INTRODUCTION TO EMBEDDED SYSTEMS

Instructors

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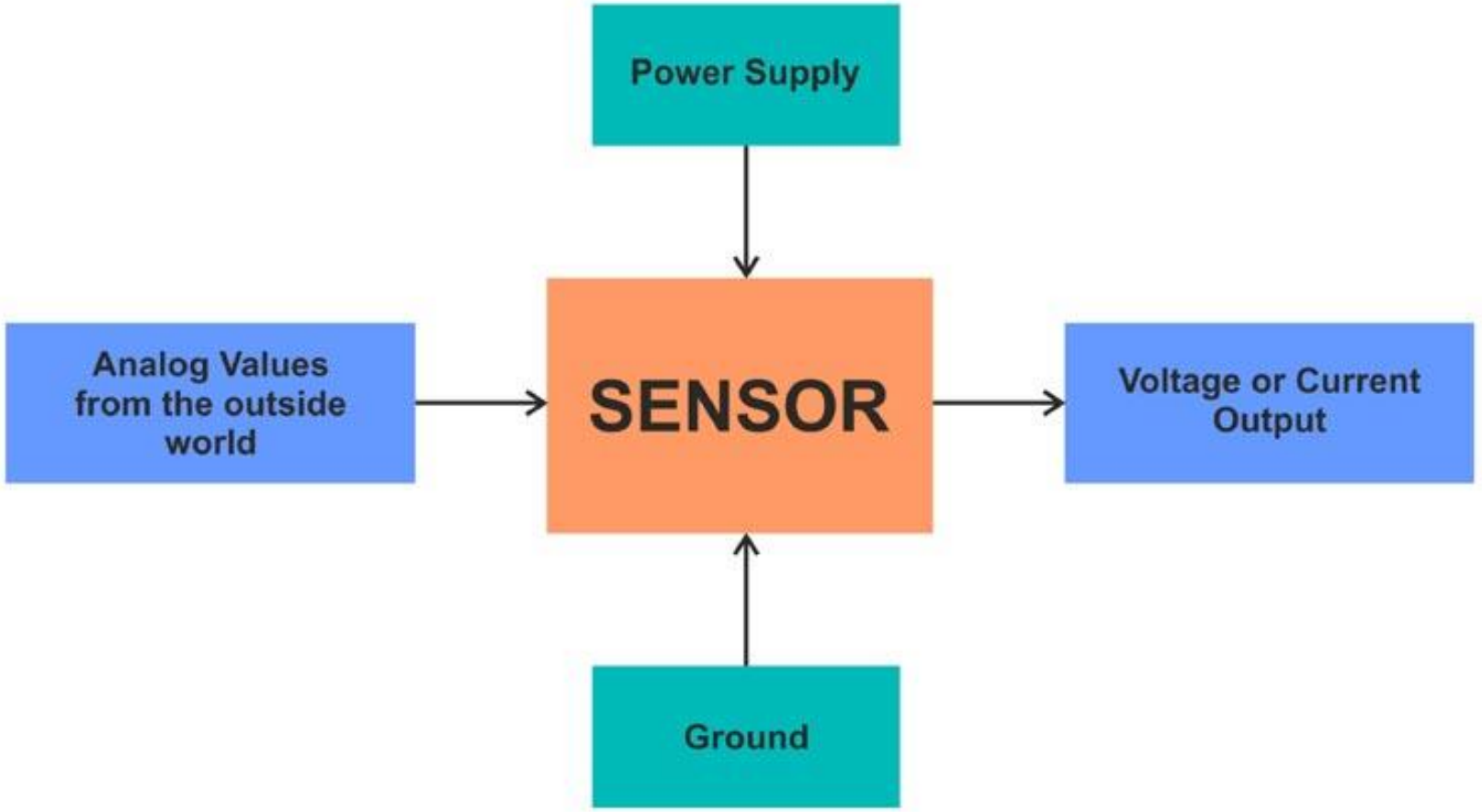
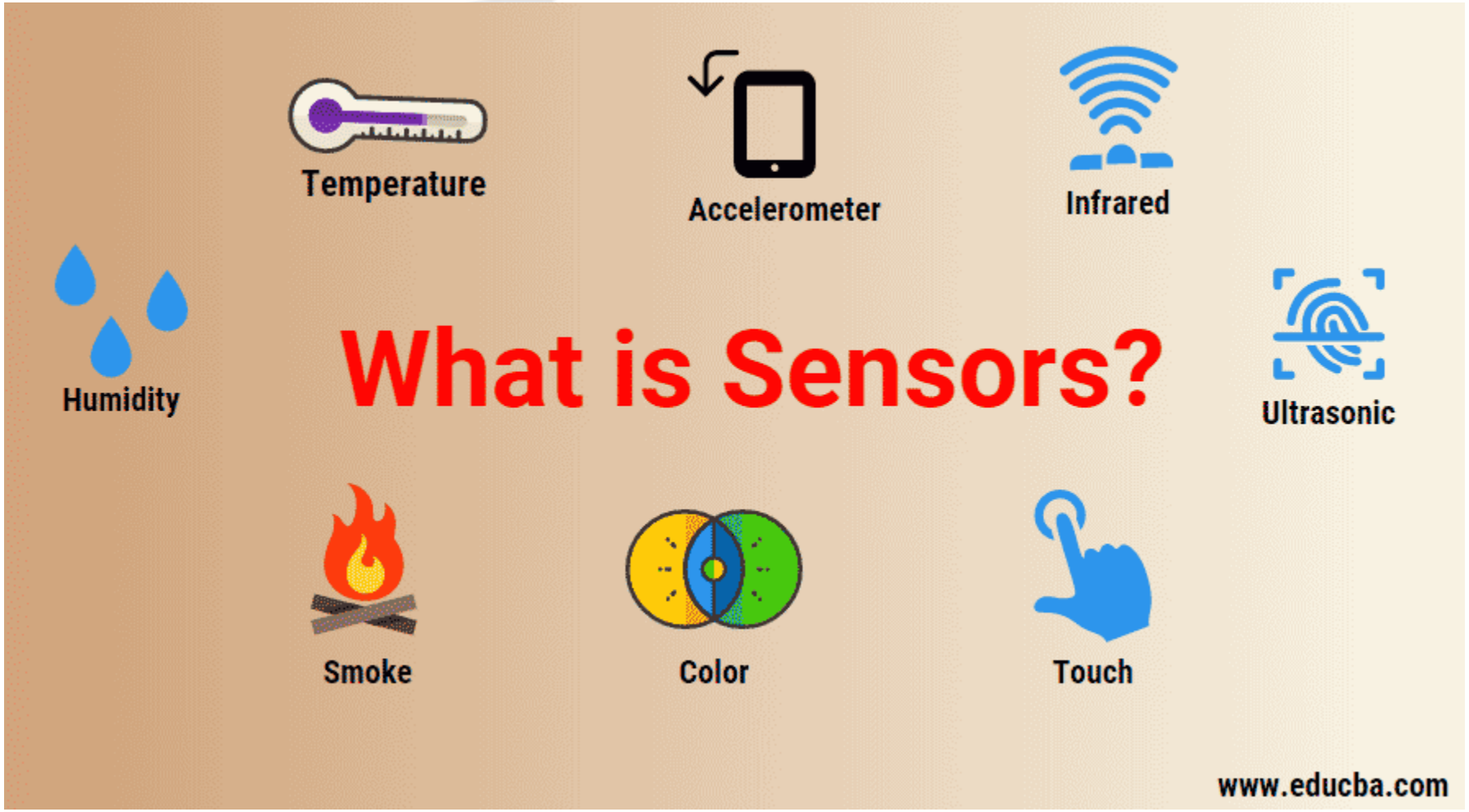
Sensors

