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Line Follower Robot with Obstacle Avoidance

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Abstract - One of the most available robots in applications are the line followers. These robots normally follow either white or a black line. This paper introduces an Autonomous Emergency Indicating Line Follower and Obstacle Avoiding Robot. The robot moves on a specific path determined by the user and detects the obstacle that comes in its way. The vehicle robot stops and diverts its route and returns back to original path, once the obstacle has been overcome. Whenever the robot gets lost from the track, the robot automatically follow the predefined path. The robot is achieved through the implementation of many sensors interacting with the controllers. An experimental study of time taken by the robot for different length obstacle as well as for different speed of the robot is also performed.

Key Words: Sensors, Obstacle Detection, Line Follower

1.INTRODUCTION

Line Follower Robots with Obstacle detection, and surveillance are autonomous machines designed to navigate predefined paths while detecting and circumventing obstacles. This project is motivated by their potential applications in industry, education, and various real-world scenarios, as well as the technical challenge and innovation it offers. Catering to a wide spectrum of needs, Line Follower Robots with Obstacle removal possess the ability to autonomously track paths while evading obstacles. The project is driven by its practicality in industries, educational relevance, and the quest for technical innovation.

2. OBJECTIVE

The primary aim of this project is to design and develop a Line Follower Robot with advanced obstacle removal capabilities. This robot will autonomously follow designated paths while detecting and circumventing obstacles in real-time, making it applicable for industrial automation, education.

3. PROBLEM STATEMENT

In places such as industries, Hospitals, Factories and VIP roads there is a need of manpower for different purposes. Need more labors for transporting and loading. There are certain needs that can’t be fulfilled by humans or not trustable.

4.METHODOLOGY

We are developing an autonomous line follower robot using an Arduino Nano. Initially, IR sensors 1 and 2 detect the path; if it's a black line, the Arduino signals the L298 motor driver, propelling the robot forward. The robot is equipped to detect and remove obstacles: the HCSR04 sensor identifies obstacles and display the corresponding distance range on 16*2 lcd display. The Arduino then directs the SG-90 servo to sweep the obstacle, and once cleared, the robot resumes its path and then it continues. We've integrated an ESP32 Cam for surveillance.

To bolster our robot's navigational capabilities, we've integrated an obstacle detection and avoidance system. Enter the HCSR04 sensor, designed to detect obstacles in the robot's path. Upon detecting an obstruction, this sensor promptly relays distance measurements to the Arduino Nano, which in turn orchestrates the necessary actions.

For the task of obstacle clearance, we've enlisted the SG-90 servo motor. Upon receiving instructions from the Arduino Nano, this servo motor undergoes a sweeping motion, effectively clearing the obstacle from the robot's path. Once the obstacle is successfully navigated, the robot seamlessly resumes its intended trajectory.

To enhance our robot's functionality and provide real-time surveillance capabilities, we've incorporated an ESP32 Cam module. This addition allows the robot to capture visual data of its surroundings, enabling remote monitoring and analysis of its operational environment.

5.HARDWARE SPECIFICATION

- Arduino Nano
- ESP32 Camera
- HC-SR04
- DC Motor
- Motor Driver
- IR Sensors
- Chassy Board
- Wheels
- Li-ion Battery
- Motor (SG90)
- 16X2 LCD

