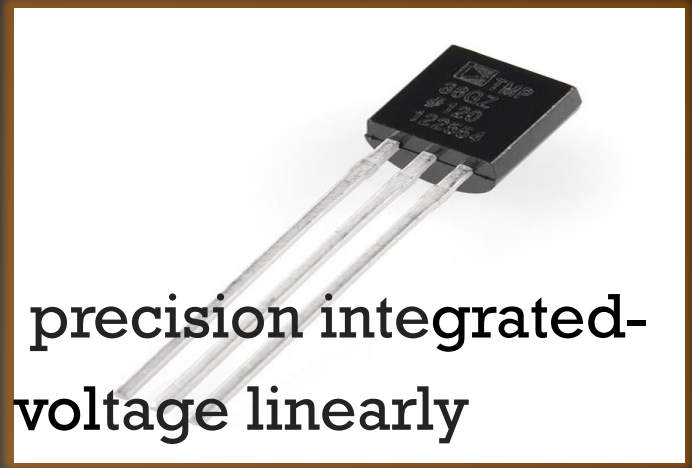
A temperature sensor is a thermocouple or a resistance temperature detector (RTD) that gathers the temperature from a specific source and alters the collected information into understandable type for an apparatus or an observer.

APPLICATIONS





LM-35

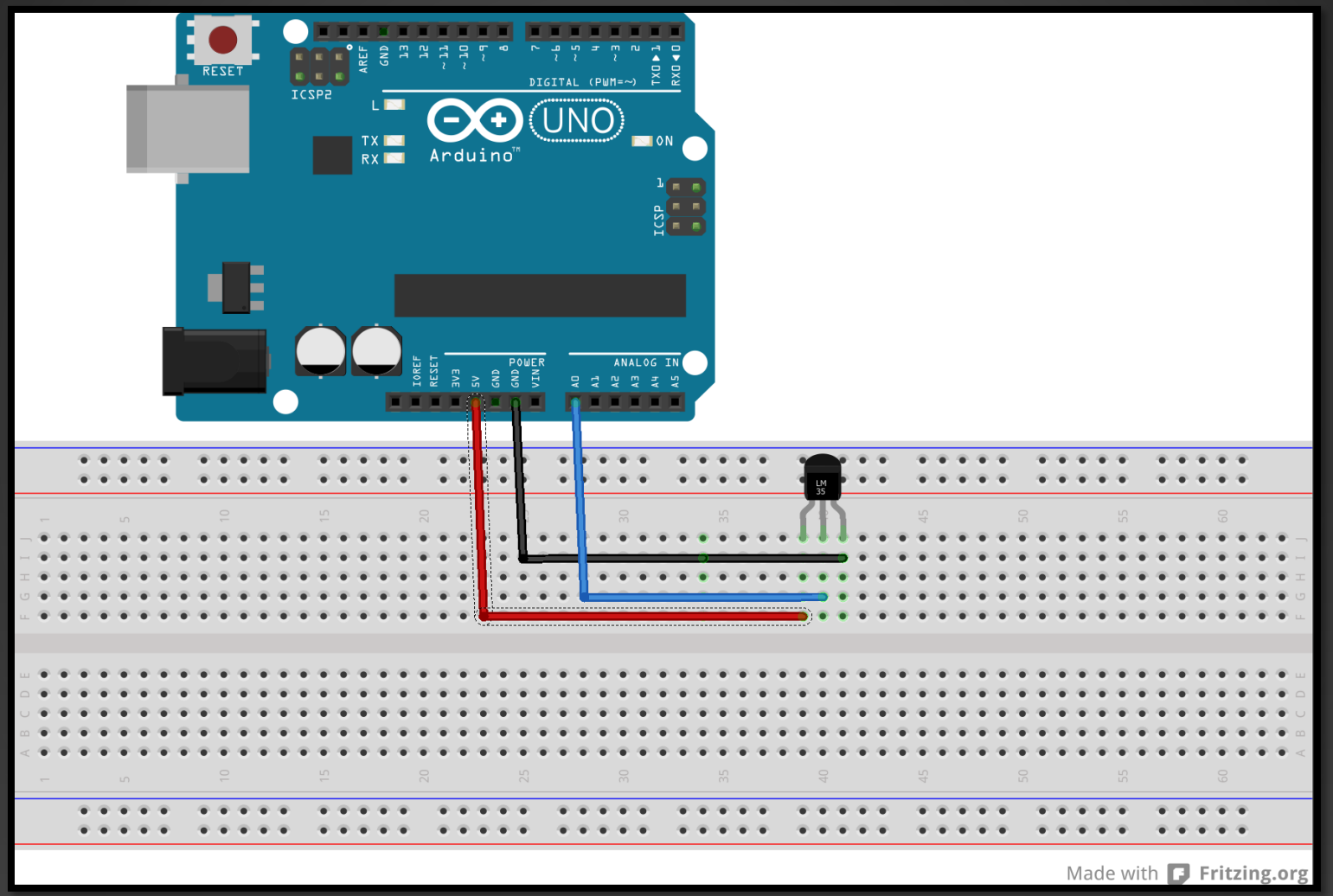


- The Temperature Sensor LM35 series are precision integrated-circuit temperature devices with output voltage linearly proportional to the Centigrade temperature
- The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

TECHNICAL SPECIFICATIONS

- Calibrated directly in Celsius (Centigrade)
- Linear + 10-mV/°C scale factor
- 0.5°C ensured accuracy (at 25°C)
- Rated for full −55°C to 150°C range
- Suitable for remote applications

CIRCUIT DIAGRAM



CODE:-

```
float temp;
int tempPin=0;
void setup( ) {
        Serial.begin(9600);
}
void loop()   {
temp=analogRead(tempPin);
temp=temp*0.48828125;
Serial.print("TEMPERATURE = ");
Serial.print(temp);
Serial.print("*C");
Serial.println( );
delay(1000);     }
```