- A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine.
- It measures the physical quantity and converts it to an electrical signal which can be read by an observer.


Power Supply
Analog Values from the outside world
SENSOR
Voltage or Current Output
Ground

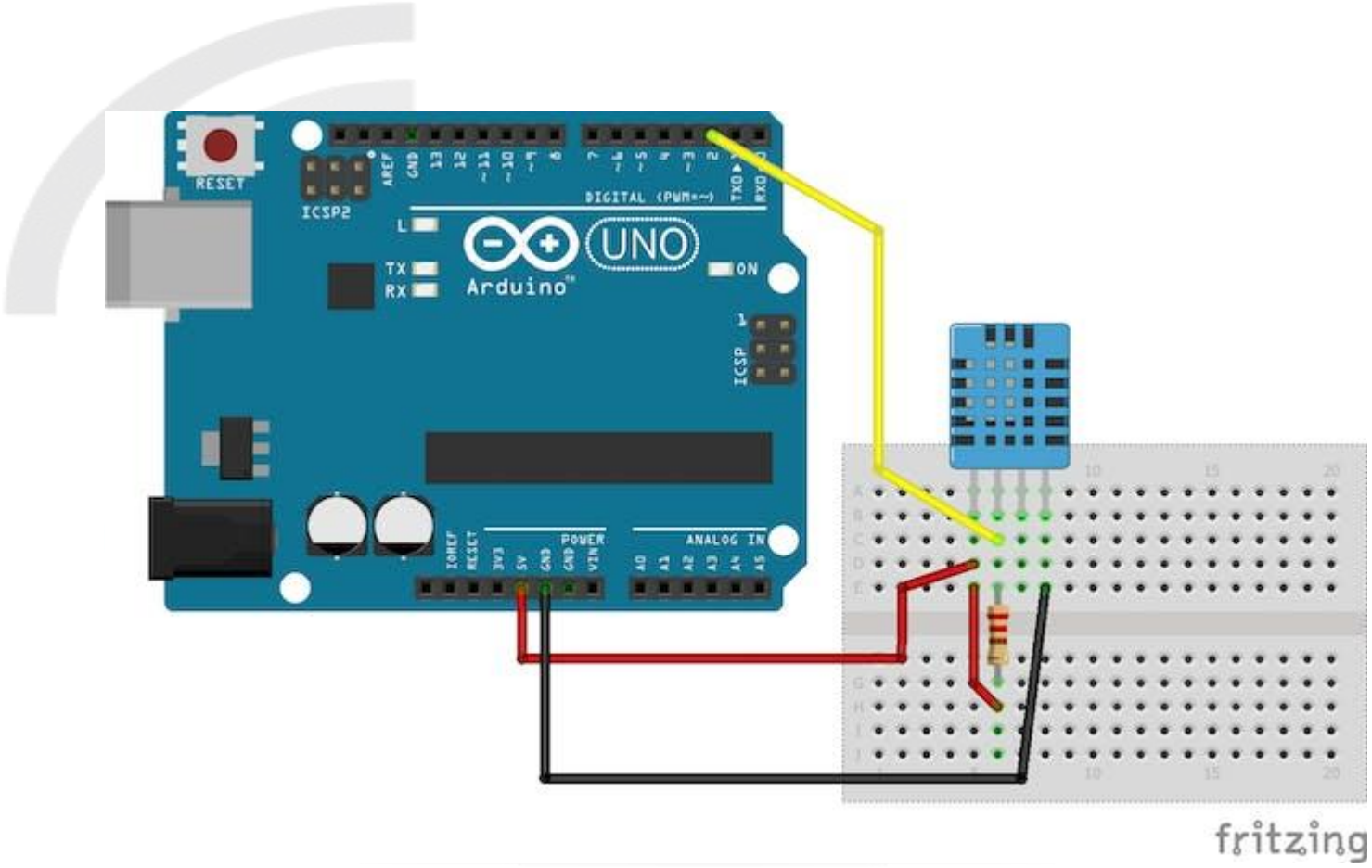

Temperature
Accelerometer
Infrared
Humidity
What is Sensors?
Ultrasonic
Smoke
Color
Touch
www.educba.com

Different Types of Sensors

DHT11/22 Sensor

- It is a basic, ultra low-cost digital temperature and humidity sensor.
- It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed)