6.SOFTWARE SPECIFICATION

- Arduino IDE

7.SYSTEM DESIGN

- **BLOCK DIAGRAM**

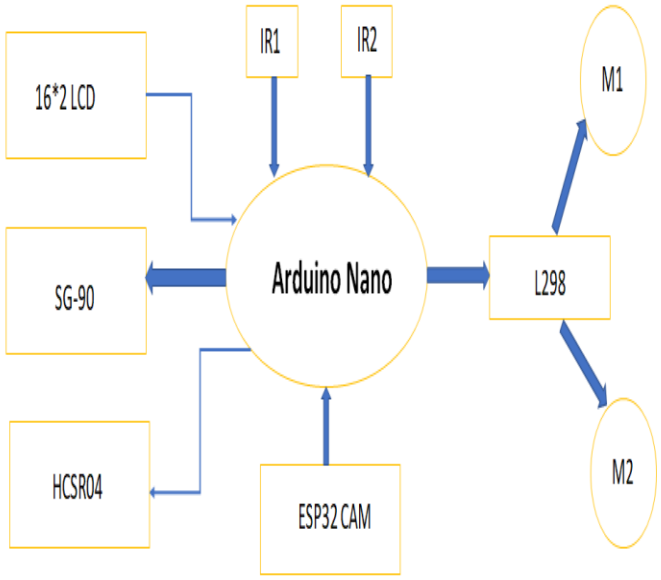


Fig -1: Block Diagram

- **CIRCUIT DIAGRAM**

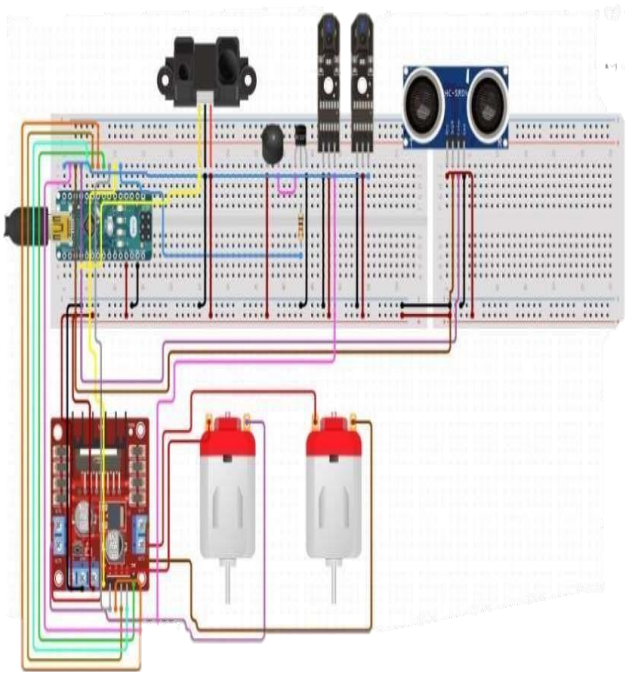


Fig -2: Circuit Diagram

8. RESULT & DISCUSSION

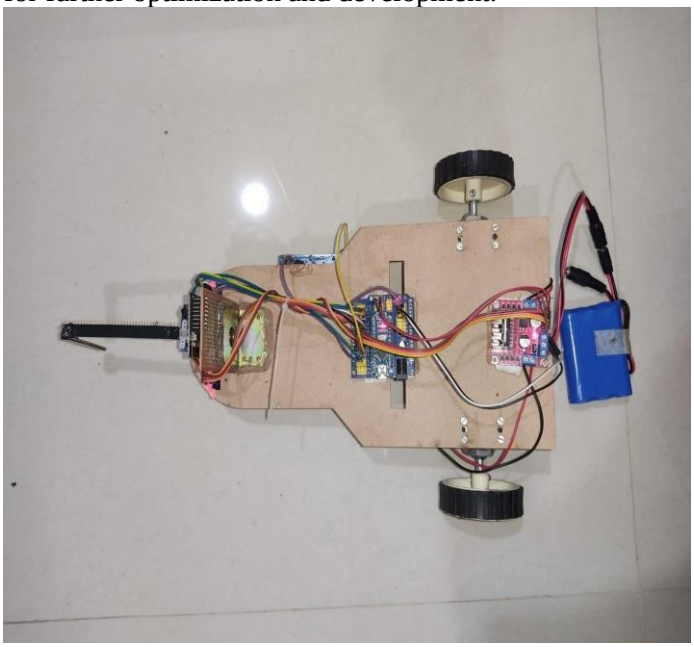
Line follower robot with obstacle detection and surveillance would involve analysing the effectiveness of the robot in following a predefined path (the line), detecting obstacles in its path, and surveilling its surroundings.

