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Line Following Robot

Aditya Hanawate, Saurabh Chavan, Vyankatesh Bandsode, Om Bhalekar, Prof. Mohite B.S

Department of Electronic & Telecommunication Engineering, JSPM's Bhivrabai Sawant Polytechnic Wagholi, India

ABSTRACT: This paper presents the design and implementation of a line follower robot using an Arduino Uno microcontroller. The robot is capable of automatically following a predefined path using infrared (IR) sensors. The IR sensors detect the contrast between the line and the surface, and the microcontroller processes this input to control the movement of the motors through a motor driver.

The system is designed to be simple, cost-effective, and efficient for basic automation applications. The robot continuously adjusts its direction based on sensor feedback to stay on the path. This project demonstrates the fundamental concepts of embedded systems, robotics, and automation.

The developed system can be applied in industrial automation, automated guided vehicles (AGVs), and material handling systems. The results show that the robot performs accurately under controlled conditions and provides a reliable solution for path-following tasks.

I. INTRODUCTION

In recent years, automation and robotics have become an essential part of modern technology. Line follower robots are one of the most basic and widely used autonomous robotic systems. These robots are designed to follow a specific path or line using sensor-based detection and control mechanisms.

A line follower robot operates by detecting a contrasting line (typically black on a white surface) using infrared (IR) sensors. The sensor data is processed by a microcontroller, which controls the movement of the robot by adjusting the speed and direction of the motors.

In this project, a line follower robot is developed using an Arduino Uno, IR sensors, motor driver, and DC motors. The system is designed to automatically follow a predefined path without human intervention.

Line follower robots are widely used in industrial applications such as automated guided vehicles (AGVs), warehouse automation, and material handling systems. This project provides a simple, cost-effective, and efficient solution while demonstrating fundamental concepts of embedded systems and robotics.

II. LITERATURE SURVEY

Various researchers and engineers have developed line follower robots using different techniques and technologies. These robots are widely used in industries for automation and reducing human effort in repetitive tasks.

Earlier systems used basic analog circuits and simple sensors for line detection. With the advancement of technology, microcontroller-based systems became more popular due to their flexibility and ease of programming. Infrared (IR) sensors are commonly used in such systems because they are cost-effective and provide reliable performance for line detection.

Some advanced line follower robots use image processing and camera-based systems to improve accuracy and adaptability. However, these systems are complex and expensive, making them less suitable for beginner-level and low-cost applications.

Arduino-based systems are widely used in educational and prototype projects due to their simplicity, open-source nature, and low cost. Researchers have also implemented PID control algorithms and multiple sensor arrays to improve the performance and accuracy of line follower robots.

In this project, a simple and efficient approach is used by implementing a line follower robot using IR sensors and an Arduino Uno, making it suitable for educational purposes and basic automation tasks.

III. METHODOLOGY

The proposed system is a line follower robot developed using an Arduino Uno, IR sensors, motor driver, and DC motors. The IR sensors detect the line based on the difference in surface reflectivity.

The sensor signals are sent to the Arduino Uno, which processes the input and controls the movement of the motors. Based on the sensor output, the robot moves forward, turns left, or turns right to follow the path.

The motor driver is used to drive the motors according to the signals from the microcontroller. The system continuously monitors the path and adjusts its movement in real-time, ensuring accurate line tracking.

1. System Design Methodology

The system is designed as an autonomous line follower robot using an Arduino Uno, IR sensors, motor driver, and DC motors. The overall design includes sensing, processing, and actuation stages.

The IR sensors detect the path, the Arduino Uno processes the input signals, and the motor driver controls the motors accordingly. The system is designed to operate in real-time and continuously adjust its direction to follow the line accurately.

2. Hardware Methodology

The hardware implementation consists of IR sensors for line detection, an Arduino Uno as the control unit, a motor driver module for motor control, and DC motors for movement. A power supply is used to provide the required voltage to all components.

The IR sensors are placed at the front of the robot to detect the line. The outputs of the sensors are connected to the input pins of the Arduino Uno. The motor driver is connected between the Arduino and the motors to control their speed and direction.

3. Software Methodology

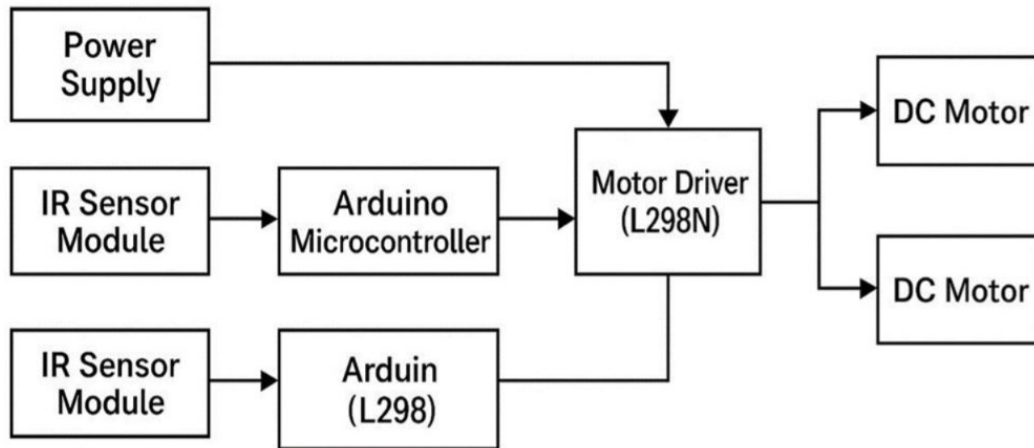
The software is developed using the Arduino IDE. The program is written in embedded C and uploaded to the Arduino Uno. The code continuously reads the input from the IR sensors and makes decisions based on predefined conditions. If both sensors detect the line, the robot moves forward. If the left sensor detects the line, the robot turns left, and if the right sensor detects the line, the robot turns right. The software ensures real-time response and smooth operation of the robot.