PIN EXPLANATION

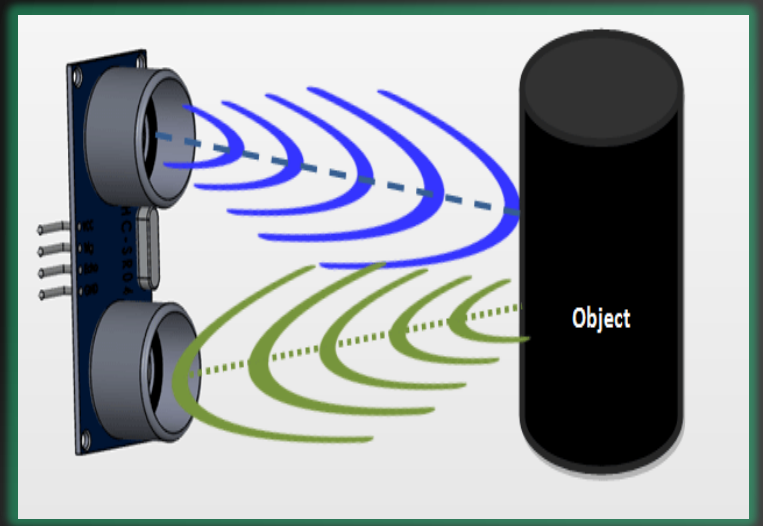
LM35 sensor has three terminals - V_s, V_{out} and GND. We will connect the sensor as follows –

- Connect the $+V_s$ to +5v on your Arduino board.
- Connect V_{out} to Analog0 or A0 on Arduino board.
- Connect GND with GND on Arduino.

The Analog to Digital Converter (ADC) converts analog values into a digital approximation based on the formula ADC Value = sample * 1024 / reference voltage (+5v). So with a +5 volt reference, the digital approximation will be equal to input voltage * 205.

ULTRASONIC SENSORS

WHAT IS AN ULTRASONIC SENSOR?



Ultrasonic sensors measure distance by using ultrasonic waves

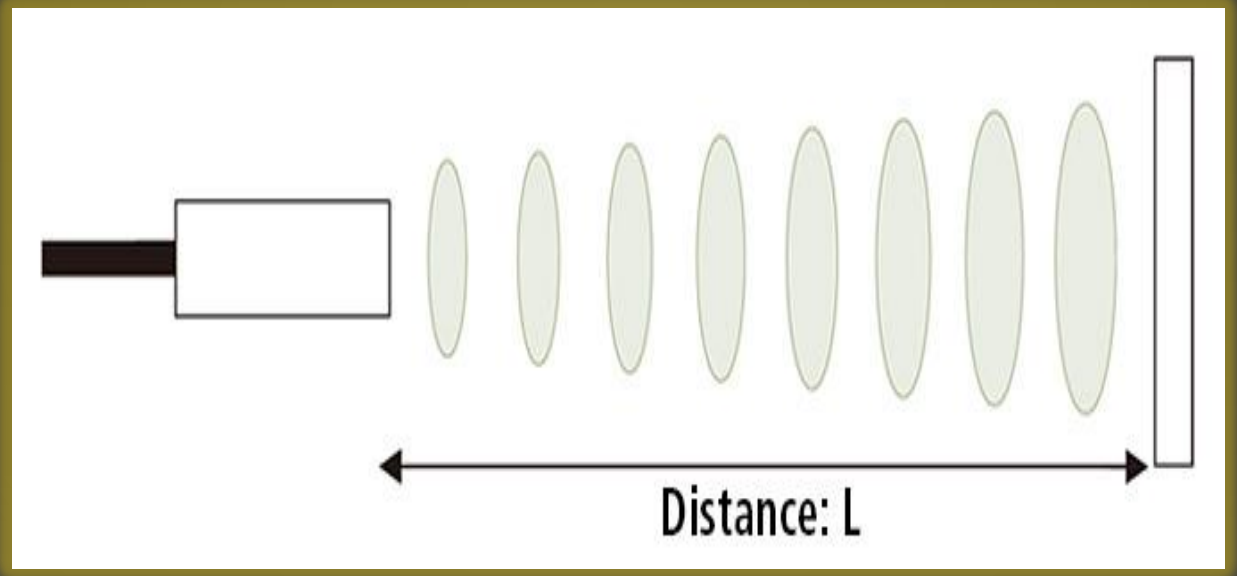
The sensor head emits an ultrasonic wave and receives the reflected wave back from the target

They measure the distance to the target by measuring the time between the emission and reception