DHT11 Sensor Connection to Board



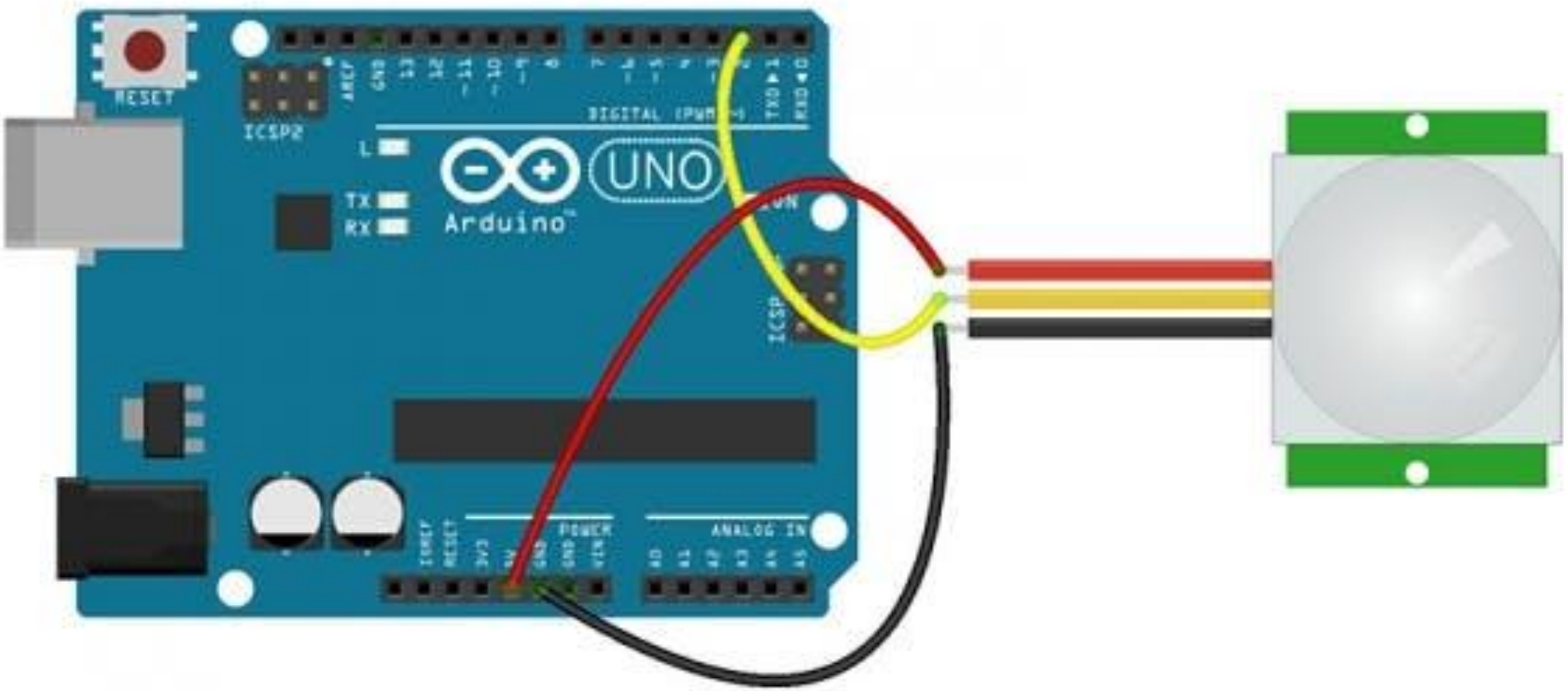
Sample Code

```
#include <DHT.h>
#define DHTPIN 2
#define DHTTYPE DHT22
DHT dht(DHTPIN, DHTTYPE);
void setup() {
  Serial.begin(115200);
  dht.begin();
}

void loop(){
  float temp = dht.readTemperature();
  float hum = dht.readHumidity();
  Serial.print("Temperature is :");
  Serial.print(temp);
  Serial.print("C ");
  Serial.print("Humidity is :");
  Serial.print(hum);
  Serial.println("% ");

}
```

PIR Sensors

PIR sensors are used in thermal sensing applications, such as motion detection and security systems.