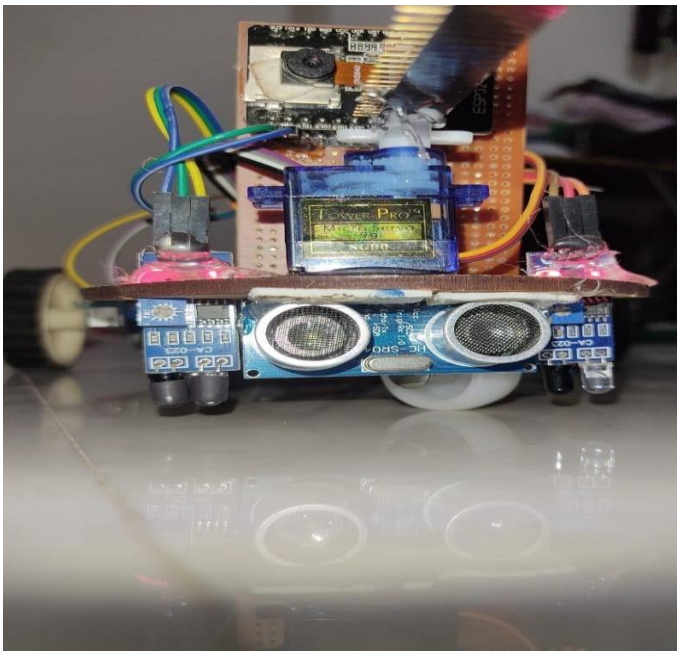
This would include evaluating factors such as:
1. Accuracy of line following: Assessing how accurately the robot follows the line under various conditions such as different lighting, surface colours, and line widths. Obstacle detection capability: Evaluating the robot's ability to detect obstacles in its path using sensors such as ultrasonic sensors, infrared sensors, or cameras.

2. Obstacle avoidance: Determining how effectively the robot avoids obstacles once detected, including its speed and manoeuvrability in navigating around them. Surveillance coverage: Analysing the robot's ability to monitor its surroundings using sensors or cameras, including its field of view, range, and accuracy in detecting objects or movements.

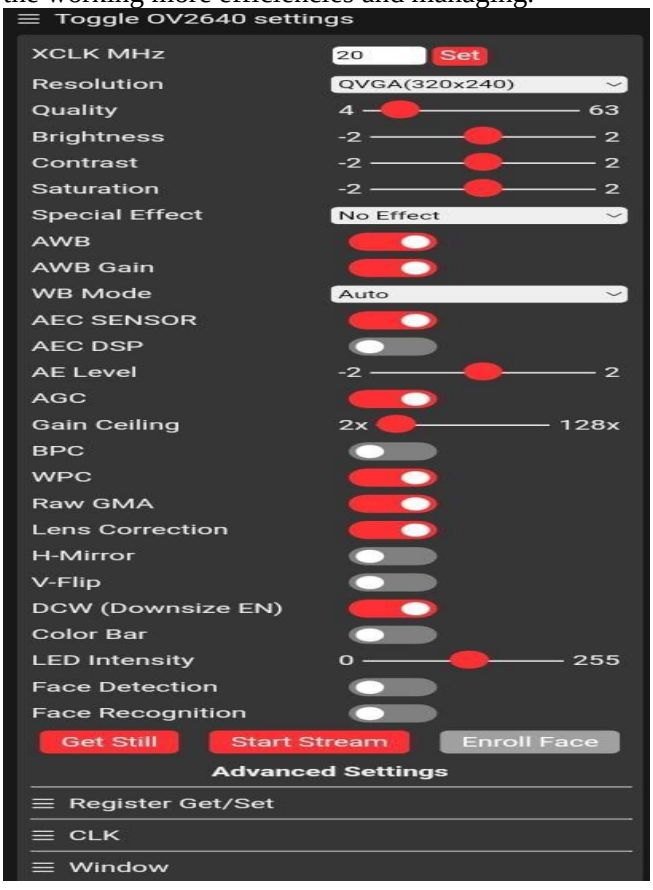
3. Integration and system robustness: Assessing the overall performance and reliability of the system, including how well the different components (line following, obstacle detection, surveillance) work together and how the robot responds to unexpected situations.

4. Real-world applicability: Considering the practical usability of the robot in various scenarios such as indoor navigation, outdoor exploration, or security patrol. By conducting experiments and tests based on these criteria, researchers can evaluate the effectiveness and performance of the line follower robot with obstacle detection and surveillance, leading to valuable insights for further optimization and development.