4. Working Methodology

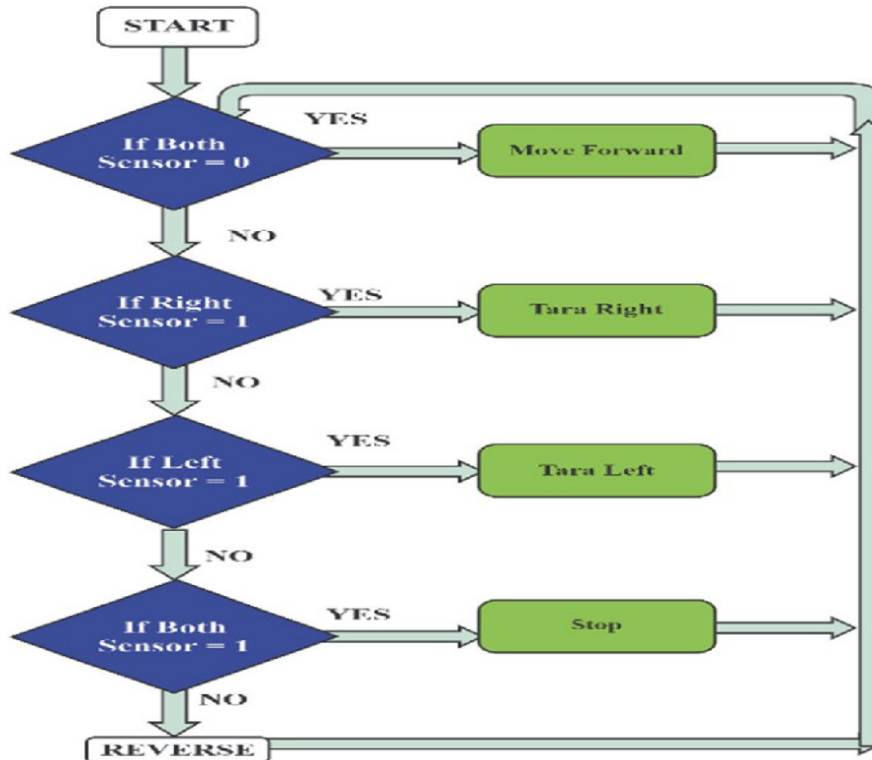
The working of the system is based on sensor detection and control logic. The IR sensors detect the presence or absence of the line and send signals to the Arduino Uno.

The Arduino processes these signals and controls the motor driver to move the robot in the required direction. The robot continuously adjusts its movement based on sensor input, allowing it to follow the path accurately without human intervention.

Block Diagram



Flowchart :



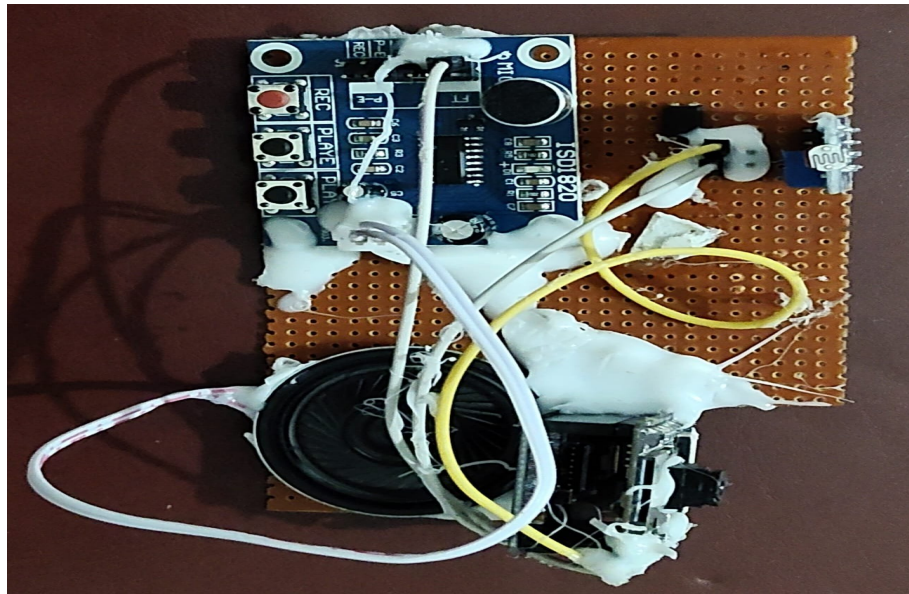
IV. EXPERIMENTAL RESULTS

The developed line follower robot was tested on a predefined track consisting of a black line on a white surface. The robot successfully detected the line using IR sensors and followed the path accurately.

The system was able to perform basic movements such as moving forward, turning left, and turning right based on sensor input. The response of the robot was fast and stable under normal lighting conditions.

It was observed that the robot performed best on smooth surfaces with clear contrast between the line and the background. Minor deviations occurred at sharp turns, but the robot was able to correct its path quickly.

Overall, the results show that the system is reliable, efficient, and suitable for basic line-following applications.



In this project, a line follower robot was successfully designed and implemented using an Arduino Uno, IR sensors, and a motor driver. The robot is capable of following a predefined path automatically without human intervention.

The system is simple, cost-effective, and efficient for basic automation tasks. It demonstrates the fundamental concepts of robotics, embedded systems, and sensor-based control.

The project can be used in various applications such as industrial automation, automated guided vehicles, and material handling systems. The performance of the robot confirms that it is a reliable solution for path-following tasks.

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