
# University of Asia Pacific

## Department of Computer Science and Engineering

## CSE 437: Robotics Lab

# LAB REPORT

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**Experiment Number: 03**

**Experiment Title: Design an obstacle avoidance maze-solving robot.**

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## 1. Experiment Name

Design an obstacle avoidance maze-solving robot.

## 2. Objective

To design and implement an obstacle avoidance robot using an Arduino microcontroller and ultrasonic sensor that can automatically detect obstacles and change direction without human control.

## 3. Apparatus / Hardware & Software Requirements

**Hardware Components:**

- Arduino Uno
- Ultrasonic Sensor (HC-SR04)
- L298N Motor Driver Module
- 2 DC Motors
- Robot Chassis with Wheels
- Breadboard
- Jumper Wires
- 9V Battery
- Power Switch

**Software:**

- Arduino IDE
- TinkerCad

## 4. Circuit Diagram / Schematic

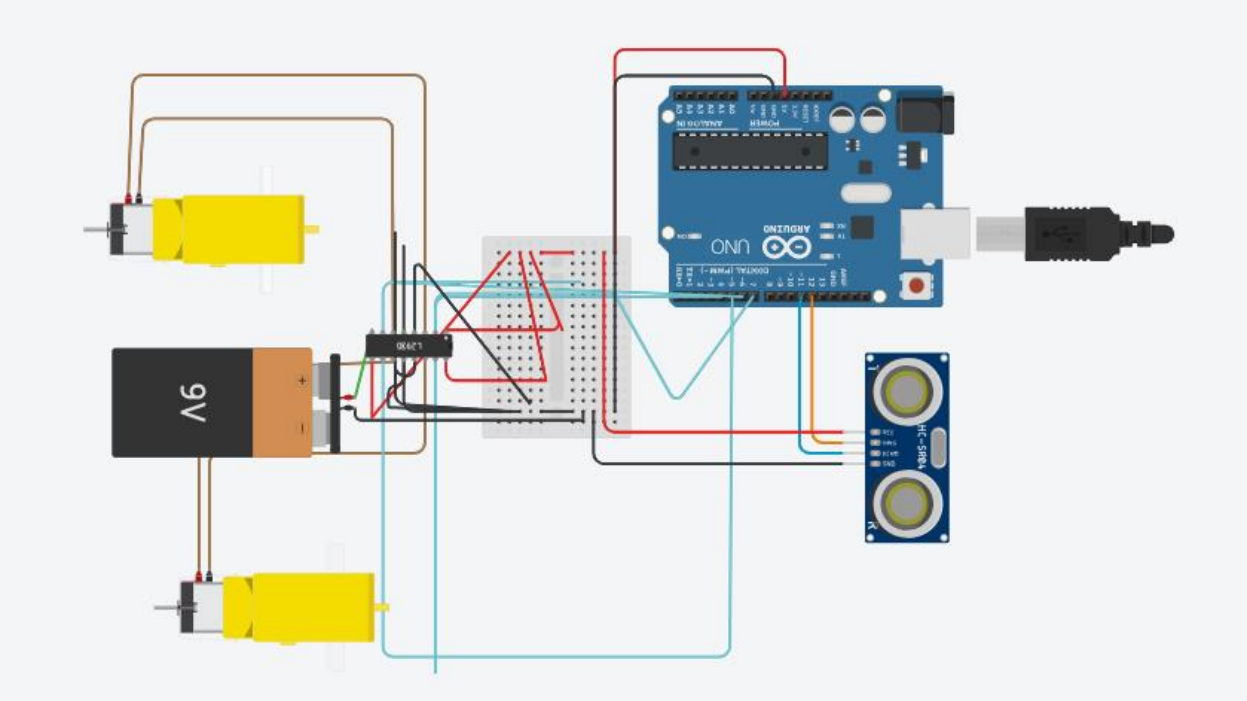


Fig:1 - Obstacle avoidance maze-solving robot.

## 5. Code / Program

```
const int trig = 12;
const int echo = 11;

const int leftFrwrd = 7;
const int leftBack = 6;
const int rightFrwrd = 5;
const int rightBack = 4;

int duration = 0;
int distance = 0;
```

```
void setup()
{
  pinMode(trig , OUTPUT);
  pinMode(echo , INPUT);

  pinMode(leftFrwrd , OUTPUT);
  pinMode(leftBack , OUTPUT);
  pinMode(rightFrwrd , OUTPUT);
  pinMode(rightBack , OUTPUT);

  pinMode(13 , OUTPUT);
  digitalWrite(13 , HIGH);
  pinMode(10 , OUTPUT);
  digitalWrite(10 , LOW);

  Serial.begin(9600);
  Serial.println("=== Obstacle Avoidance Robot Started ===");
}
void loop()
{
  digitalWrite(trig, LOW);
  delayMicroseconds(2);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);
```

```
duration = pulseIn(echo, HIGH);
distance = (duration * 0.034 / 2);

Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");
if(distance < 50 && distance > 0)
{
  Serial.println("Obstacle Detected!");
  Serial.println("Motor Action: LEFT SHIFT");
  digitalWrite(leftFrwrd , LOW);
  digitalWrite(leftBack , HIGH);
  digitalWrite(rightFrwrd , HIGH);
  digitalWrite(rightBack , LOW);

  delay(300);
}
else
{
  Serial.println("Path Clear");
  Serial.println("Motor Action: MOVE FORWARD");
  digitalWrite(leftFrwrd , HIGH);
  digitalWrite(leftBack , LOW);
  digitalWrite(rightFrwrd , HIGH);
```

```
  digitalWrite(rightBack , LOW);
 }
 Serial.println("---------------------------------");
 delay(200);
}
```

## 6. Output / Observations

After uploading the program to the Arduino board and powering the robot, the system operated according to the programmed logic.