PIR Sensor Connection to Board



Sample Code

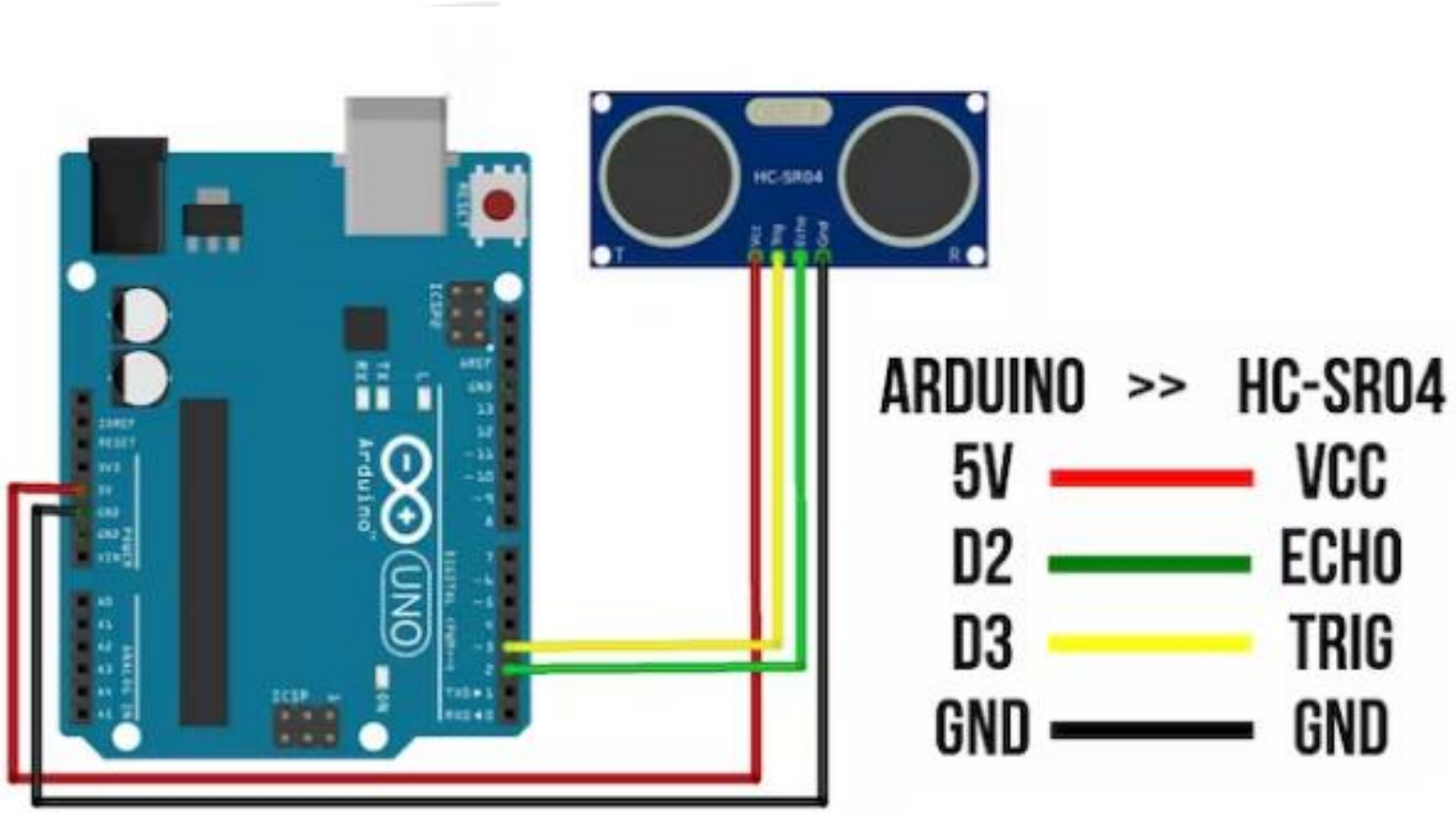
```
int pirPin = 2;                 // PIR Out pin
int pirStat;                    // PIR status
void setup() {
 pinMode(pirPin, INPUT);
 Serial.begin(9600);
}
```

```
void loop(){
 pirStat = digitalRead(pirPin);
 if (pirStat == HIGH) {            // if motion detected
   Serial.println("Motion Detected");
 }
 else {
   Serial.println("No Motion Detected");
 }
}
```

Ultrasonic Sensors

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal.