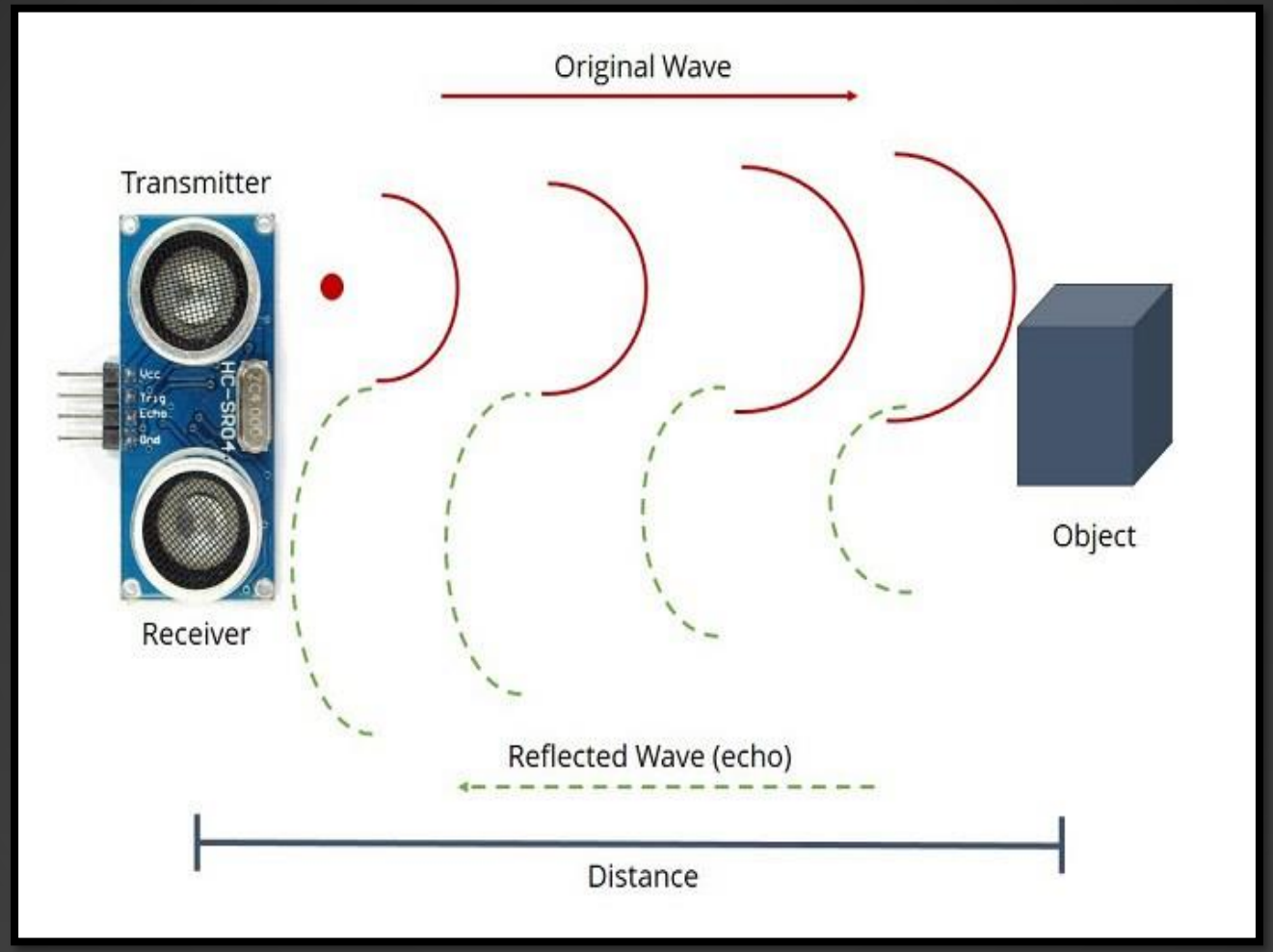
DISTANCE CALCULATION

The distance is:- *Distance L = (T × C) / 2*

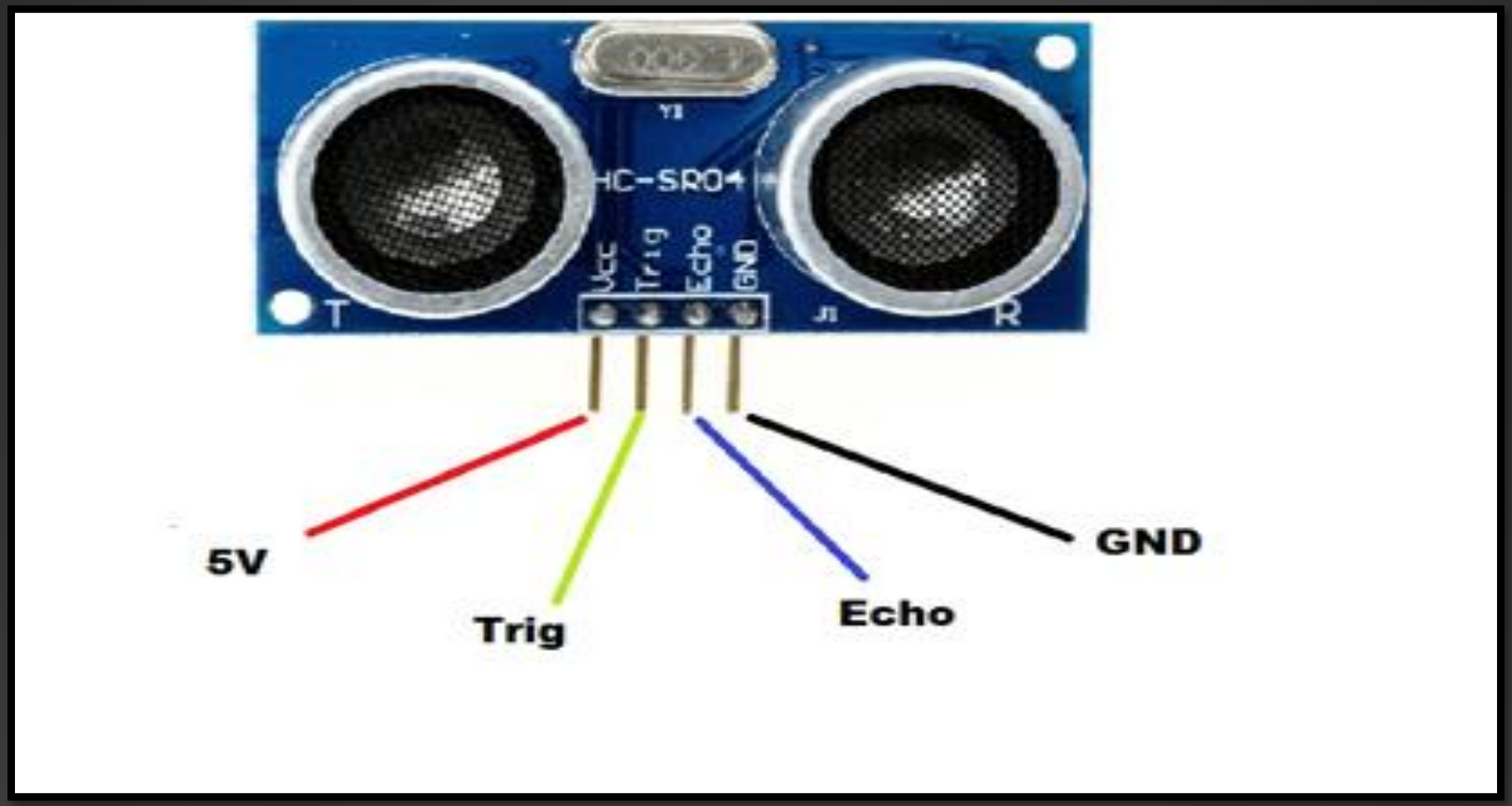
where L is the distance, T is the time between the emission and reception, and C is the sonic speed



