Obstacle Avoiding Robot

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Abstract

This project report communicates the design, development, and analysis of a smart robot capable of avoiding obstacles autonomously. The project aimed to create a reliable and adaptable robot that could navigate and avoid obstacles in a variety of settings. The robot's abilities were achieved through a combination of software development, hardware integration, and system operation. The project's goals, methodology, key findings, and implications for future research and innovations in autonomous robotics are detailed in the report.

Introduction

Research and advancements in autonomous robotics have become increasingly important, with applications ranging from personal assistance to industrial automation. Among the various capabilities of autonomous robots, the ability to avoid obstacles is crucial for navigation and safety. This project's primary objectives were the development, implementation, and assessment of an object-avoiding car system. This introduction briefly summarizes the project's goals, justification, and scope, setting the stage for a comprehensive analysis of the robot's development and results.

Literature Review

1. The integration of Arduino-based systems with ultrasonic sensors for obstacle detection has been a significant area of research, leading to the development of more efficient and intelligent robotic systems [1].

2. Autonomous robots equipped with ultrasonic sensors have been widely used for obstacle avoidance, enhancing their ability to navigate complex environments without human intervention [2].

3. Advances in sensor technology, particularly ultrasonic sensors, have improved the accuracy and reliability of obstacle detection in autonomous robots, making them more effective in various applications [3].

4. The use of microcontrollers like the Arduino UNO, combined with ultrasonic sensors and motor drivers, has enabled the development of cost-effective and efficient obstacle-avoiding robots [4].

Components Used

***1. L298N H-Bridge Motor Driver Module**: Enables real-time direction and speed control of DC motors. Can handle motors with up to 2A peak current and voltages between 5 and 35V.*

Figure 1 L298N H-Bridge Motor Driver

***2. Ultrasonic Sensor Module (HC-SR04)**: The ultrasonic sensor module consists of a transmitter and receiver. It emits ultrasonic waves at a frequency of 40 kHz and measures the time it takes for the echo to return after bouncing off an obstacle. This time measurement is used to calculate the distance to the obstacle. The HC-SR04 sensor has a detection range of 2 cm to 400 cm and*

a resolution of 0.3 cm, making it suitable for precise distance measurements in the robot's navigation system.

Figure 2 Ultrasonic Sensor

3. Arduino UNO*: An open-source microcontroller board based on the ATmega328P. It features digital and analog I/O pins, which can be interfaced with various sensors and motor drivers.*

Figure 3 Arduino UNO

4. 4WD Smart Robot Car Chassis Kit with DC Motor*: Provides a four-wheel-drive platform for the robot, with pre-drilled holes for adding sensors and electronics.*

Figure 4 (4WD) Smart Robot Car Chassis

5. 12-volt Rechargeable Cells*: Provide the necessary power supply for the robot's motors and electronics.*

Figure 5 12-volt Rechargeable Cells

Methodology

1. Planning*: Discussed the project overview and listed the required components.*

2. Assembly*: Constructed the robot's chassis from wood and assembled the DC motors and motor driver.*

3. Sensor Setup*: Installed the ultrasonic sensor on the front of the car for obstacle detection.*

4. Wiring*: Connected the sensors and motor driver to the Arduino Uno according to the wiring scheme.*

5. Code Development*: Developed the Arduino code to control the motors and read sensor data.*

6. Testing and Debugging*: Uploaded the code to the Arduino and tested the robot's functionality, making necessary adjustments to ensure proper operation.*

Code

```
const int trigPin = 2;
const int echoPin = 3;
int distance;
long duration;

#define ENA_PIN 11
#define ENB_PIN 10
#define MOTOR_LEFT_PIN1 7
#define MOTOR_LEFT_PIN2 6
#define MOTOR_RIGHT_PIN1 5
#define MOTOR_RIGHT_PIN2 4

void setup()
{
  Serial.begin(9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);

  // Set motor control pins as outputs
  pinMode(ENA_PIN, OUTPUT);
  pinMode(ENB_PIN, OUTPUT);
  pinMode(MOTOR_LEFT_PIN1, OUTPUT);
  pinMode(MOTOR_LEFT_PIN2, OUTPUT);
  pinMode(MOTOR_RIGHT_PIN1, OUTPUT);
  pinMode(MOTOR_RIGHT_PIN2, OUTPUT);
}

void moveForward() {
  // Set motor directions for forward motion
  digitalWrite(MOTOR_LEFT_PIN1, HIGH);
  digitalWrite(MOTOR_LEFT_PIN2, LOW);
  digitalWrite(MOTOR_RIGHT_PIN1, HIGH);
  digitalWrite(MOTOR_RIGHT_PIN2, LOW);

  analogWrite(ENA_PIN, 185); // Full speed for left motor
  analogWrite(ENB_PIN, 185); // Full speed for right motor
  Serial.println("Moving Forward");
}

void moveBackward() {
  // Set motor directions for backward motion
  digitalWrite(MOTOR_LEFT_PIN1, LOW);
  digitalWrite(MOTOR_LEFT_PIN2, HIGH);
  digitalWrite(MOTOR_RIGHT_PIN1, LOW);
  digitalWrite(MOTOR_RIGHT_PIN2, HIGH);

  analogWrite(ENA_PIN, 185); // Full speed for left motor
  analogWrite(ENB_PIN, 185); // Full speed for right motor
  Serial.println("Moving Backward");
}

void turnLeft() {
  // Set motor directions for left turn
  digitalWrite(MOTOR_LEFT_PIN1, LOW);
  digitalWrite(MOTOR_LEFT_PIN2, HIGH);
  digitalWrite(MOTOR_RIGHT_PIN1, HIGH);
  digitalWrite(MOTOR_RIGHT_PIN2, LOW);

  // Set motor speeds
  analogWrite(ENA_PIN, 150); // Reduce speed for left motor
  analogWrite(ENB_PIN, 155); // Full speed for right motor
  Serial.println("Turning Left");
}
```

```

void Stop(){
  // Set motor speeds to zero
  analogWrite(ENA_PIN, 0);
  analogWrite(ENB_PIN, 0);
  Serial.println("Stopped");
}

void loop()
{
  digitalWrite(trigPin, LOW); // Clear the trigPin by setting it LOW
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH); // Trigger the sensor by setting the trigPin HIGH for 10 microseconds
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  // Read the echoPin, returns the sound wave travel time in microseconds
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.034 / 2; // Calculate the distance in centimeters

  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");
  delay(60); // Wait for next measurement

  if(distance >= 15){
    moveForward();
  }else{
    Stop();
    delay(250);
    moveBackward();
    delay(2500);
    turnLeft();
    delay(2000);
  }
}
```

