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AUTO SPEED CONTROL OF ROBOTIC VEHICLE USING ULTRASONIC SENSOR

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ABSTRACT

The Objective of this project is to develop a system to keep the vehicle secure and protect it by the occupation of the intruders. The main aim of the project to develop a system automatic speed control of vehicle and accident avoidance using ultrasonic sensor. whenever any obstacle is detected in running vehicle depends on distance automatically control the speed of vehicle. Give alarm to driver alert. The ultrasonic sensor system continuously sends signals and monitors any car or other obstacles are in front of car. The distance up to which ultrasonic sensor can work may be up to 4 meter. When any obstacle or vehicle detected by ultrasonic sensor system it will send signal to the embedded board. After receiving this signal embedded board sends a signal to the motor to reduce the car speed automatically which can control car speed immediately. Vehicle is controlled automatically without any manual operation when the vehicle is at lesser distance away from the front vehicle. Also give alarm to alert to the driver. Many accidents at High-ways are taking place due to the close running of vehicles, all of sudden, if the in front vehicle driver reduces the speed or applied breaks, then it is quite difficult to the following vehicle driver to control his vehicle, resulting accident. To avoid this kind of accident, the warning system, which contains alarm system can arrange at rear side of each and every vehicle.

INTRODUCTION

This auto speed control system is widely applicable in areas such as warehouse automation, delivery robots, and autonomous vehicles, where precise movement and obstacle avoidance are crucial. It enhances both the efficiency and safety of robotic systems, ensuring that the vehicles can operate effectively in a variety of environments without constant manual oversight.

Obstacle Detection with Ultrasonic Sensors:

The core of the system revolves around ultrasonic sensors, which are placed around the vehicle to detect obstacles in its path. These sensors work by emitting ultrasonic sound waves, which travel through the air. When these waves hit an object, they bounce back to the sensor.

Data Processing and Analysis:

The microcontroller (such as an Arduino or Raspberry Pi) receives the data from the ultrasonic sensors. This data represents the distance between the vehicle and any objects within its proximity. The microcontroller continuously monitors the sensor inputs to assess the environment and detect potential obstacles in real-time.

Speed Control Algorithm : Based on the distance readings from the ultrasonic sensors, a speed control algorithm is applied. The algorithm is designed to adjust the vehicle's speed in response to the proximity of obstacles:

- Clear Path: If no obstacles are detected or they are far away (beyond a predefined threshold), the vehicle maintains or increases its speed for efficient movement.

- Proximity Warning: As the distance to an obstacle decreases (when the object gets closer), the system begins to slow down the vehicle to prevent collisions.
- Collision Avoidance: If an obstacle is detected within a critical range, the system reduces the speed further or completely stops the vehicle to avoid collision.

Motor and Driver Control: Motor drivers, which controls the vehicle movements receive commands from the micro controller.

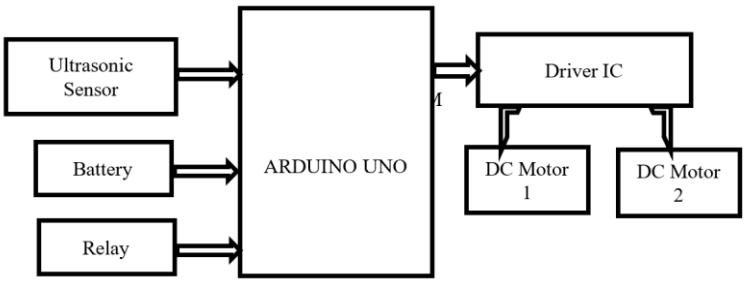

Figure.1 Block Diagram

LITERATURE SURVEY

- Patel et al. (2021) proposed an ultrasonic-based speed control system for robotic vehicles, where the sensor continuously monitors the distance between the robot and obstacles. Based on the proximity data, the microcontroller dynamically adjusts the speed to prevent collisions. Similarly, Kumar & Singh (2020) developed an intelligent robotic vehicle that utilizes multiple ultrasonic sensors to provide real-time feedback for adaptive speed regulation. The system ensures smoother navigation by decelerating near obstacles and resuming normal speed when the path is clear.
- Sharma et al. (2019) implemented an Arduino-based robotic vehicle equipped with ultrasonic sensors for obstacle avoidance and speed control. Their study demonstrated that real-time sensor data processing significantly improves the vehicle's operational safety in dynamic environments. Another study by Gupta et al. (2018) focused on integrating fuzzy logic with ultrasonic sensors to achieve more precise speed modulation, making the robotic vehicle suitable for industrial automation applications.
- These studies highlight the importance of ultrasonic sensor-based speed control in robotic systems, emphasizing enhanced safety, real-time adaptability, and efficient navigation. The continuous advancements in sensor technology and embedded control systems further contribute to improving autonomous robotic applications in industrial, military, and service robotics domains.

