Course Name: Internet of Things Lab **Course code:** 21CSP-344

Experiment 2.1

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Subject Name: Internet of Things Lab **Subject Code:** 21CSP-344

Aim: Formulate distance of an object using an ultrasonic sensor

Objectives:
- Learn about ultrasonic sensor.

Software used: Arduino UNO

Hardware used:
- Arduino Uno R3 board
- Ultrasonic sensor (HC-SR04)
- 16×2 LCD I2C Display
- Jumper Wires

Theory:

Ultrasonic Sensor: An ultrasonic sensor is a device that uses ultrasonic waves, which are sound waves with frequencies higher than the upper audible limit of human hearing (typically above 20,000 hertz), to detect and measure distances or proximity to objects. The sensor emits ultrasonic waves and then listens for the waves to bounce back after hitting an object. By measuring the time it takes for the waves to return, the sensor can calculate the distance between itself and the object based on the speed of sound in the medium through which the waves traveled (usually air).

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)

Applications of Ultrasonic Distance Measurement:

- Used in RADAR system.
- To measure distance without physical contact with measuring instruments.
- Used in object detection for security purposes.

Circuit Diagram:

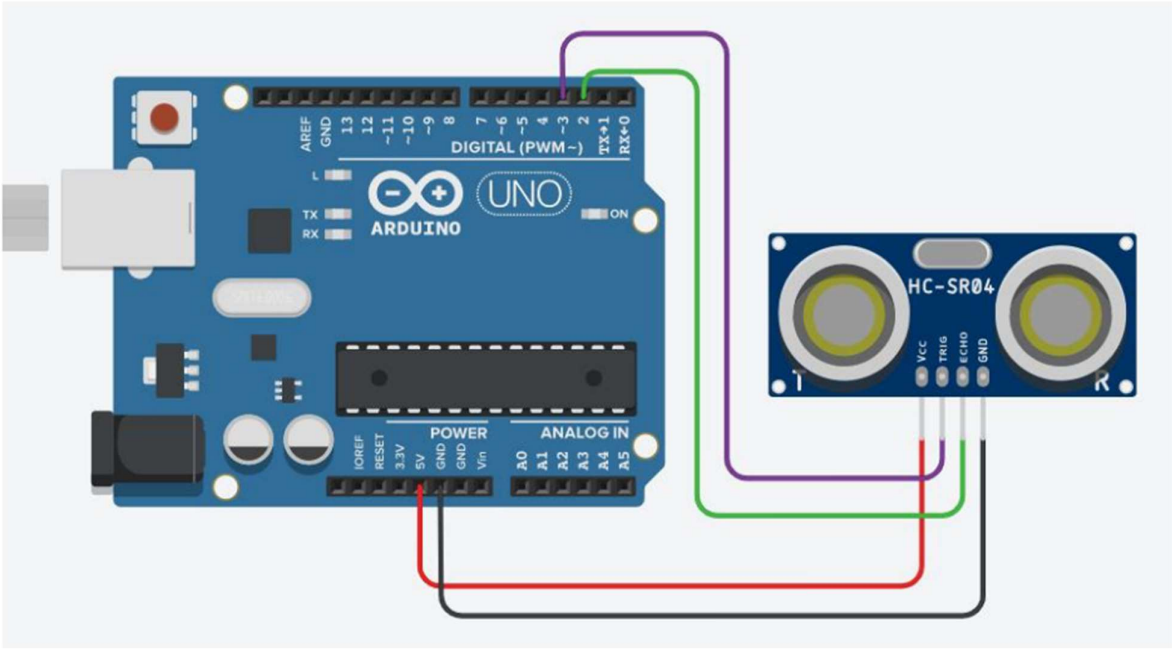

Figure: Ultrasonic Distance measurement circuit

Code:

```
  int red1 = 10;
int trigger = 5;
int echo = 7;
int duration;
int distance;
```

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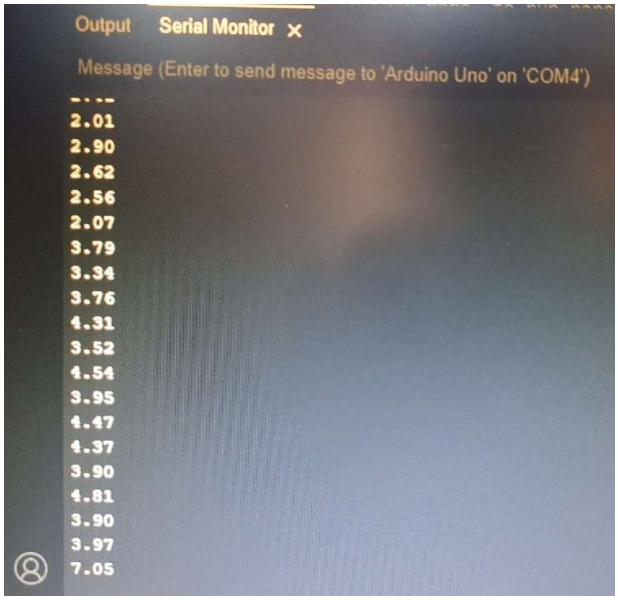
```
void setup(){
  Serial.begin(9600);
  pinMode(trigger, OUTPUT);
  pinMode(echo, INPUT);
}
void loop(){
  digitalWrite(trigger, LOW);
  digitalWrite(trigger, HIGH);
  delay(100);
  digitalWrite(trigger, LOW);
  duration = pulseIn(echo, HIGH);

distance = (duration * 0.0324) / 2;
  Serial.println(distance);
  delay(200);
}
```



Result/Conclusion:
The ultrasonic sensor is capable of measuring distance to an object by emitting ultrasonic waves and the result is printed to the serial monitor in the Arduino IDE.

Learning Outcomes:

- Learned about IOT applications.
- Learned about different types of sensors and their uses.
- Learned about ultrasonic sensors.