Experiment 2.1

Student Name: Aayush Gurung **UID: 20BCS5323**
Branch: CSE **Section/Group: DM-607/A**
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1. Aim

To measure the distance of an object using an ultrasonic sensor.

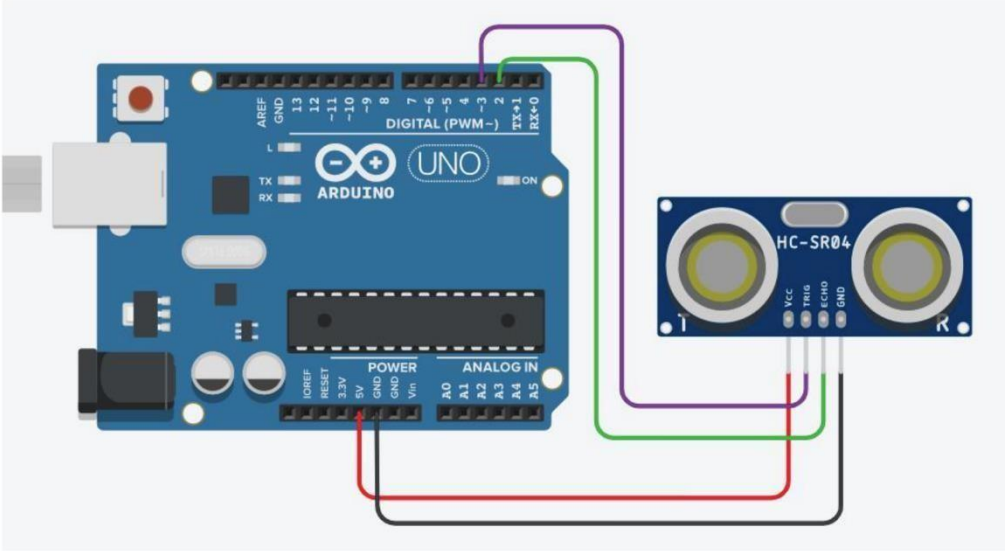
2. Apparatus / Simulator Used

Components Required:

You will need the following components − •
3 jumping wires

- 1 Arduino Uno R3
- 1 Ultrasonic sensor
- 1 Aux cable

3. Circuit Diagram



4. Theory

Ultrasonic Sensor:

An ultrasonic Sensor is a device used to measure the distance between the sensor and an object without physical contact. This device works based on time-to-distance conversion.

Working Principle of Ultrasonic Sensor:

Ultrasonic sensors measure distance by sending and receiving the ultrasonic wave. The ultrasonic sensor has a sender to emit the ultrasonic waves and a receiver to receive the ultrasonic waves. The transmitted ultrasonic wave travels through the air and is reflected by hitting the Object. Arduino calculates the time taken by the ultrasonic pulse wave to reach the receiver from the sender.

We know that the speed of sound in air is nearly 344 m/s,

So, the known parameters are time and speed (constant). Using these parameters, we can calculate the distance traveled by the sound wave.

Formula: Distance = Speed * Time

In the code, the "duration" variable stores the time taken by the sound wave traveling from the emitter to the receiver. That is double the time to reach the object, whereas the sensor returns the total time including sender to object and object to receiver. Then, the time taken to reach the object is half of the time taken to reach the receiver. so, we can write the expression as,

Distance = Speed of Sound in Air * (Time Taken / 2)

Note: Speed of sound in air = 344 m/s.

5. Code

```
#define echoPin 9 // attach pin D2 Arduino to Echo pin of Sensor module
#define trigPin 7 // attach pin D3 Arduino to Trig pin of Sensor module long
duration; // Declare variable to store echo time duration
int distance; // Declare variable to store the result (distance)
```

```
void setup() { // initialize digital pin 13 as an output.
pinMode(trigPin,OUTPUT); // Sets the trigPin as an OUTPUT
pinMode(echoPin, INPUT); // Sets the echoPin as an INPUT // Serial
Communication is starting with 9600 of baudrate speed
Serial.begin(9600);
}
void loop() {
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = duration * 0.0344 / 2;
Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");
}
```

6. Output