Serial Monitor Output -

The Arduino IDE Serial Monitor displayed real-time system status messages along with measured distance values.

Example output:

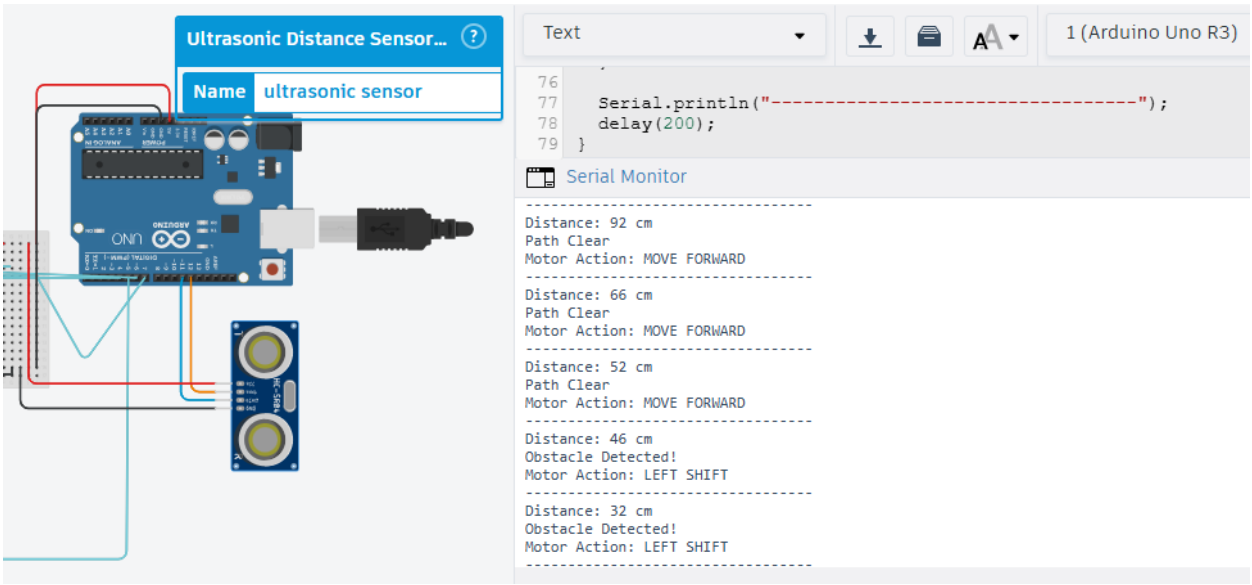


Fig: 2 - Output of serial monitor

Motor Behavior Observation -

| Distance Range | Condition | Motor Action | Description |
|---|---|---|---|
| > 50 cm | Path Clear | Move Forward | Robot moves straight |
| < 50 cm | Obstacle Detected | Left Shift | Robot turns left to avoid obstacle |
| < 50 cm | Obstacle Detected | Right Left Shift | Robot turns right to avoid obstacle |

Table:1 - Motor Behavior

**Physical Output -**

- When no obstacle is detected within 50 cm, the robot moves forward.
- When an obstacle is detected within 50 cm, the robot performs a left shift (turn) to avoid collision.
- The LED on pin 13 remains ON indicating power status.
- Distance values and motor actions are continuously displayed in the Serial Monitor.

The robot successfully demonstrated automatic obstacle detection and avoidance behavior.

## 6. Result

The obstacle avoidance robot was tested under different distance conditions to evaluate its performance and response accuracy. The system operated according to the programmed logic and demonstrated reliable obstacle detection and avoidance behavior.

Key Results:

- The ultrasonic sensor successfully measured real-time distance in centimeters.
- When the measured distance was greater than 50 cm, the robot moved forward smoothly.
- When the distance was less than 50 cm, the robot detected an obstacle and performed a left shift to avoid collision.
- Serial Monitor continuously displayed distance values and motor action status.
- The motor driver responded correctly to control signals from the Arduino.

Overall, the robot showed stable, accurate, and consistent performance during testing, confirming proper integration of sensor, microcontroller, and motor control system.

## 8. Conclusion

In this experiment, an obstacle avoidance robot was successfully designed and implemented using an Arduino microcontroller and an ultrasonic sensor. The system was able to measure the distance of nearby objects and make real-time decisions to avoid collisions. The integration of the ultrasonic sensor with the motor driver allowed the robot to detect obstacles accurately and respond immediately by changing its direction. Through this project, practical knowledge of embedded systems, sensor interfacing, motor control, and logical programming was gained. The experiment enhanced understanding of autonomous robotic systems and demonstrated how simple hardware components and programming logic can be combined to create an intelligent and self-operating robotic system.