Ultrasound Sensor Connection to Board



Sample Code

```
int echoPin = 2;
int trigPin = 3;
// defines variables
long duration; // variable for the duration of sound wave travel
int distance; // variable for the distance measurement

void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an OUTPUT
  pinMode(echoPin, INPUT); // Sets the echoPin as an INPUT
  Serial.begin(9600); // Serial Communication is starting with
9600 of baudrate speed
}
```

```
void loop() {
  // Clears the trigPin condition
  digitalWrite(trigPin, LOW);
  delay(2000);
  // Sets the trigPin HIGH (ACTIVE) for 10 microseconds
  digitalWrite(trigPin, HIGH);
  delay(1000);
  digitalWrite(trigPin, LOW);
  // Reads the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  // Calculating the distance
  distance = duration * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");
}
```

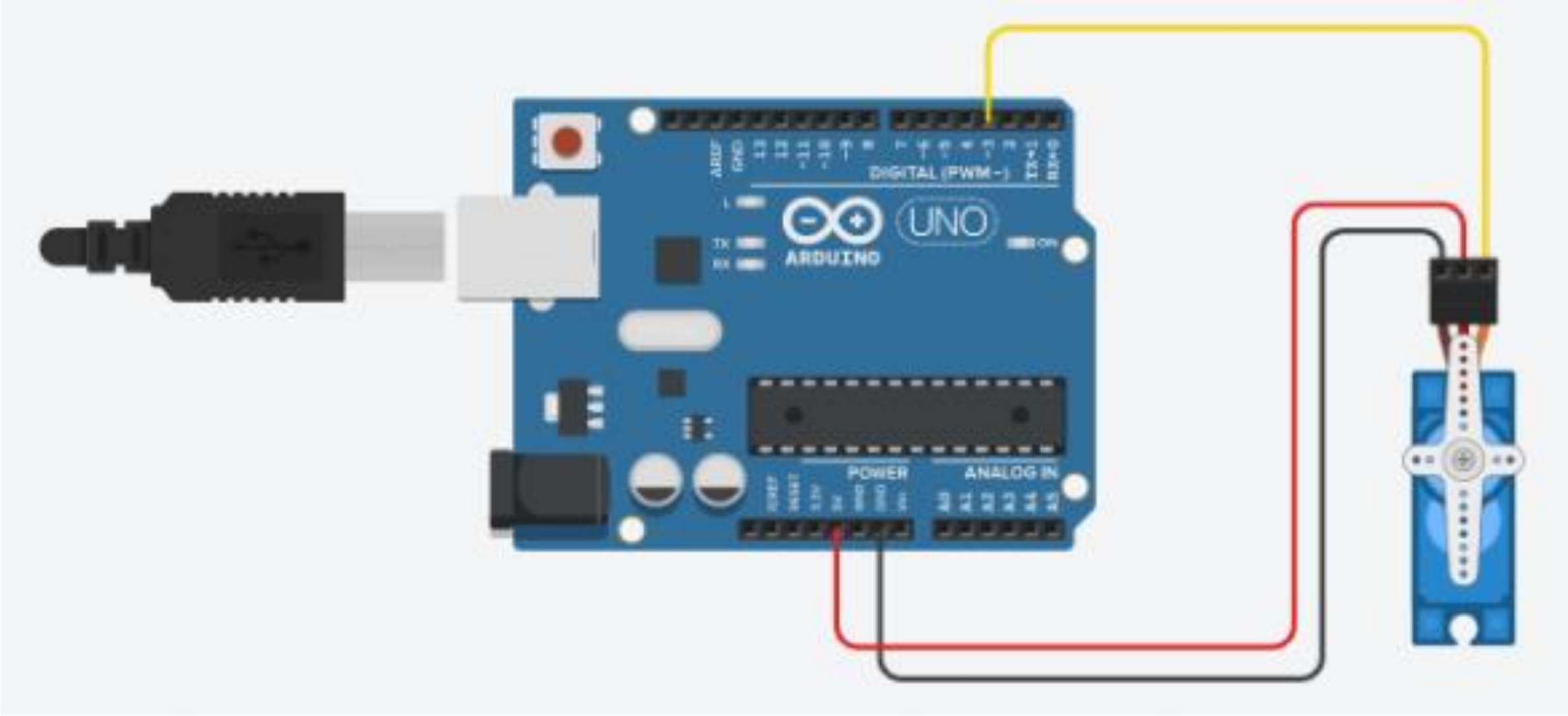
Actuators

- An actuator converts electrical signals into another (i.e. not-electrical) form of energy e.g. light, sound.

Servo Motor Actuator

- A Servo Motor is a small device that has an output shaft.
- This shaft can be positioned to specific angular positions by sending the servo a coded signal.

