Experiment 5

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1. Aim:

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

2. Objective:

- Basic working principle of ultrasonic sensor.
- Details about Ultrasonic Sensor

3. Components Required:

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

4. Script and Output:

Arduino:

It is an open-source electronics platform. It consists ATmega328 8-bit Micro controller. It can be able to read inputs from different sensors & we can send instructions to the micro controller in the Arduino. It provides Arduino IDE to write code & connect the hardware devices like Arduino boards & sensors.

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

5. Setup:

1. Connect the Echo pin of the sensor to the D3 pin of the Arduino.
2. Connect the Trig pin of the sensor to the D2 pin of the Arduino.
3. Navigate to Tools and select board and port.
4. Verify and compile the code, then upload the code to the Arduino Uno R3 board.
5. Monitor the output in the Serial monitor (Set the baud rate as 9600). To open Serial monitor **Tools>Serial Monitor** or (**Ctrl+Shift+M**).

6. Code:

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x20, 16, 2); // Format -> (Address,Width,Height )

#define echoPin 2 // attach pin D2 Arduino to Echo pin of Sensor module
#define trigPin 3 // 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()
{
   lcd.init(); // initialize the lcd
   lcd.backlight(); // Turn on the Backlight

   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);

   // The text to be printed in serial monitor
   Serial.println("Distance measurement using Arduino Uno");
   delay(500);
}
```

```
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");
   lcd.clear(); // Clear the display buffer
   lcd.setCursor(0, 0); // Set cursor for "Distance:" (Column, Row)
   lcd.print("Distance:"); // print "Distance:" at (0, 0)
   lcd.setCursor(0,1); // Set cursor for output value  (0, 1)
   lcd.print(distance); // print Output in cm at (0, 1)
   lcd.setCursor(4, 1); // move cursor to   (4, 1)
   lcd.print("cm"); // print "cm" at (4, 1)

   delay(100);
}
```

7. Figure/Screenshots:

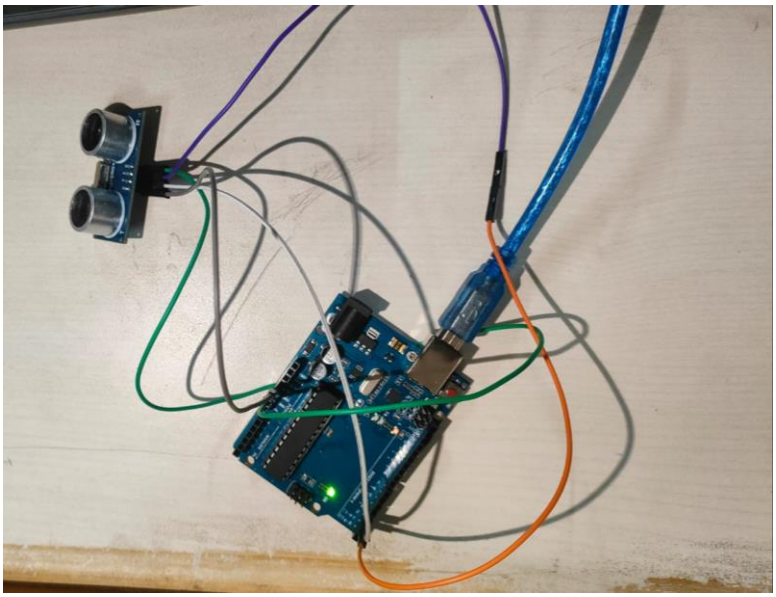

Fig.1: Distance measuring using Ultrasonic sensor, connected Arduino, jumper wires, and connection cable on serial monitor.

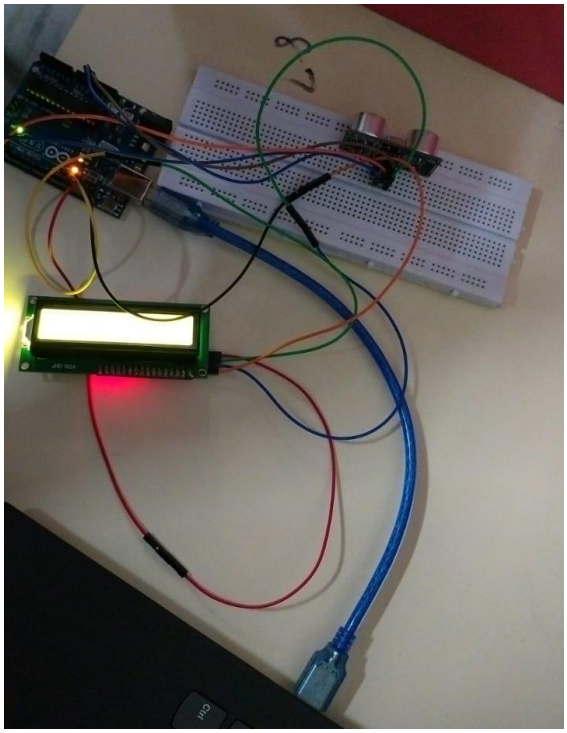

Fig.2: Distance measuring using Ultrasonic sensor, connected Arduino, jumper wires, and connection cable on LCD Display.

8. Result/Output:

The output of the experiment was a numerical value representing the distance of an object from the ultrasonic sensor. The result was accurate within the range of the sensor's capabilities.

Fig.3: Serial Monitor Output

9. Analysis of the experiment:

The experiment involved using an ultrasonic sensor with an Arduino board to measure distance. The sensor emitted high frequency sound waves which bounced off an object and returned to the sensor. The time taken for the sound wave to travel was calculated by the Arduino, and this was used to determine the distance of the object from the sensor. The experiment was successful in accurately measuring distance within a range of a few centimeters to several meters.