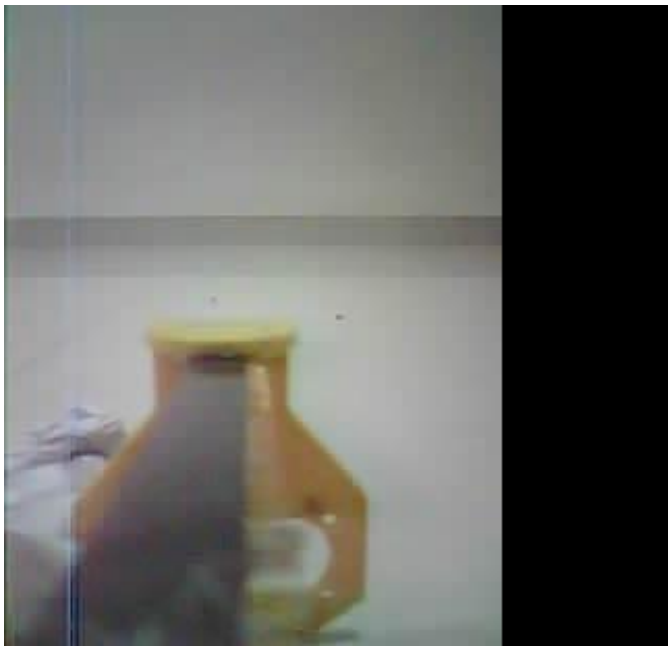




By utilizing the Net Analyzer app, users can easily over seeing the entire upcoming path followed by robot, receiving real-time obstacle and it's distance updates on the lcd, and make adjustments as necessary without the needs for manual interventions. This automations the processed, enhances efficiencies, and ensuring that the robot followed the predefined path operate smoothly and effectively. Ultimately, the integrating of the Net Analyzer app into the robot offers conveniences, flexibilities, and control, making user to effectively see the working more efficiencies and managing.



As we can see on Net Analyzer app the obstacle clearance, upon receiving instructions from the Arduino Nano, servo motor undergoes a sweeping motion, effectively clearing the obstacle from the robot's path. Once the obstacle is successfully navigated, the robot seamlessly resumes its intended trajectory.



The project demonstrates the remarkable effectiveness of an autonomous line-following robot that boasts cutting-edge obstacle detection and removal capabilities, signaling a new era of automation and efficiency across diverse industries.

By integrating advanced technologies such as infrared sensors for path detection, obstacle sensors for real-time hazard identification, and servo motors for obstacle clearance, our robot showcases versatility and adaptability. Its capacity to autonomously traverse predefined paths while dynamically responding to

environmental challenges highlights its potential to transform operations across numerous sectors.

In industries like manufacturing and logistics, where precision and efficiency are crucial, our autonomous robot pledges to streamline processes, minimize downtime, and optimize resource utilization. By reducing reliance on human intervention, there's a tangible decrease in operational costs and a substantial increase in productivity.

Moreover, our robot's versatility extends beyond industrial settings. In environments prioritizing safety, such as healthcare facilities or hazardous areas, its autonomous obstacle detection and removal capabilities ensure enhanced safety protocols and risk mitigation strategies.

Additionally, the integration of surveillance functionalities through the ESP32 Cam module opens up avenues for improved security and monitoring applications. Whether it involves surveilling remote areas, monitoring critical infrastructure, or ensuring compliance with safety regulations, our robot offers unparalleled versatility and functionality.

The project not only highlights the effectiveness of an autonomous line-following robot but also its potential to revolutionize industries through heightened efficiency, decreased human supervision, and versatile applications. With its advanced capabilities, our robot serves as a symbol of innovation, poised to redefine the future of automation across various sectors.

9. CONCLUSION

The project showcases an innovative autonomous line-following robot integrated with obstacle detection and removal features. Through the utilization of advanced sensors and algorithms, the robot can autonomously navigate predefined paths while efficiently identifying and circumventing obstacles. This technology exhibits versatility, suitable for various industrial applications where repetitive tasks are prevalent. Additionally, the robot's capacity to operate autonomously reduces the necessity for constant human oversight, thereby enhancing efficiency and safety in tasks like material handling, assembly line operations, and warehouse management. Overall, the project underscores the transformative potential of autonomous robotic systems in optimizing traditional industrial processes by streamlining operations and diminishing the dependence on human intervention.

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