WORKING


Original Wave
Transmitter
Vcc
Trig
Echo
Gnd
HC-SR04
Receiver
Object
Reflected Wave (echo)
Distance

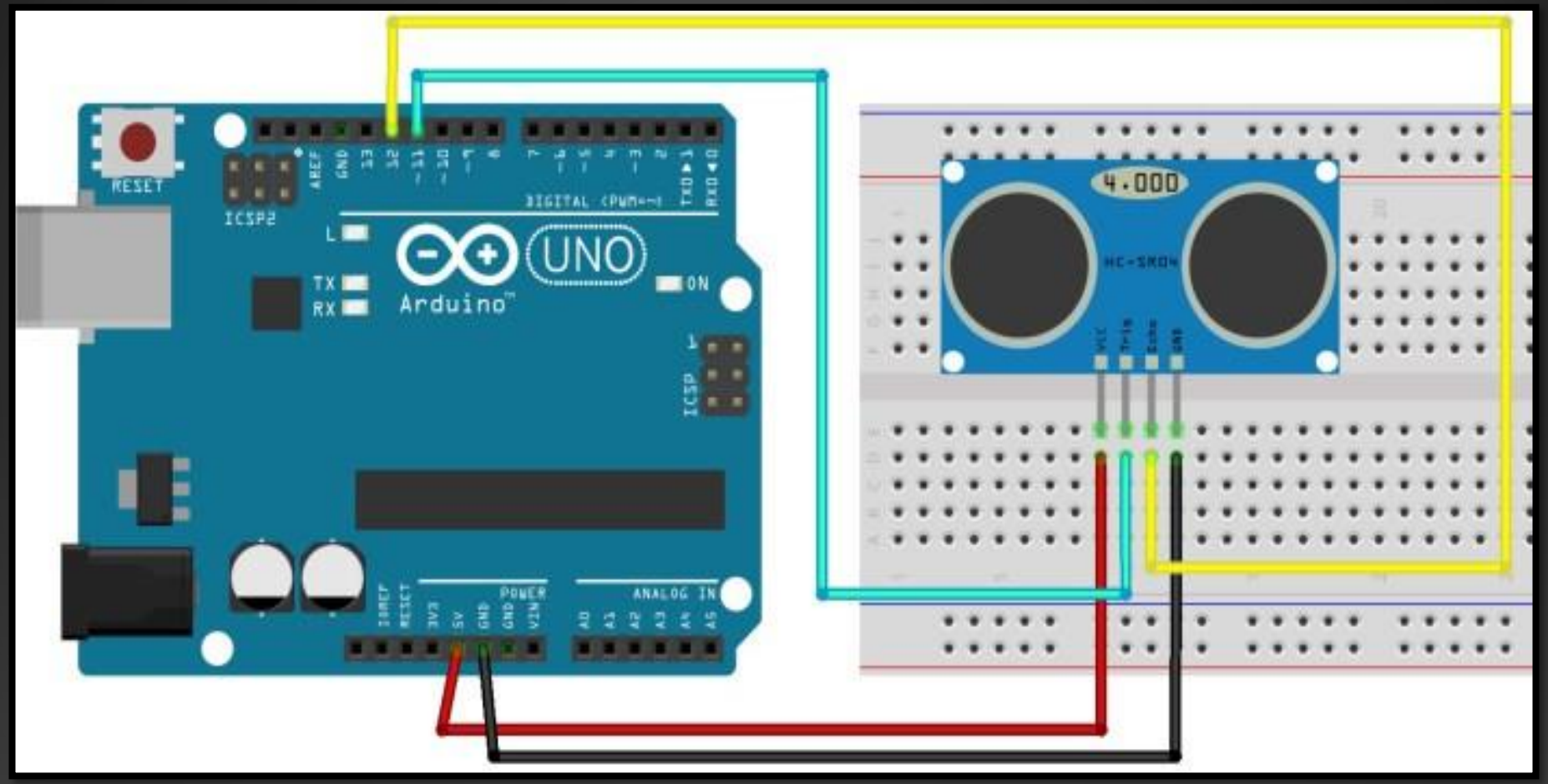
HC-SR04



HC-SR04 SENSOR FEATURES

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Operating Frequency: 40KHz

CONNECTIONS



SOURCE CODE

```
const int Trig_pin=11;
const int Echo_pin=12;
void setup( ) {
pinMode(Trig_pin,OUTPUT);
pinMode(Echo_pin,INPUT);
Serial.begin(9600);  }
void loop( ) {
long distance, duration;
digitalWrite(Trig_pin,LOW);
delayMicroseconds(2);
digitalWrite(Trig_pin,HIGH);
delayMicroseconds(10);
digitalWrite(Trig_pin,LOW);
duration=pulseIn(Echo_pin,HIGH);
distance=(duration*0.034)/2;
If(distance>100||distance<0)
        Serial.println("out of range");
else {
        Serial.print(distance);
        Serial.println("cm");  }
        delay(1000);  }
```

