<p align="center">**Distance Measurement Using Ultrasonic Sensor**</p>

AIM: To measure distance using an ultrasonic sensor (HC-SR04) with an Arduino and turn on an LED if the object is within a threshold distance.

Components Required:

1. **Arduino Board** (e.g., Uno, Mega, Nano)
2. **HC-SR04 Ultrasonic Sensor**
3. **LED**
4. **220Ω Resistor** (for LED)
5. **Jumper Wires**
6. **Breadboard (optional)**

THEORY: Ultrasonic sensors work based on the principle of sound wave reflection. The HC-SR04 sensor consists of a transmitter and a receiver. The transmitter emits ultrasonic waves, which reflect back when they hit an object. The receiver detects the reflected waves, and the time taken for the round trip is used to calculate the distance.

Formula Used: Distance (cm) = (Time * Speed of Sound) / 2

Since the speed of sound is approximately 343 m/s or 0.0343 cm/µs, the formula simplifies to: Distance = Time (in µs) * 0.017

CIRCUIT CONNECTIONS:

1. Connect the VCC pin of the ultrasonic sensor to the 5V pin of Arduino.
2. Connect the GND pin of the ultrasonic sensor to the GND pin of Arduino.
3. Connect the TRIG pin of the ultrasonic sensor to digital pin 6 of Arduino.
4. Connect the ECHO pin of the ultrasonic sensor to digital pin 7 of Arduino.
5. Connect the anode of the LED to digital pin 3 of Arduino via a 220Ω resistor.
6. Connect the cathode of the LED to GND.

PROCEDURE:

1. Connect the components as per the circuit diagram.
2. Open Arduino IDE and write the provided code.
3. Upload the code to the Arduino board.
4. Open the Serial Monitor to observe the distance measurements.
5. Place an object at varying distances in front of the sensor.
6. Observe the LED behavior: It turns ON if the object is closer than 50 cm and turns OFF otherwise.
7. Record the observations.
8. The Serial Monitor displays the measured distance in centimeters.
9. The LED lights up if an object is within 50 cm of the sensor.
10. The LED turns off when the object is beyond 50 cm

Code:

```
*
 * Created by ArduinoGetStarted.com
 *
 * This example code is in the public domain
 *
 * Tutorial page: https://arduinogetstarted.com/tutorials/arduino-ultrasonic-
sensor-led
 */

// constants won't change
const int TRIG_PIN = 6; // Arduino pin connected to Ultrasonic Sensor's TRIG
pin
const int ECHO_PIN = 7; // Arduino pin connected to Ultrasonic Sensor's ECHO
pin
const int LED_PIN  = 3; // Arduino pin connected to LED's pin
const int DISTANCE_THRESHOLD = 50; // centimeters

// variables will change:
float duration_us, distance_cm;

void setup() {
  Serial.begin (9600);        // initialize serial port
  pinMode(TRIG_PIN, OUTPUT); // set arduino pin to output mode
  pinMode(ECHO_PIN, INPUT);  // set arduino pin to input mode
  pinMode(LED_PIN, OUTPUT);  // set arduino pin to output mode
}

void loop() {
  // generate 10-microsecond pulse to TRIG pin
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  // measure duration of pulse from ECHO pin
  duration_us = pulseIn(ECHO_PIN, HIGH);
  // calculate the distance
  distance_cm = 0.017 * duration_us;

  if(distance_cm < DISTANCE_THRESHOLD)
    digitalWrite(LED_PIN, HIGH); // turn on LED
  else
    digitalWrite(LED_PIN, LOW);  // turn off LED

  // print the value to Serial Monitor
  Serial.print("distance: ");
```

```
    Serial.print(distance_cm);
    Serial.println(" cm");

    delay(500);
}
```

OUTPUT

Hardware setup & Serial monitor Picture

CONCLUSION: The experiment successfully demonstrates the working of an ultrasonic sensor with Arduino. The measured distance values correspond to the expected range, and the LED control based on the threshold is achieved.