Pictures

Figure 6 back view

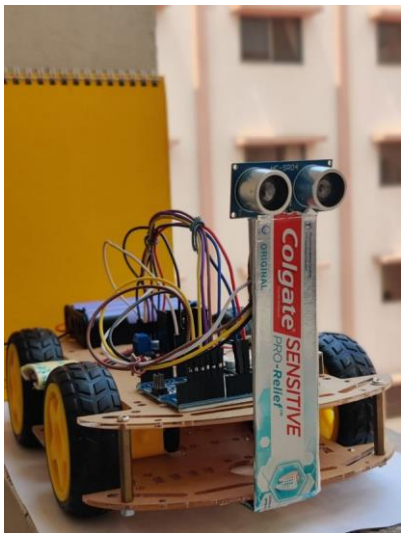

Figure 7 front view

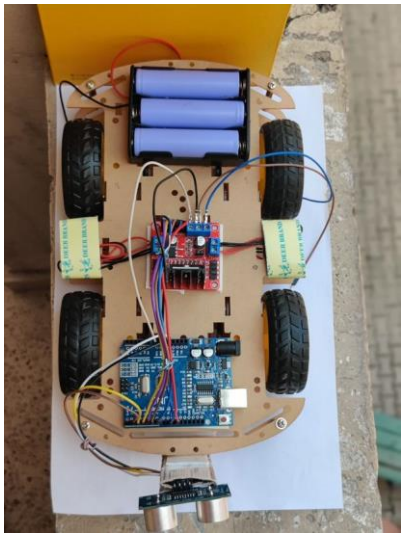

Figure 8 top view

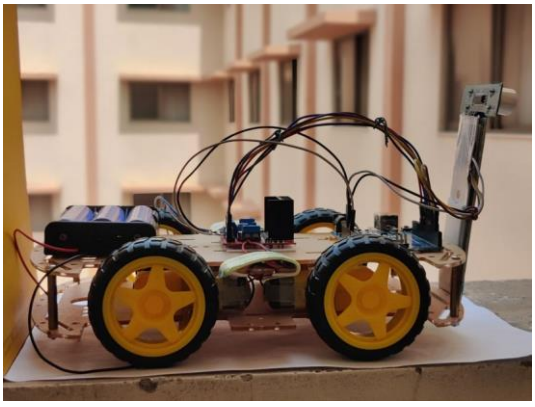

Figure 9 side view

Discussion

The development of autonomous robots relies on the integration of microcontrollers, sensors, and output devices. This project demonstrated how a combination of ultrasonic sensors and motor drivers could be used to create an object-avoiding robot. The project highlighted the importance of robust sensor data processing and control algorithms for autonomous navigation.

Conclusion

The Object Avoiding Car project enhanced our understanding of various sensors and components. By developing a fully functional robot from scratch, we gained valuable insights into the assembly of hardware and the development of control algorithms. This project improved our programming skills and familiarity with the Arduino Uno, laying a strong foundation for future robotics projects.

References

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[2] R. Singh, P. Singh, and M. Chawla, "Autonomous Obstacle Avoiding Robot Using Arduino," International Journal of Engineering Development and Research, vol. 6, no. 2, pp. 445-450, 2018.

[3] K. S. Suresh and K. S. Rao, "Obstacle Detection and Avoidance Robot," International Journal of Computer Applications, vol. 104, no. 12, pp. 35-38, Oct. 2014.

[4] A. Kumar and R. Kumar, "Ultrasonic Sensor Based Obstacle Avoiding Autonomous Car," International Journal of Science and Research, vol. 6, no. 6, pp. 2319-7064, June 2017.