APPLICATIONS

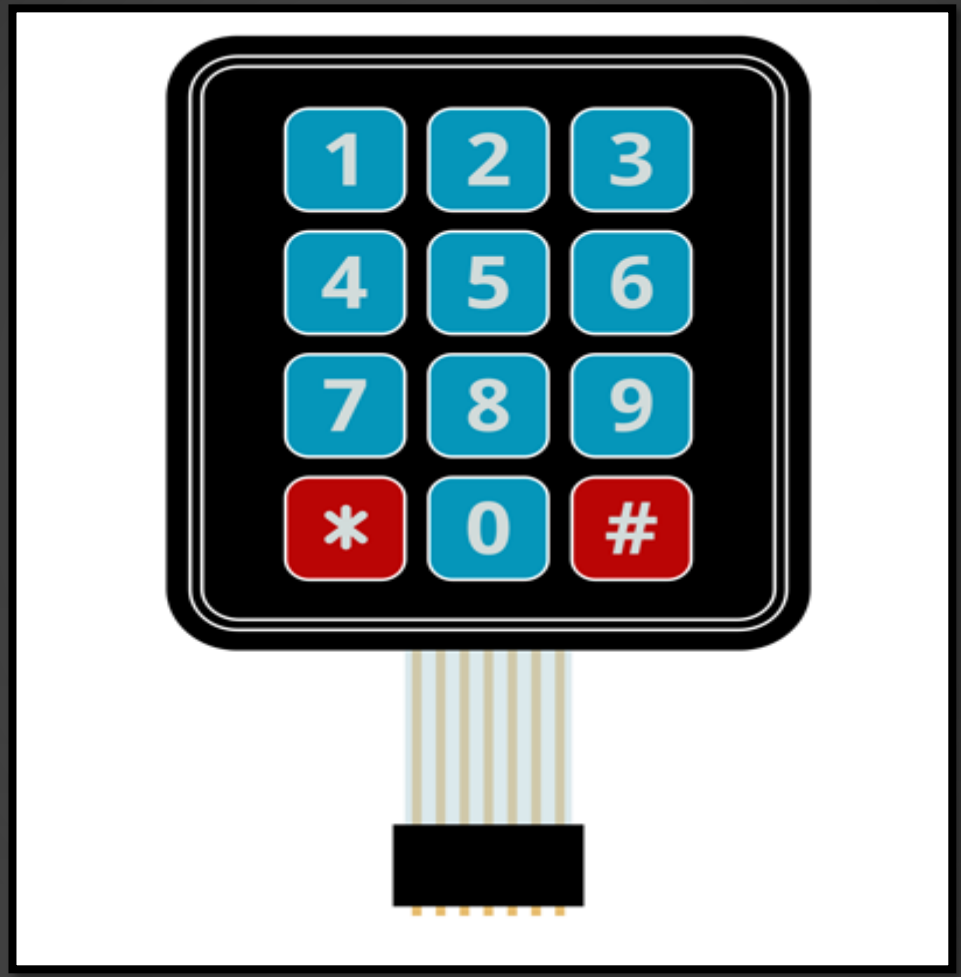
Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.

Used to measure the distance within a wide range of 2cm to 400cm

Can be used to map the objects surrounding the sensor by rotating it

Depth Sensing of certain places like wells, pits etc can be measured since the waves can penetrate through water

KEYPAD

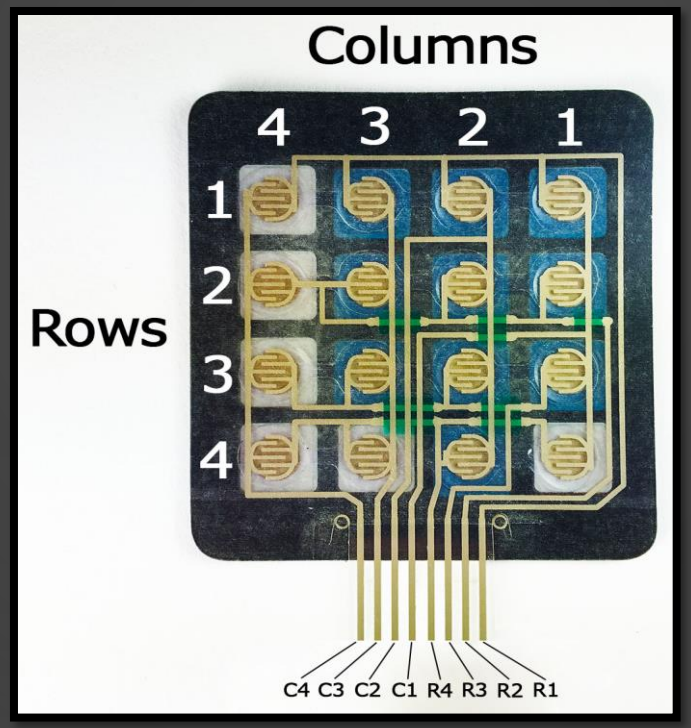


WHAT IS KEYPAD?

- A keypad is one of the most commonly used input devices in microprocessor applications.
- Membrane-type keypads are an economical solution for many applications. They are quite thin and can easily be mounted wherever they are needed.

WORKING

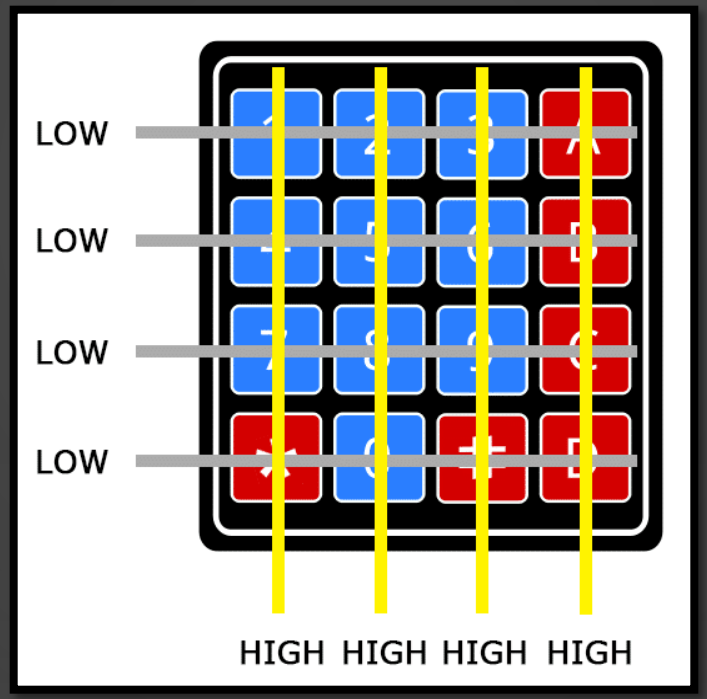
- Beneath each key is a membrane switch. Each switch in a row is connected to the other switches in the row by a conductive trace underneath the pad.
- Each row and column is brought out to a single pin, for a total of 8 pins on a 4X4 keypad:



