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Line Follower and Object Detection

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ABSTRACT

This paper presents the development of a self-navigating line follower robot integrated with an obstacle detection mechanism. The system utilizes infrared (IR) sensors to follow a predefined path and ultrasonic sensors to detect and avoid obstacles. An Arduino Uno microcontroller processes sensor data and controls motor operations to ensure smooth movement. This design is aimed at improving automation in applications such as industrial logistics, automated transportation, and warehouse management.

Keywords— Autonomous Robot, IR Sensor, Ultrasonic Sensor, Arduino Uno, Obstacle Detection

1. Introduction

Automation has become essential in various industries, leading to the adoption of intelligent robotic systems. A line follower robot (LFR) is a type of autonomous mobile robot that follows a designated path using IR sensors that detect surface contrast. However, traditional LFRs are limited to predefined routes and cannot adapt to obstacles in their path. This paper focuses on enhancing LFR functionality by incorporating real-time obstacle detection and avoidance mechanisms, improving navigation efficiency in dynamic environments.

2. Working Principle of Line Following

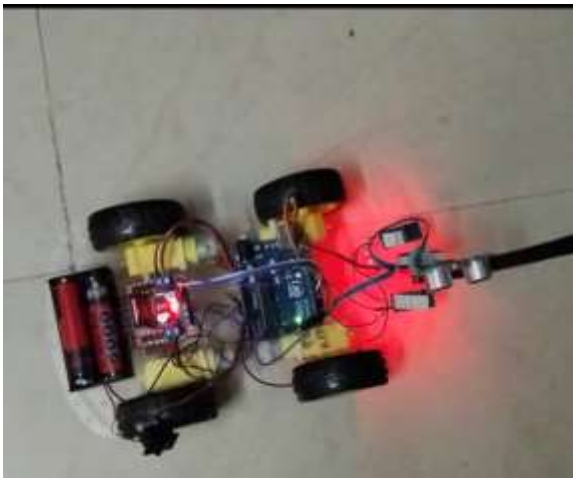
A line follower robot operates by detecting changes in surface contrast using IR sensors. The robot's control algorithm follows these rules:

• Moves straight when both sensors detect the path.

• Turns left if only the left sensor detects the path.

• Turns right if only the right sensor detects the path.

• Stops when no sensors detect the path. By continuously processing sensor data, the microcontroller ensures accurate and adaptive movement.



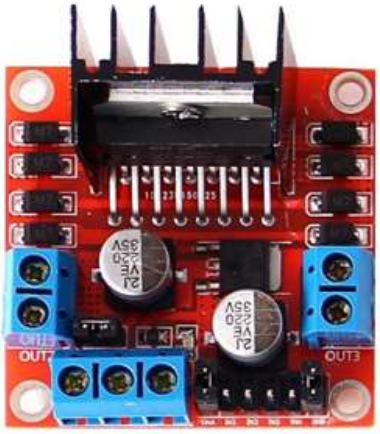
3. System Architecture

The system is composed of essential hardware components for autonomous operation:

• Microcontroller: Arduino Uno for sensor data processing and motor control.

• Sensors: IR sensors for line tracking and ultrasonic sensors for obstacle detection.

• Motor Driver: L298N dual H-bridge driver for efficient motor operation.



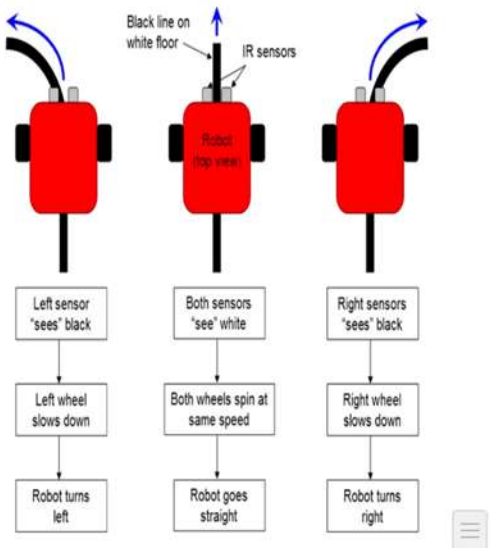
• Actuators: Four DC motors for movement.

• Power Source: Rechargeable lithium-polymer battery.

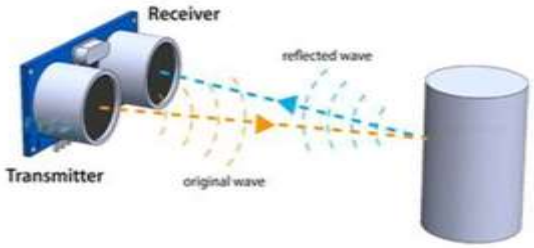
4. Implementation Methodology

The system's functionality is divided into two primary tasks:

- Path Tracking: The IR sensors continuously monitor the path andsend data to the microcontroller, which adjusts motor speed and direction accordingly.



- Obstacle Avoidance: The ultrasonic sensor measures distances to obstacles. If an obstacle is detected within a set threshold, the system determines a safe alternative path and adjusts its movement accordingly.



7. Experimental Evaluation

The robot was tested in different environments, including straight and curved paths, as well as obstacle-filled tracks. The system demonstrated effective navigation, maintaining its path while dynamically adjusting to avoid obstacles. The results indicate that the robot can operate reliably in structured environments with real-time decision-making capabilities. Below is a flowchart of it.

8. Conclusion :

Enhancements The proposed line follower robot with obstacle detection improves efficiency in automation by integrating sensor-based navigation and real-time decision-making.

9. Future developments :

May include AI-based navigation for better adaptability, IoT connectivity for remote monitoring, and enhanced sensor accuracy to optimize performance in complex environments.

10. References

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