**TITLE**

**Project:** Autonomous Obstacle Avoidance Robot

**Project Duration:** March 2024

**Submitted By**: Aritro Dutta

**Supervisor/Guide**: Prakash Ghose

**TABLE OF CONTENTS**

1. Introduction
2. Features
3. Components Used
   * Hardware
   * Software
4. Project Design
   * Theory
   * Connections
   * Code
5. Installation and Setup
6. Testing and Results
7. Challenges Faced
8. Future Work
9. Conclusion

**INTRODUCTION**

The Autonomous Obstacle Avoidance Robot is designed to navigate its environment autonomously by detecting and avoiding obstacles in real-time. This project demonstrates expertise in robotics, sensor integration, and embedded systems programming. The robot’s main objective is to move without human intervention and adjust its path dynamically based on sensor data.

**FEATURES**

* Real-time obstacle detection using Ultrasonic/IR sensors.
* Automated navigation and dynamic path adjustment.
* Integration of motors and a motor driver for precise and responsive movement.

**COMPONENTS USED**

**HARDWARE:**

* Arduino UNO
* Jumper Wires
* Ultrasonic & IR Sensors
* DC & Servo Motors
* L298D Motor Driver
* Robot Chassis
* Power Source (Battery)

**SOFTWARE:**

* Arduino IDE
* Autodesk Tinkercad

**PROJECT DESIGN**

**THEORY:**

* **Arduino UNO:** A programmable microcontroller board featuring 14 digital I/O pins, 6 analog inputs, and multiple communication protocols (Serial, I2C, SPI).
* **Sensors:** Convert physical phenomena into electrical signals for the robot’s decision-making.
  + **Ultrasonic Sensor:** Detects the distance of nearby objects.
  + **IR Sensor:** Identifies obstacles within a specific range.
* **Actuators:** Convert electrical energy into physical motion.
  + **DC Motors:** Facilitate movement of the robot.
  + **Servo Motors:** Enable precise angular control.

**CONNECTIONS:**

* Ultrasonic and IR sensors are connected to the input pins of the Arduino UNO.
* Motors are connected via the L298D motor driver to ensure smooth and controlled movement.
* The robot chassis provides structural stability, while the power source supplies energy.

**CODE:**

The Arduino code manages sensor input and motor control. It ensures that the robot avoids obstacles by dynamically adjusting its path based on real-time data. Refer to the Code directory for the full implementation.

**INSTALLATION & SETUP**

1. Clone the repository.
2. Open the .ino file in the Arduino IDE.
3. Use Autodesk Tinkercad for simulating the circuit and visualizing connections virtually to ensure accuracy before physical assembly.
4. Assemble the robot chassis by mounting motors, wheels, and other components to create a stable framework.
5. Connect the Arduino UNO to your system and upload the code.
6. Attach the power source (battery) to power the robot.

**TESTING & RESULTS**

The robot was tested in a controlled environment with various obstacles. It successfully detected and avoided these obstacles, dynamically adjusting its path based on sensor input. The robot’s movements demonstrated reliable and efficient obstacle avoidance, achieving the project’s primary objective.

**CHALLENGES FACED**

* **Sensor Calibration:** Achieving accurate distance measurements required fine-tuning of sensor thresholds.
* **Circuit Stability:** Ensuring reliable connections between components was time-consuming.
* **Power Management:** Managing battery life to sustain prolonged operation.

**FUTURE WORK**

* **AI/ML Integration:** Implementing machine learning algorithms for smarter navigation and decision-making.
* **Enhanced Design:** Upgrading the robot’s chassis for better performance in varied terrains.
* **Additional Sensors:** Incorporating cameras or LiDAR for advanced obstacle detection.

**CONCLUSION**

The Autonomous Obstacle Avoidance Robot successfully demonstrates the integration of hardware and software to achieve real-time obstacle avoidance. This project highlights the potential of robotics in automation and serves as a foundation for future innovations.