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A Project Report On
Line Follower

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ABSTRACT

This project report outlines the design and realization of a line-following robot (LFR) using an Arduino and multiple Infrared (IR) sensors. The LFR is engineered to autonomously track and follow a line (white or black) by calibrating sensors to distinguish between line surfaces. Key functionalities include real-time corner detection and movement, and adaptive motion planning. The report comprehensively discusses project objectives, system features, technical analysis of Arduino programming and sensor integration, methodological approaches, practical challenges encountered, conclusive findings, and a reference list. Future improvements are proposed to advance the LFR's performance and expand its applicability in various dynamic environments.

Contents

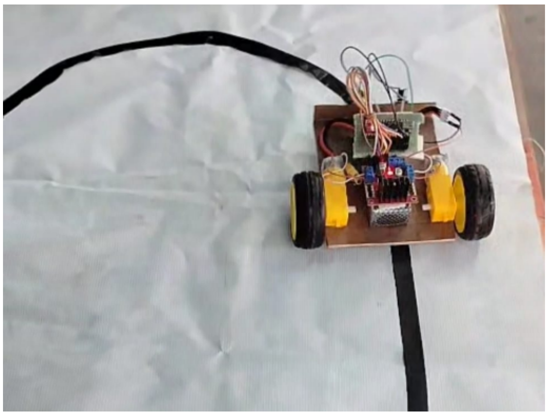
1 INTRODUCTION

Creating a line-following robot with Arduino and three IR sensors is an intriguing project. Unlike commonly found examples that might use fewer sensors or more complex sensor arrays, this project utilizes a three-sensor configuration to enhance accuracy and robustness in line detection. This approach provides better discrimination between the line and the surrounding surface, allowing for smoother and more reliable navigation. IR sensors detect the the contrast between the line and the floor, guiding the robot along the intended path.

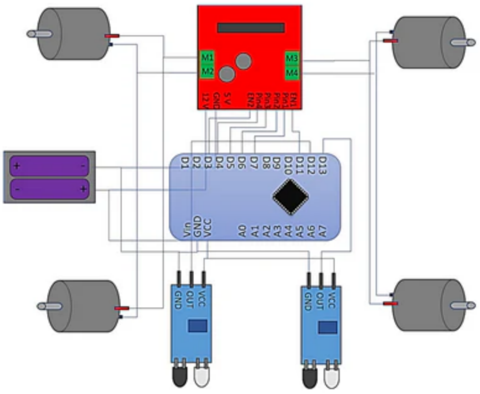
2 MATERIALS AND COMPONENTS

- Arduino Nano board
- Infrared (IR) sensor module ×3
- L298N motor driver
- Robot chassis (plywood)
- BO motors ×2
- Wheels ×2
- Li-po battery 3S 12.6V
- Jumper wires
- Matrix Board
- Soldering Iron and Solder Wire

3 SYSTEM DESIGN



(a) Robot Assembly



(b) Block Diagram

Figure 1: System Design Overview

The line-following robot system consists of a chassis with two motors driven by an L298N motor driver, controlled by an Arduino Nano. The infrared sensors at the front of the chassis detect the edges of the lines and send data to the Arduino for real-time decision making. Power is provided through a Li-po battery.

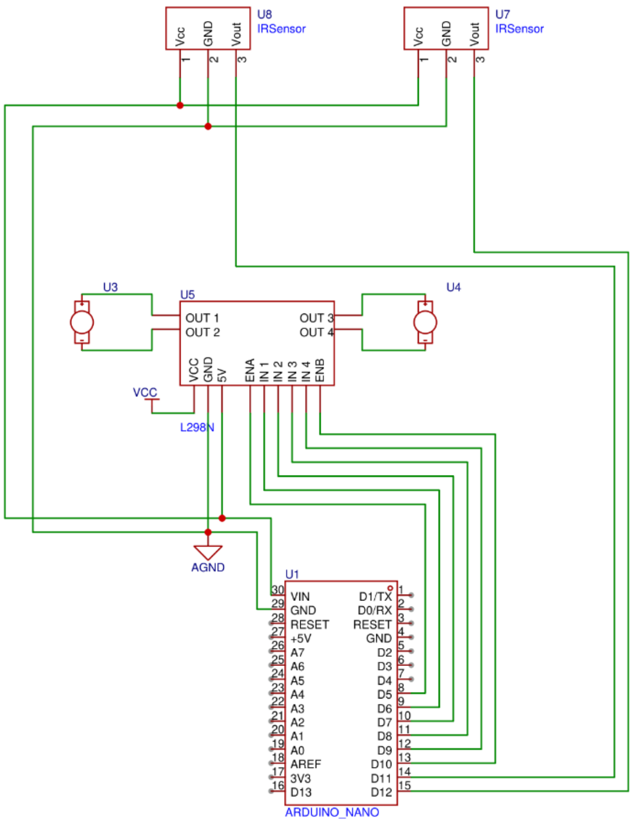


Figure 2: Schematic Diagram

4 METHODOLOGY

4.1 Hardware Setup

1. A plywood chassis of dimensions 20 cm × 15 cm was used.
2. Two BO motors were placed symmetrically onto the plywood.
3. Motors were connected to the L298N motor driver.
4. Arduino Nano was programmed with control code.
5. Connections were soldered between Arduino Nano and L298N on a matrix board.
6. A 12V Li-po battery was connected to the V+ terminal of the L298N.
7. L298N's 5V regulated output was supplied to a breadboard.
8. Arduino Nano and IR sensors were powered from the breadboard.
9. IR sensor outputs were connected to Arduino digital input pins.
10. A cardboard sensor holder was used to properly position the IR sensors.
11. A caster wheel was glued in front of the chassis for smooth turns.
12. All boards were secured using a hot glue gun.

4.2 Libraries Used

No external libraries were used as basic IR line following was implemented using digital reads and simple thresholding.

4.3 Testing and Calibration

Initial Testing: Each component was tested individually. Motors were verified using hard-coded signals, and IR sensors were tested for detection accuracy.
Calibration: Calibration of the IR sensors involved defining thresholds for digital reads under varying light conditions. Motor speed was also adjusted to ensure smooth tracking and reduce overshooting or jitter.

5 PERFORMANCE EVALUATION

The robot was able to follow basic lines and curved paths effectively. However, it struggled with sharp turns or faded lines. In external lighting conditions, the IR sensors produced unreliable inputs. On smooth surfaces, some jittering was observed due to wheel slippage. The design proved sufficient for standard patterns but had limitations in dynamic or less distinct environments.

6 FUTURE ENHANCEMENTS

- Use sensor arrays with more IR sensors (e.g., 5 or 8) for improved pattern recognition.
- Implement PID control for motor speed and turning to reduce jitter and enhance accuracy.
- Use high-traction wheels to avoid skidding on smooth surfaces.
- Scale the design for material transport in controlled environments.

7 DISCUSSION AND CONCLUSION

Building this line-following robot was a rewarding experience. It enhanced my understanding of electronics and robotics through hands-on integration of sensors, microcontrollers, and mechanical systems. Despite limitations, the robot performed reliably under basic conditions and serves as a strong foundation for more advanced designs.

References

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