Autonomous Mobile Robots Challenge

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Introduction

This project shows the design and implementation process of an autonomous four-wheel drive (4WD) mobile robot for the Embedded Systems Autonomous Mobile Robots Challenge. The main goal of this robot is the autonomous navigation of a multi-zone track consisting of line-following parts, a tunnel, obstacle avoidance, a bump, and finally a parking zone. The mobile robot is developed using a 4WD Chassis and a system of four DC motors that can be controlled using an H-bridge motor driver and a regulated power source from a battery. The hardware design is mainly focused on ensuring a stable motor control, safe power management, and operates reliably across various environmental conditions. The completed prototype successfully integrates mechanical and electrical subsystems to achieve autonomous navigation while meeting the project constraints and design requirements.

Design

The robot incorporates both mechanical, electrical and software sub systems to facilitate complete autonomous navigation. The mechanical body is based on a DC-motor-driven four-wheel-drive (4WD) chassis that offers better stability, traction, and control during turning and obstacle avoidance. An H-bridge motor driver is used to control motor speed and direction, and a regulated power supply is used to stabilize the operation of the control electronics.

The system uses several sensors environment perception such as line sensors for line detection, a light-dependent resistor (LDR) for tunnel detection, ultrasonic sensors for obstacle avoidance, and infrared sensors to detect the hallway alignment. A state-based embedded software architecture processes sensor inputs and timer events to manage navigation across all track zones, including line following, tunnel traversal, obstacle avoidance, and automated parking.

