Experiment 2

Title: Using Ultrasonic Sensor to measure the distance between the sensor and any object.

Abstract
The purpose of this project is to learn about the working and application of Arduino and Ultrasonic sensors. These instrumentational tools play a vital role in the construction of integrated and complex real-life systems. We used an ultrasonic sensor along with a microprocessor(Arduino) to measure the distance of the object in the range of the particular sensor. We will code our microprocessor to work for the particular application. As a result, we will be able to measure critical distance which as an application will be used to calculate distance.

Objective

- To understand the working principle of ultrasonic sensor
- To implement the theoretical knowledge of sensors
- To get to know about Arduino Uno use IDE to write the codes for Arduino Uno.
- To Explore Sensor Range and Response Time

Theory
Ultrasonic sensors are widely employed in robotics projects for accurate distance measurement and obstacle detection. These sensors are readily available in the market and come in various configurations, with 3-pin, 4-pin, and 5-pin modules. Generally, the most common ones are the 4-pin or 5-pin modules.
The ultrasonic module comprises two transducers one for transmitting ultrasonic waves and the other for receiving them. Both transducers are mounted on a single PCB alongside control circuitry, facilitating seamless integration into robotic projects.

Ultrasonic distance sensors offer precise, non-contact distance measurements ranging from approximately 2 cm to 400 cm. These sensors operate using ultrasound, which is a high-frequency sound with a frequency of 40 kHz.

The working principle of ultrasonic distance measurement mirrors that of RADAR. To initiate ranging, Arduino generates a brief 10 µs pulse to the trigger input. The Ultrasonic Module responds by emitting an 8-cycle burst of ultrasound at 40 kHz and elevating its echo

line. The module then listens for an echo, lowering the echo line as soon as it detects one. The width of the echo pulse is proportional to the distance to the object.

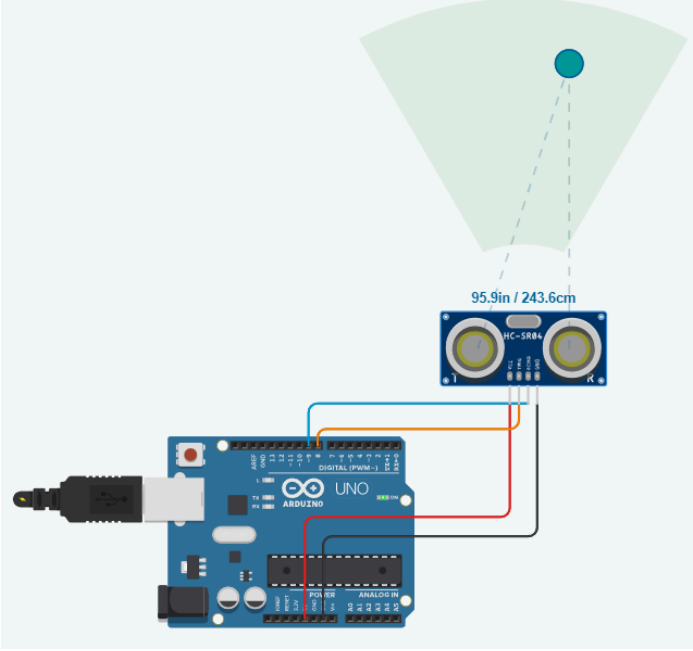
If an object is detected, the echo pulse width can be measured in microseconds. Dividing this value by 58 provides the distance in centimeters while dividing by 148 yields the distance in inches. If no object is detected, the module automatically lowers its echo line after approximately 30 ms.

The Ultrasonic Module can be triggered as frequently as every 50 ms, allowing for up to 20 measurements per second. It is crucial to wait for 50 ms before the next trigger, even if a close object is detected and the echo pulse is shorter. This delay ensures that any residual ultrasonic signals dissipate, preventing false echoes in subsequent measurements.
The sensor is capable of detecting objects within a range of 3 cm to 3 m, making it versatile for various applications.

Apparatus

- Jumper Wires
- Arduino UNO
- Ultrasonic sensor

Circuit Diagram



Code:

```
int trig =8, echo=9;
float time=0, distance=0;
void setup(){

 pinMode(trig, OUTPUT);
 pinMode(echo, INPUT);
 Serial.begin(9600);
}

void loop(){
  digitalWrite(trig, LOW);
          delay(3);
          digitalWrite(trig,HIGH);
          delayMicroseconds(10);
          digitalWrite(trig, LOW);
          time= pulseIn(echo,HIGH);
          distance= (time*0.034)/2;
          Serial.println(distance);
          delay(2000);
 }
```

Conclusion

From this particular experiment, we learned that ultrasonic sensors can detect and measure any object in its range irrespective of the material applied. It can even detect transparent material but the limitation is against any black body object that absorbs sound signals.