PROPOSED SYSTEM

The proposed methodology involves a comprehensive approach to implementing an auto speed control system for robotic vehicles using ultrasonic sensors. By focusing on real-time sensor data acquisition, adaptive speed control algorithms, and efficient motor control, the system can effectively navigate dynamic environments, avoid collisions, and optimize energy usage. The methodology also leaves room for future enhancements, such as sensor fusion and advanced algorithms, to improve performance further.

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The Auto-Speed Control System for robotic vehicles using ultrasonic sensors is designed to adjust the speed of a robot or vehicle based on its proximity to obstacles in its environment. Ultrasonic sensors are widely used in this context due to their ability to measure distances using sound waves, offering precise distance measurements in real-time. The system uses these measurements to dynamically control the speed of the vehicle for obstacle avoidance and safe navigation.

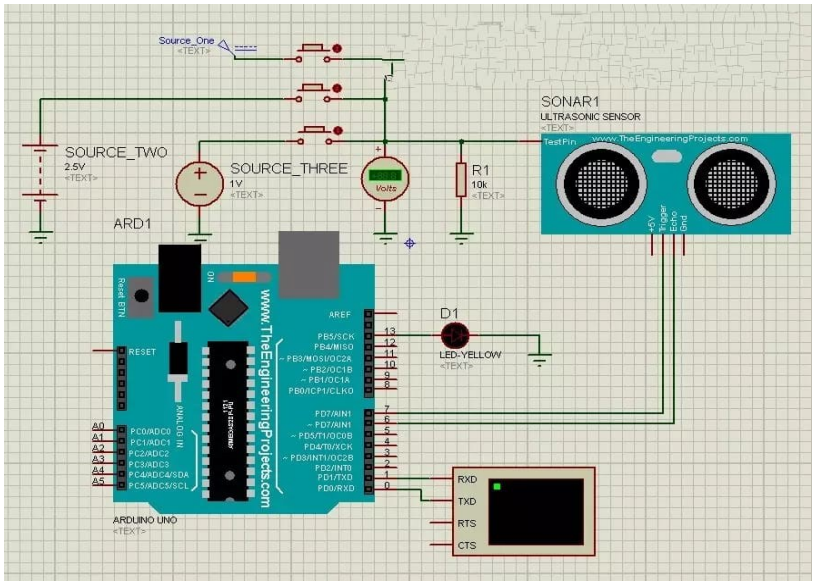

Figure.2 Schematic Diagram

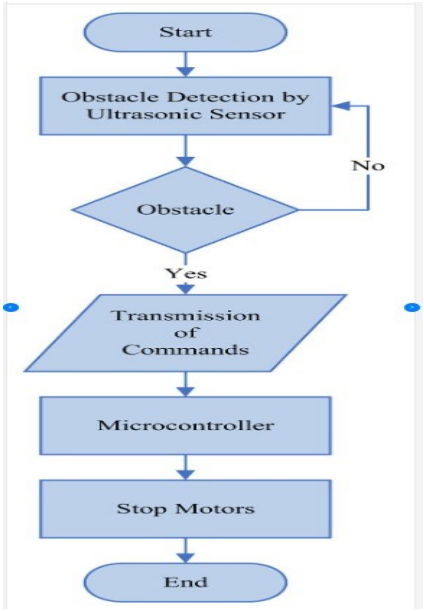

Figure.3 Flow Chart

RESULTS

The implementation of an auto-speed control system for a robotic vehicle using ultrasonic sensors has demonstrated promising results in autonomous navigation, obstacle detection, and dynamic speed adjustment.

This system uses real-time feedback from ultrasonic sensors to determine the vehicle's proximity to obstacles and adjusts its speed accordingly, ensuring safe and efficient movement in various environments.

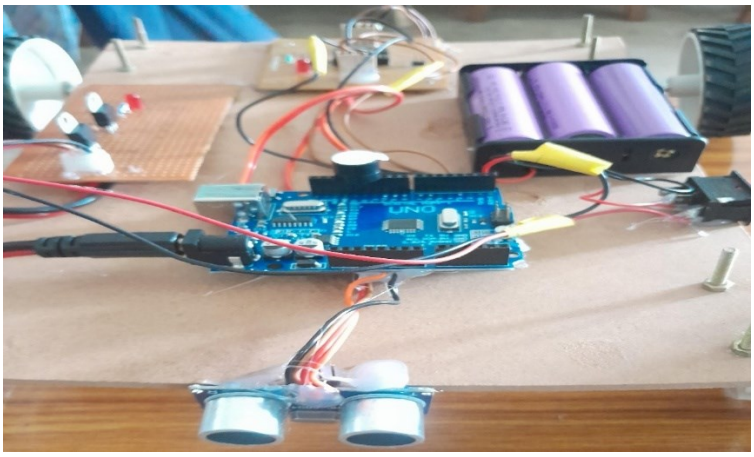

Figure.4 Distance Measurement

The minimum distance for initiating auto-speed control in robotic vehicles using ultrasonic sensors depends on several factors, including the sensor's specifications, the robot's speed, and the desired response time.

