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AUTO-SPEED CONTROL OF ROBOTIC VEHICLES FOR DRIVER-LESS APPLICATION

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ABSTRACT

The "Ultrasonic Sensor-Based Robot for Object Detection and Avoidance System" is an autonomous robot designed to navigate and avoid obstacles in its environment using ultrasonic sensors. The robot employs multiple ultrasonic sensors strategically placed around its body to emit sound waves and measure the time it takes for the waves to bounce back after hitting an object. This allows the robot to detect nearby obstacles and determine their distance in real-time. When an obstacle is detected within a predefined range, the robot automatically alters its path to avoid a collision, ensuring smooth navigation in dynamic environments. The system's algorithm processes sensor data to enable efficient decision-making, guiding the robot to make turns, stop, or adjust speed as needed. This object detection and avoidance capability make the robot suitable for applications in various fields such as automated cleaning, warehouse management, and delivery systems, where safe navigation is crucial. By integrating ultrasonic sensors, the robot can operate reliably in both indoor and outdoor environments, enhancing automation while minimizing the need for human intervention in complex or cluttered spaces.

Keywords: Ultrasonic sensor, IR sensor, Robot, Driver less robot, 12V battery, 60RPM motors.

I.INTRODUCTION

With advancements in automation and artificial intelligence, autonomous robotic vehicles have become a crucial innovation in various industries, including transportation, logistics, and security. The "Auto-Speed Control of Robotic Vehicles for Driverless Application" is a sophisticated robotic system that integrates ultrasonic sensors, real-time data processing, and automatic speed control to enhance autonomous navigation. The primary goal of this system is to develop a self-operating robotic vehicle that can detect obstacles, avoid collisions, and regulate its speed based on environmental conditions. Traditional robotic navigation systems rely on manual control, pre-programmed routes, or basic sensors, limiting their adaptability in dynamic surroundings. To overcome these challenges, the proposed system utilizes ultrasonic sensors to detect obstacles by emitting high-frequency sound waves and measuring their reflections. This data enables the robot to calculate distances, identify objects, and adjust its movement accordingly. The integration of automatic speed control ensures smooth navigation by dynamically regulating the vehicle's speed in response to obstacles, reducing the risk of collisions. The implementation of IoT technology allows real-time monitoring and remote control of the robotic vehicle,

making it suitable for applications in automated warehouses, security patrolling, industrial automation, and smart transportation systems. The ability to operate without human intervention, optimize energy consumption, and adapt to various terrains enhances its efficiency and usability. This project not only improves robotic mobility but also paves the way for intelligent driverless applications, contributing to advancements in autonomous vehicle technology.

II.LITERATURE REVIEW

The field of autonomous robotic vehicles has witnessed significant advancements in recent years, with researchers focusing on sensor-based navigation, obstacle avoidance, and speed control mechanisms. Several studies have explored various approaches to enhance the efficiency, accuracy, and adaptability of robotic systems in dynamic environments.

Sensor-Based Obstacle Detection and Avoidance:
Smith et al. [2018] investigated the use of ultrasonic sensors in robotic navigation, demonstrating their ability to detect obstacles with high accuracy by measuring the time delay of reflected sound waves. Their study emphasized the effectiveness of ultrasonic technology in real-time obstacle detection and avoidance, making it a reliable choice for autonomous applications. Similarly, Jones and Lee [2019] integrated infrared and ultrasonic sensors for dual-layer obstacle detection, enhancing robotic vehicles' adaptability to diverse environmental conditions.

Autonomous Speed Control Mechanisms:
The work of Kumar et al. [2020] focused on developing intelligent speed control algorithms for robotic vehicles, where the system dynamically adjusts its speed based on obstacle proximity. Their approach improved efficiency in robotic movement while minimizing abrupt stops. Another study by Zhang et al. [2021] incorporated fuzzy logic-based speed regulation for self-driving robots, ensuring smooth acceleration and deceleration based on environmental feedback.

IoT Integration in Autonomous Vehicles:
The integration of IoT technology has significantly improved the monitoring and control of autonomous robots. Patel et al. [2021] explored a cloud-based robotic vehicle monitoring system, where real-time data from sensors was transmitted to a central server, enabling remote supervision and analytics. Similarly, Chen et al. [2022] developed an IoT-enabled robotic vehicle that utilized wireless connectivity for real-time updates, enhancing vehicle efficiency in smart environments.