Servo Motor Actuator



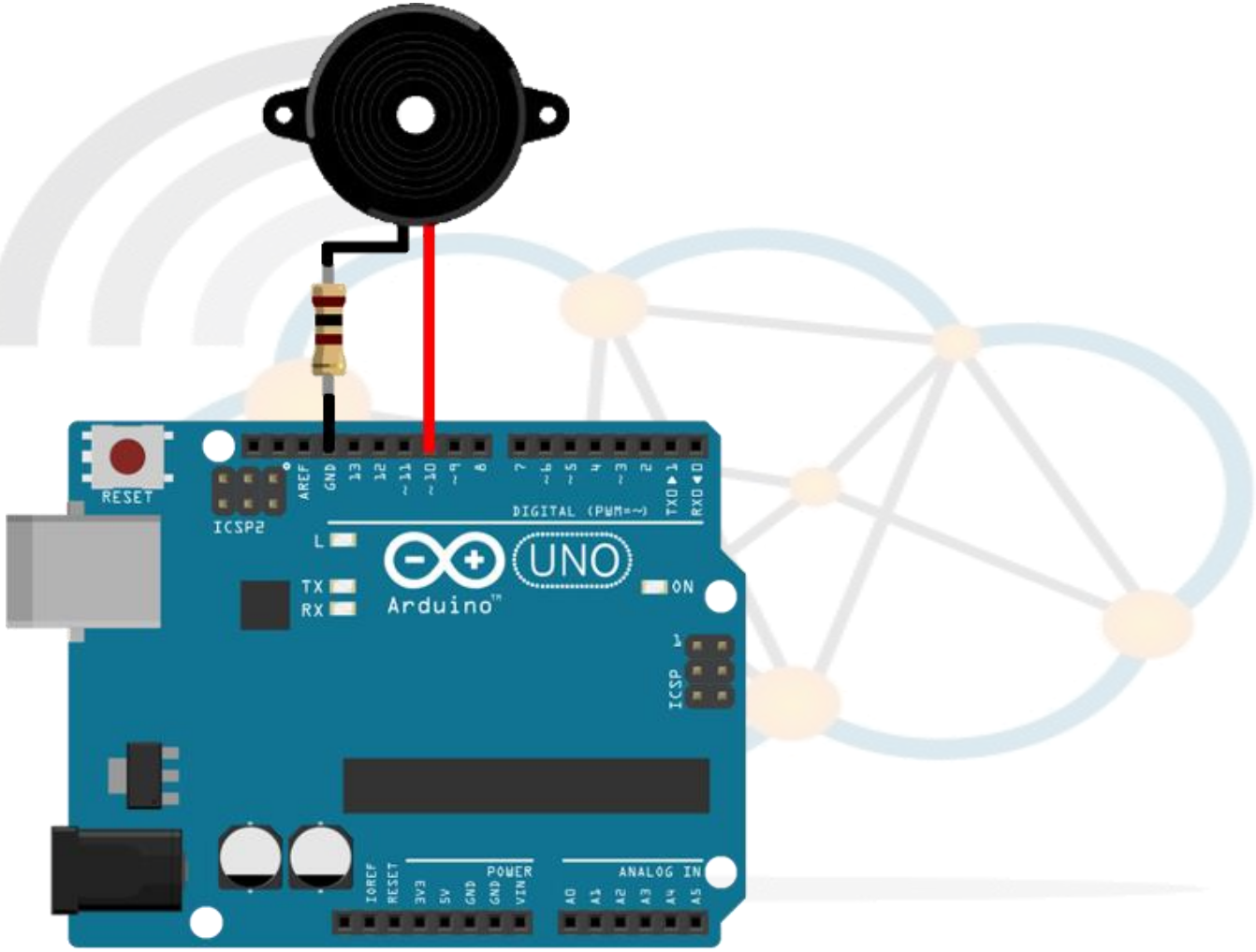
Sample Code

```
#include<Servo.h>
Servo Myservo;
int pos;
void setup() {
Myservo.attach(3);
}
void loop(){
for(pos=0;pos<=180;pos++){
Myservo.write(pos);
delay(15);
}
  delay(1000);
  for(pos=180;pos>=0;pos--){
Myservo.write(pos);
delay(15);
```

Buzzer Actuator

- A **buzzer** or piezo speaker is an audio signaling device commonly used to produce sound.