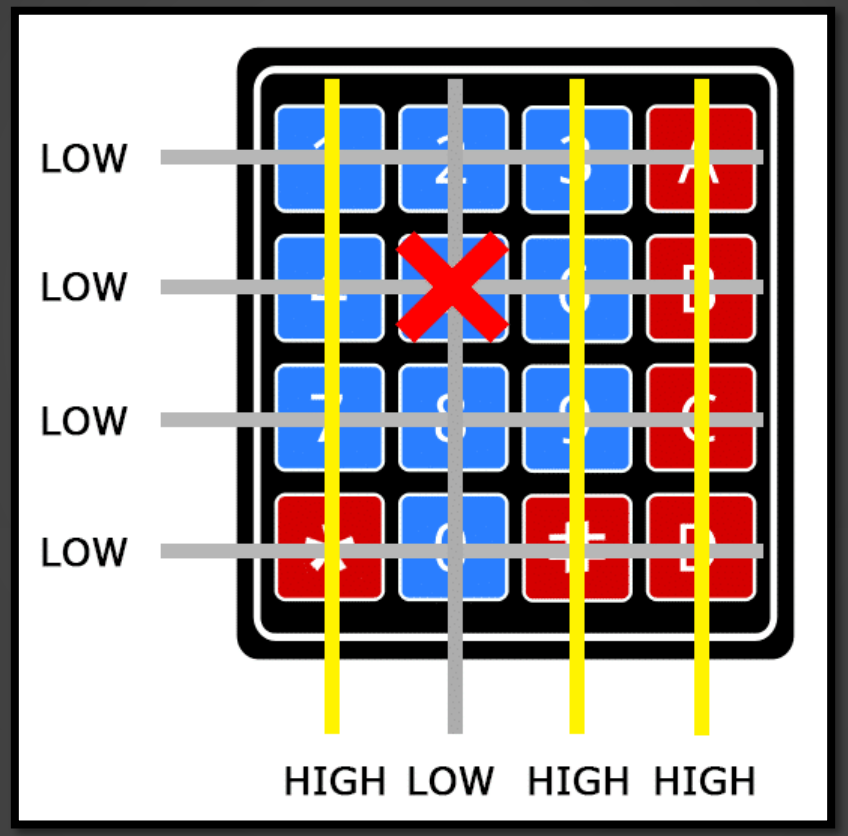
DETECTION

This happens in four steps:

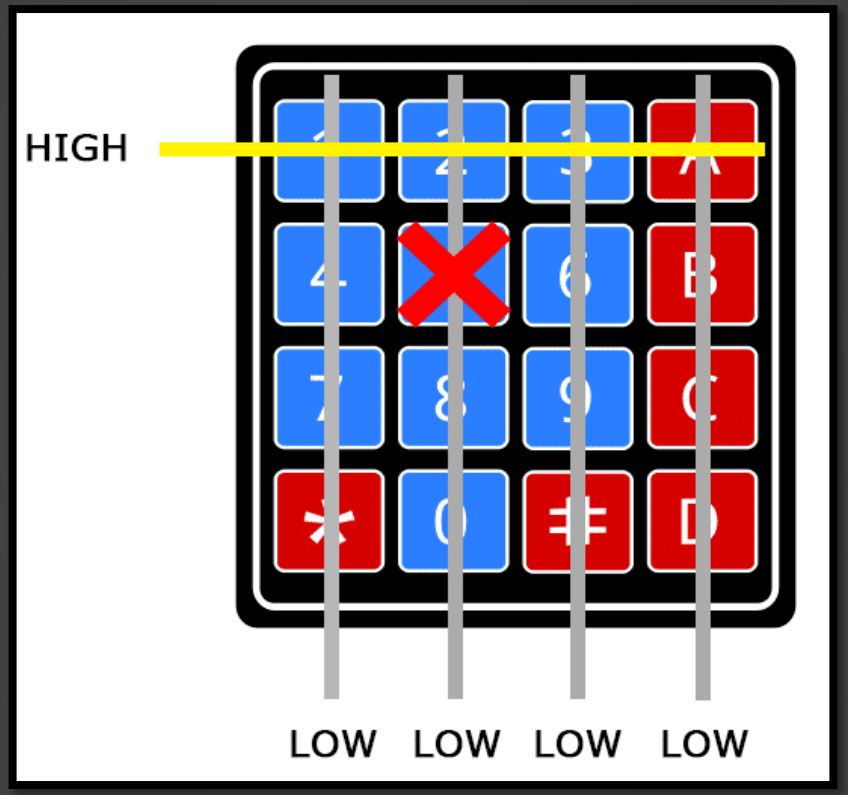
First, when no buttons are pressed, all of the column pins are held HIGH, and all of the row pins are held LOW:



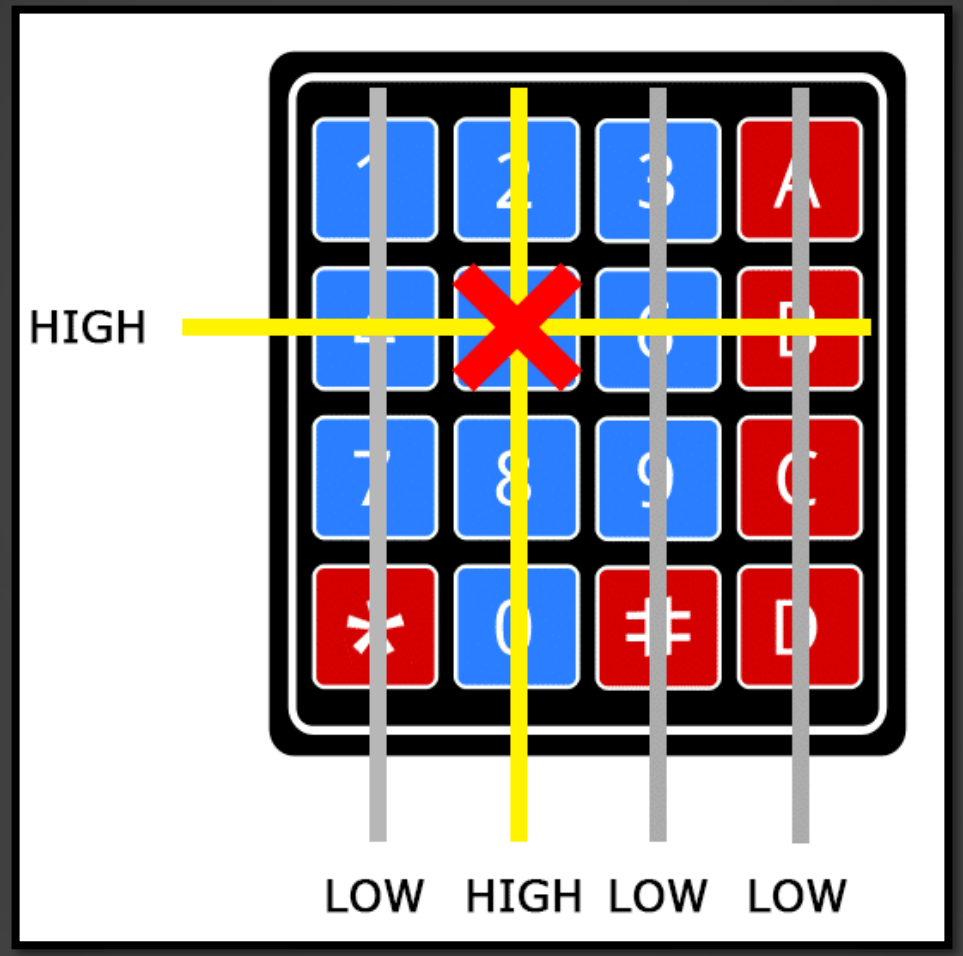
When a button is pressed, the column pin is pulled LOW since the current from the HIGH column flows to the LOW row pin:



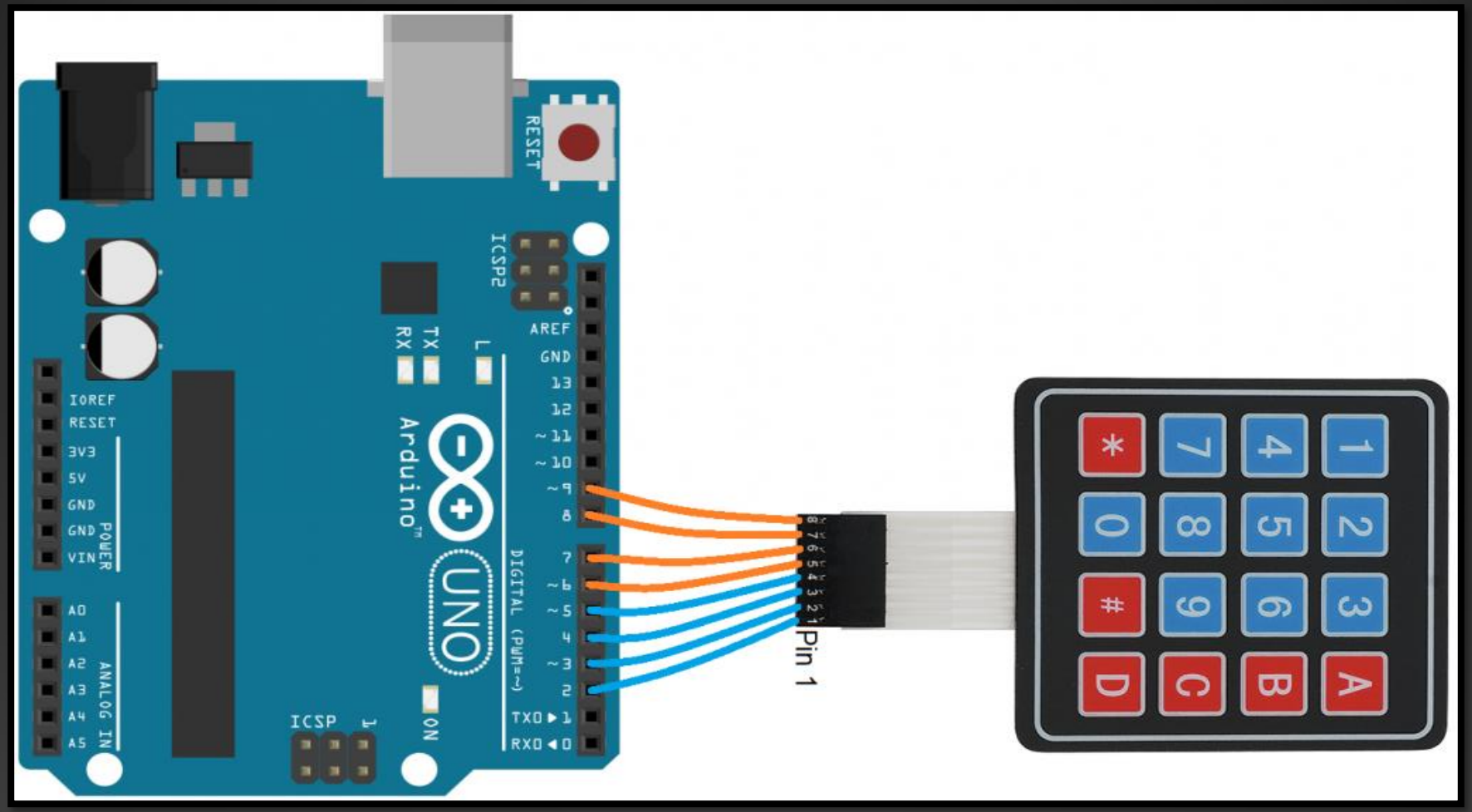
The Arduino now knows which column the button is in, so now it just needs to find the row the button is in. It does this by switching each one of the row pins HIGH, and at the same time reading all of the column pins to detect which column pin returns to HIGH:



When the column pin goes HIGH again, the Arduino has found the row pin that is connected to the button:



CONNECTIONS



CODE:

```
#include <Keypad.h>
const byte ROWS = 4;
 const byte COLS = 4;
char hexaKeys[ROWS][COLS] = {
      {'1', '2', '3', 'A'},
      {'4', '5', '6', 'B'},
      {'7', '8', '9', 'C'},
      {'*', '0', '#', 'D'}
};
byte rowPins[ROWS] = {9, 8, 7, 6};
 byte colPins[COLS] = {5, 4, 3, 2};
Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);
 void setup( ) {
 Serial.begin(9600);
}
 void loop( ) {
 char customKey = customKeypad.getKey();
 if (customKey)
   Serial.println(customKey);
}
```

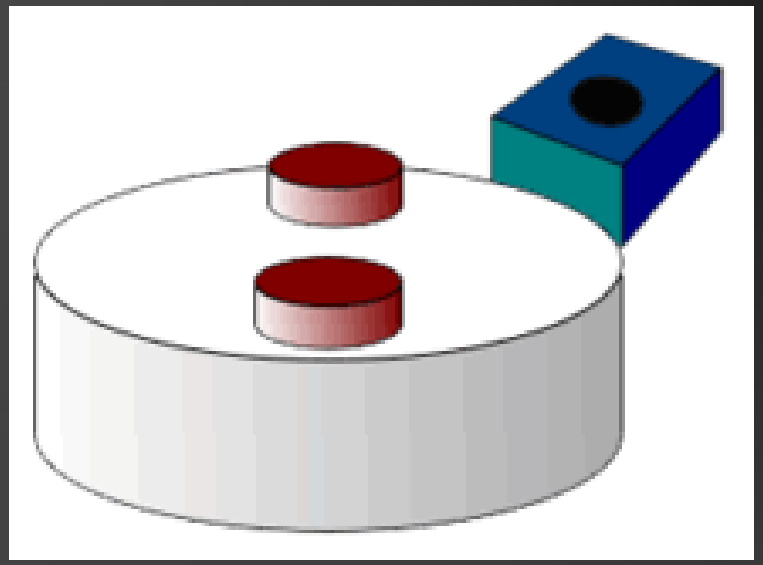
HALL-EFFECT SENSOR

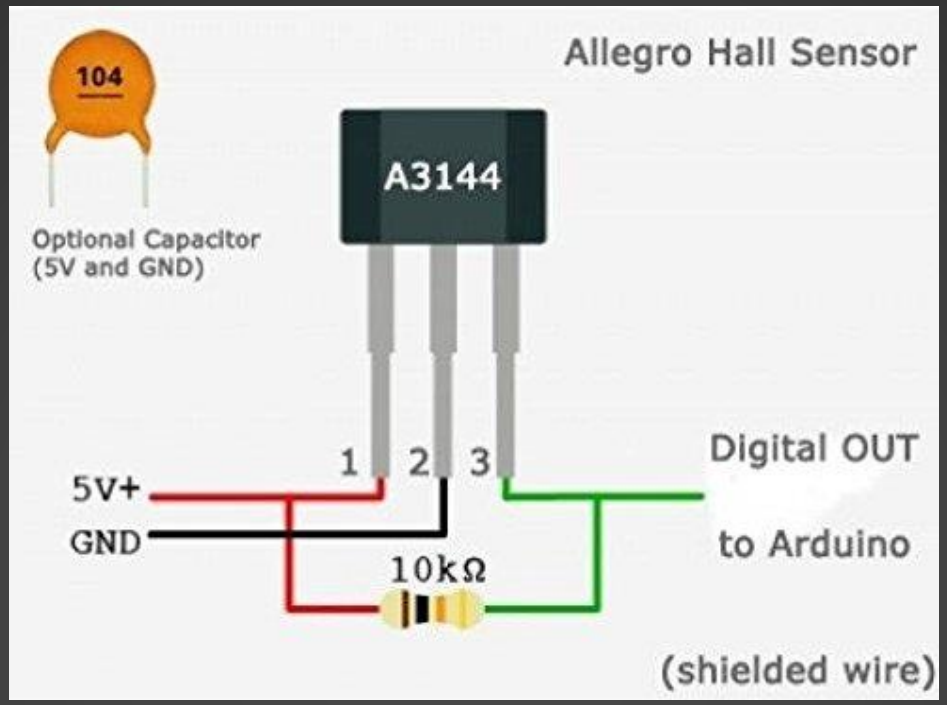
HALL-EFFECT SENSORS ARE TRANSDUCERS

(TRANSDUCER CONVERTS ONE FORM OF ENERGY INTO ANOTHER)

INTRODUCTION

- They are widely used as non-physical on-off switches
- They see application as proximity switching, positioning, speed detection, and current sensing applications





We will get a ‘LOW’ on input pin when magnetic field is present,
Otherwise, the pin will read high.

/*LOOK AT THE VALUES IN YOUR MODULE*/

CODE:

```
int hallSensorPin = 2;
int state = 0;
void setup( ) {
pinMode(hallSensorPin, INPUT);   }

void loop( ) {
state = digitalRead(hallSensorPin);
 if (state == LOW)
        Serial.println("ON");
 else
        Serial.println("OFF");
 delay(250);   }
```