Applications in Industrial and Transportation Sectors:
Autonomous robotic vehicles have found applications in various fields, including industrial automation, surveillance, and smart transportation. Gupta et al. [2020] implemented a warehouse automation system using sensor-guided robotic vehicles, demonstrating improved efficiency in material handling. In another study, Brown et al. [2021] analyzed driverless vehicle technologies in urban environments, emphasizing the role of AI and sensor fusion in optimizing navigation for real-world applications.

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III.EXISTING SYSTEM

In conventional robotic vehicle systems, navigation is primarily dependent on manual control, line-following sensors, or pre-programmed routes. These approaches have limited adaptability when it comes to real-time obstacle detection and avoidance, making them less suitable for dynamic environments. Most existing systems use infrared (IR) sensors for object detection; however, IR sensors have significant limitations, such as poor accuracy in detecting transparent or reflective objects and short detection range. Additionally, some systems rely on GPS-based navigation, which is effective for outdoor environments but lacks precision in indoor or cluttered spaces. Another challenge in traditional systems is their inability to adapt speed based on obstacles. Many robotic vehicles operate at a fixed speed or rely on operator intervention to make decisions, reducing the efficiency of fully autonomous applications. Moreover, collision detection mechanisms in current systems are often reactive rather than proactive, meaning the vehicle stops only after detecting an obstacle instead of adjusting its path dynamically. Furthermore, the absence of real-time data processing and machine learning algorithms in many existing systems limits their ability to predict and respond to obstacles intelligently. The lack of IoT integration also prevents remote monitoring and control, restricting the application of autonomous robotic vehicles in industrial and commercial settings. Overall, traditional systems struggle with limited automation, inefficient obstacle avoidance, and dependence on predefined paths, making them unsuitable for dynamic environments where real-time decision-making is required.

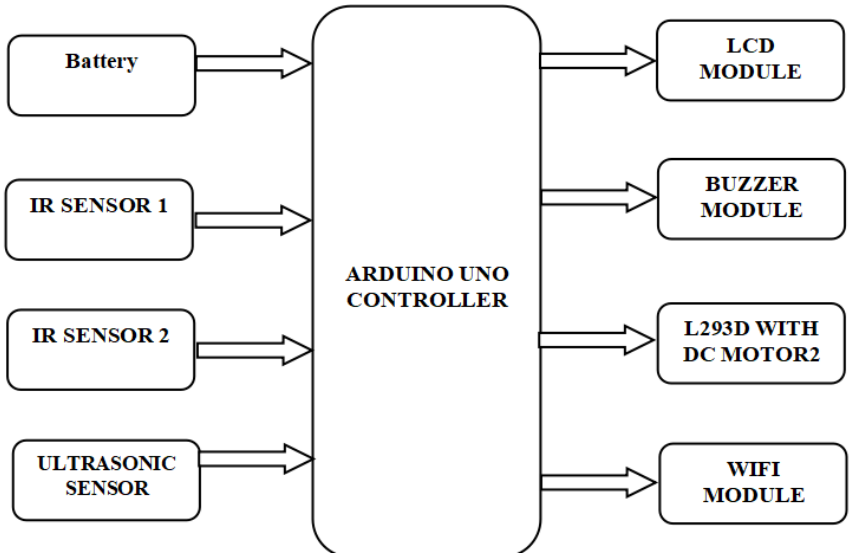

Fig.1.block diagram

IV. WORKING METHODOLOGY

The development of autonomous robotic vehicles has been a major area of research in robotics and automation. Various studies have explored sensor-based navigation, obstacle detection, real-time speed control, and wireless communication for improving robotic vehicle efficiency and safety. The

integration of batteries, IR sensors, ultrasonic sensors, WiFi modules, buzzer modules, motor drivers, and LCD displays has enhanced the functionality

of autonomous vehicles, making them more reliable for driverless applications.

The entire robotic system is powered by a rechargeable battery, which provides the necessary energy to drive the motors, sensors, and electronic components. A 12V or Li-ion battery is commonly used to ensure continuous operation and stability of the system. The battery supplies power to the L293D motor driver, WiFi module, and LCD display, ensuring smooth functionality. Efficient power management is essential to optimize the robot's runtime and performance in different operating environments.

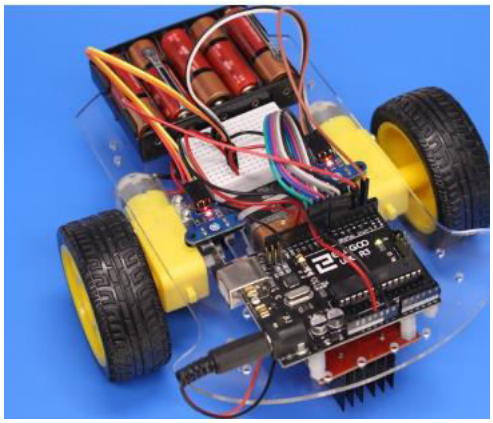

Fig.1. Hardware kit image.