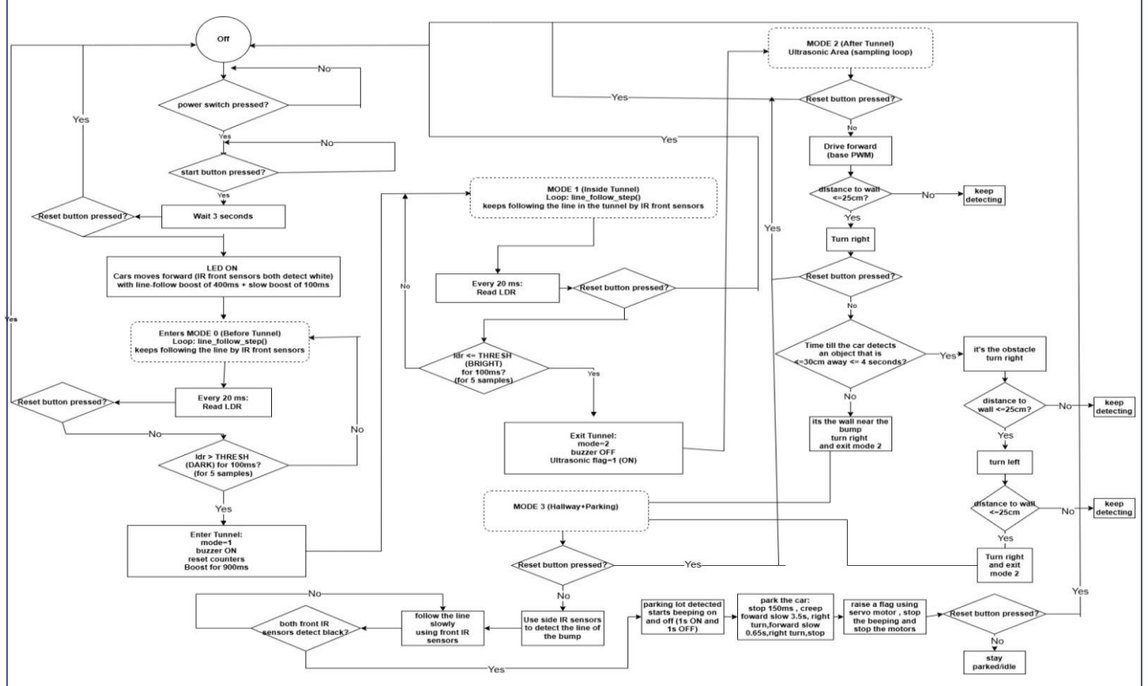

Figure 1: Software Flowchart

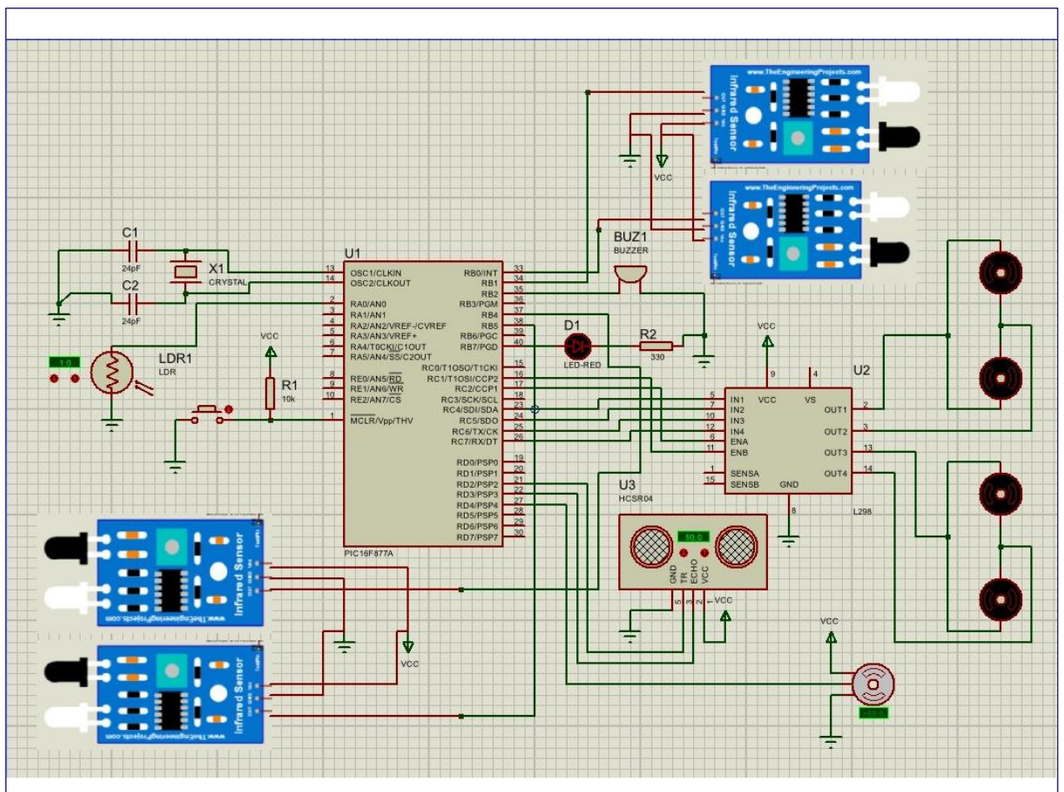

Figure 2: Schematic Diagram

Results

Our Autonomous Mobile Robot yielded promising results, successfully achieving the objectives outlined in the project. Check out snapshots of our robot in action:

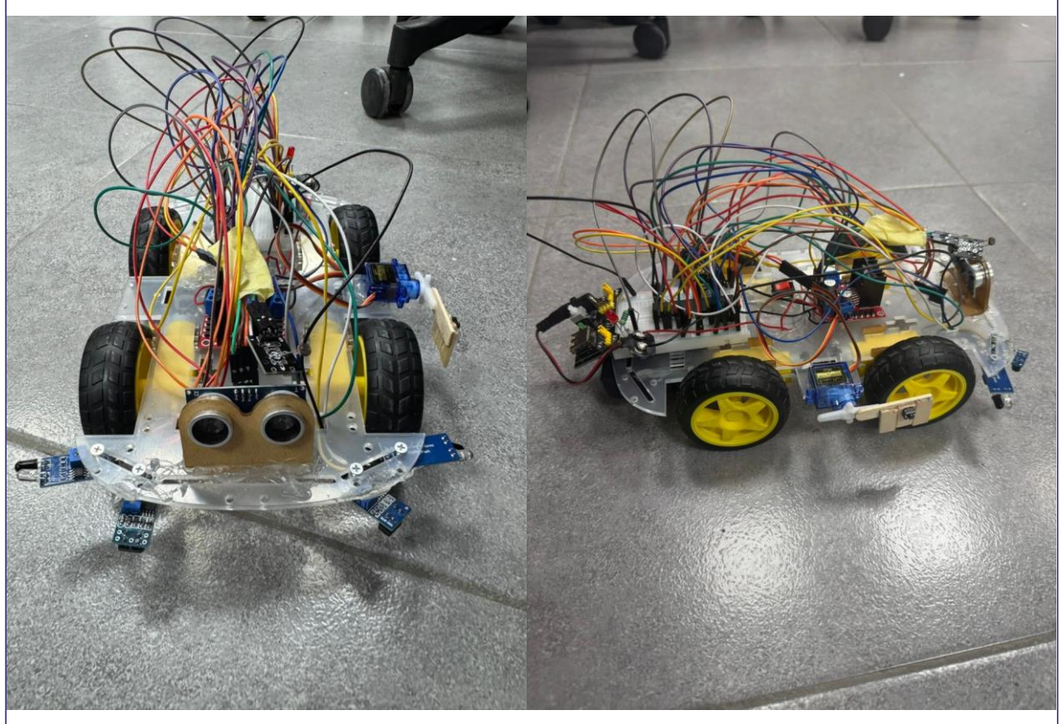

Figure 3: Autonomous Mobile Robot Prototype

Conclusion

This project successfully demonstrates the design and development of an autonomous mobile robot capable of moving along a multi-zone track. The project combines the design of a mechanical system, an electrical system, and software into a complete self-contained system that meets the needs of the Embedded Systems: Autonomous Mobile Robots Challenge. The introduction of the four-wheel-drive system improved the robot's stability and agility. Sensor integration and the use of timers in the software ensured that the robot moves autonomously. The robot's behavior is governed by a state-based embedded software architecture that processes sensor inputs and timing events to control navigation decisions across all track zones. This project provides relevant experience in robotics and problem-solving.