Buzzer Actuator



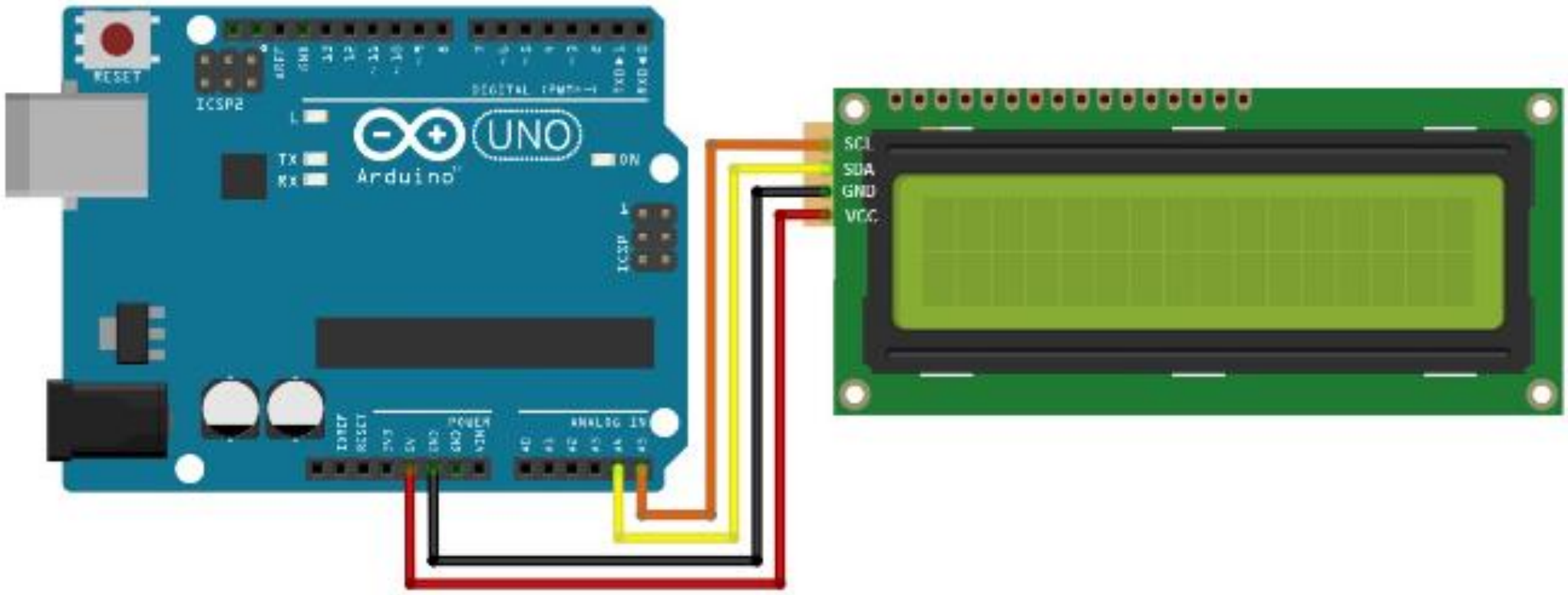
Sample Code

```
int buzzer=10;                //Defining variable and the GPIO pin on Arduino
void setup()
{
  pinMode(buzzer, OUTPUT);    //Defining the pin as OUTPUT
  //put your setup code here:
}

void loop() {
  digitalWrite(buzzer, HIGH);   //Setting the pin HIGH
  delay(2000);
  digitalWrite(buzzer, LOW);    //Setting the pin HIGH
  delay(2000);
  //put your main code here, to run repeatedly:
}
```

LCD Screen

- LCDs (**Liquid Crystal** Displays) are used in embedded system applications for displaying various parameters and status of the system.

LCD Screen



Sample Code

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,20,4);  // set the LCD address to 0x27 for a 16 chars and 2 line display
void setup(){
  lcd.init();                    // initialize the lcd
  lcd.init();
  // Print a message to the LCD.
  lcd.backlight();
  lcd.setCursor(1,0);
  lcd.print("hello everyone");
  lcd.setCursor(1,1);
  lcd.print(“Hey");
}
```