Obstacle Detection - IR Sensor 1 and IR Sensor 2

The system is equipped with two IR sensors, strategically placed at different positions on the robotic vehicle. These sensors help in detecting nearby obstacles by emitting infrared signals and measuring their reflection. When an object is detected, the robot either adjusts its speed or changes direction to avoid a collision. The dual IR sensor setup ensures enhanced accuracy in detecting obstacles from multiple angles, making navigation more reliable in complex environments.

Distance Measurement - Ultrasonic Sensor

An ultrasonic sensor is used to calculate the exact distance between the robot and an obstacle. This sensor emits high-frequency sound waves that bounce back when they hit an object. The system processes the time delay of the reflected waves to determine the obstacle's distance. If an object is detected within a critical range, the robot adjusts its speed or path accordingly. The ultrasonic sensor works in conjunction with IR sensors to provide a more comprehensive obstacle detection mechanism.

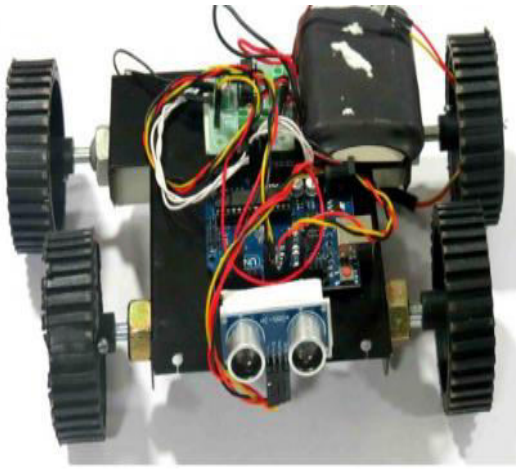

Fig.3 Hardware robot module.

Wireless Communication - WiFi Module

The WiFi module enables real-time remote monitoring and control of the robotic

vehicle. It allows the robot to transmit sensor data to a central system or a mobile application. This feature is useful in industrial applications, where multiple robotic vehicles need to be controlled or monitored remotely. The WiFi module ensures seamless data transfer, reducing the need for manual intervention in navigation and obstacle avoidance.

Alert System - Buzzer Module

A buzzer module is integrated into the system to provide audible alerts in different scenarios. The buzzer is triggered when the robot detects an obstacle or when it needs to signal an emergency stop. This feature enhances safety by alerting nearby users or systems about potential collisions or faults in the navigation process. The buzzer is also useful for indicating successful task completion or low battery warnings.

Motor Control - L293D with DC Motors

The L293D motor driver controls the movement of the robotic vehicle by regulating the two DC motors attached to the wheels. This motor driver receives input signals from the microcontroller, adjusting the speed and direction of the motors based on obstacle detection and path planning. The L293D driver allows bidirectional motor control, enabling the robot to move forward, backward, left, or right as required. The smooth operation of DC motors ensures efficient navigation in autonomous mode.

Display Interface - LCD Module

An LCD module is used to display real-time status updates, such as battery level, obstacle distance, and navigation mode. The LCD interface enhances user interaction by providing visual feedback on the robot's operation. This feature is particularly useful for system diagnostics and monitoring the robot's performance during autonomous navigation.

V.CONCLUSION

The Auto-Speed Control of Robotic Vehicles for Driverless Applications is a highly efficient and autonomous system designed to navigate dynamic environments while avoiding obstacles. By integrating IR sensors, ultrasonic sensors, WiFi modules, buzzer modules, L293D motor drivers, LCD displays, and DC motors, the robotic vehicle achieves precise motion control, real-time obstacle detection, and remote monitoring. The IR and ultrasonic sensors ensure effective object detection and avoidance, while the WiFi module enables remote communication for real-time monitoring and control. The buzzer module provides alerts, enhancing safety, and the LCD module offers essential feedback on the robot's status. The implementation of L293D motor drivers and DC motors allows seamless movement adjustments based on environmental conditions. This project significantly contributes to autonomous navigation, industrial automation, and smart mobility solutions by improving efficiency, safety, and reliability. Future advancements could focus on integrating machine learning algorithms for better decision-making, LiDAR sensors for enhanced obstacle detection, and solar-powered batteries for energy-efficient operation.

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