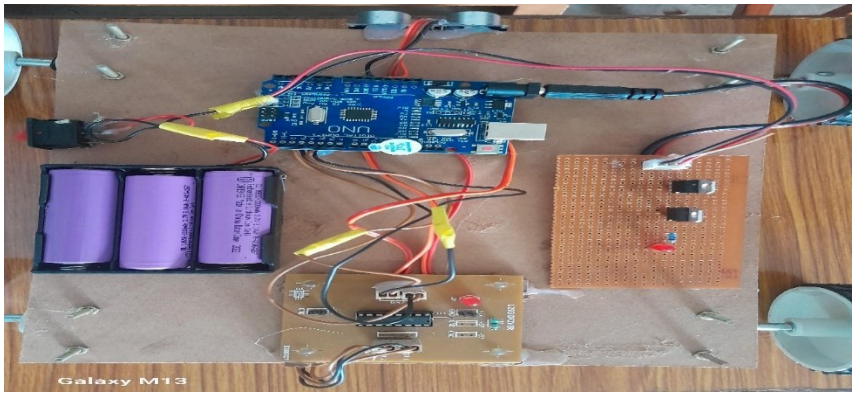

Figure. 5 Circuit Diagram

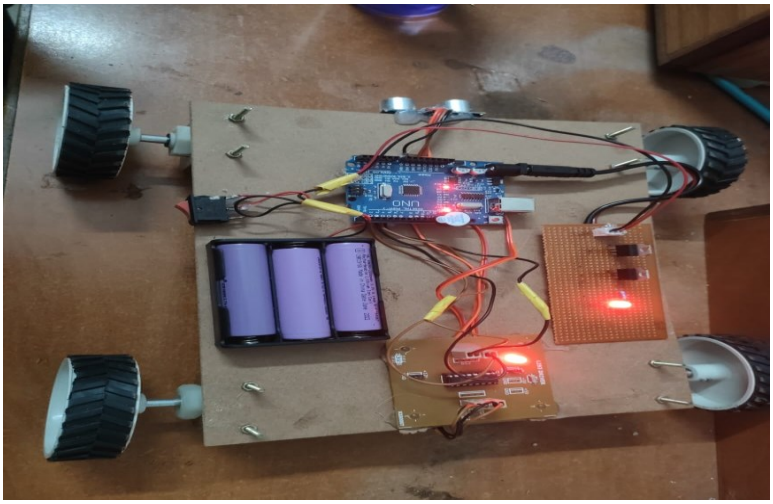

Figure.6 Robo Setup

ADVANTAGES

1. **Collision Avoidance:** The system ensures obstacle detection and automatic speed adjustment, reducing the risk of collisions.
2. **Real-Time Adaptability:** Ultrasonic sensors provide continuous monitoring, enabling instant speed modifications based on environmental conditions.
3. **Energy Efficiency**: By adjusting speed dynamically, the robotic vehicle conserves energy, optimizing battery usage.
4. **Cost-Effective:** Ultrasonic sensors are inexpensive and reliable, making them an affordable solution for intelligent robotic navigation.
5. **Enhanced Safety:** The automated control minimizes human intervention, improving safety in industrial and hazardous environments.
6. **Versatility:** The system can be integrated with various microcontrollers and platforms, making it adaptable to different robotic applications.

APPLICATIONS

1. **Industrial Automation:** Used in manufacturing plants and warehouses for automated material handling while avoiding obstacles.
2. **Autonomous Vehicles:** Integrated into self-driving cars and robotic transport systems for intelligent navigation and speed control.
3. **Military and Surveillance:** Applied in unmanned ground vehicles (UGVs) for reconnaissance missions and border patrolling.
4. **Medical Assistance:** Used in robotic wheelchairs and hospital automation systems to prevent collisions in crowded areas.
5. **Agriculture:** Implemented in autonomous farming robots for safe and efficient crop monitoring and harvesting.
6. **Smart Traffic Systems:** Helps in the development of intelligent transportation solutions by managing vehicle speed in congested areas.

CONCLUSION

The auto-speed control system for a robotic vehicle using ultrasonic sensors has demonstrated its potential as a reliable solution for autonomous navigation. By utilizing real-time distance measurements from ultrasonic sensors, the system effectively detects obstacles and adjusts the vehicle's speed accordingly, ensuring safety and smooth operation in various environments. The integration of a microcontroller to process sensor data and control the vehicle’s movements has been successful in creating an adaptive, real-time feedback loop, which allows the vehicle to respond promptly to obstacles, avoid collisions, and maintain efficient movement.

The system has proven effective in environments with clear, easily detectable obstacles, and has shown the ability to slow down, stop, or resume motion based on the proximity of obstacles. While the ultrasonic sensors provide

good performance in many conditions, their limitations in terms of detection range and accuracy in challenging environments (such as highly reflective surfaces or adverse weather conditions) need to be considered.

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