Voice Controlled and Touch screen Operated Intelligent Wheelchair

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Abstract:
This paper presents the design and development of a Voice Controlled Smart Robotic Vehicle integrated with obstacle detection, GPS tracking, and an emergency alert system. The system is built using an ESP microcontroller, L298N motor driver, four 100 RPM DC motors, ultrasonic sensor, Neo-6M GPS module, DF Player Mini, and an 8-ohm speaker. The vehicle operates through voice commands such as forward, backward, left, and right, enabling hands-free navigation. An ultrasonic sensor continuously monitors the surroundings and provides voice-based obstacle alerts to enhance safety. The integrated GPS module allows real-time location tracking of the vehicle. Additionally, an emergency tactical switch is incorporated to send instant notifications to the administrator during critical situations. The proposed system combines automation, safety, and intelligent control, making it suitable for smart mobility, assistive applications, and surveillance-based environments.

Key Words: Voice Control System, ESP Microcontroller, L298N Motor Driver, Ultrasonic Sensor, Neo-6M GPS Module, Emergency Alert System, Smart Robotic Vehicle.

INTRODUCTION

With the rapid advancement in embedded systems and automation technologies, smart robotic vehicles have gained significant attention in assistive mobility, surveillance, and intelligent transportation applications. Traditional robotic systems often rely on manual controls, which may not be convenient or safe in certain situations. Therefore, integrating voice-based control and safety mechanisms can significantly enhance usability and operational efficiency.

This project presents a Voice Controlled Smart Robotic Vehicle that operates using simple voice commands such as forward, backward, left, and right. The system is built around an ESP microcontroller, which processes input commands and controls four 100 RPM DC motors through an L298N motor driver module. To improve safety, an ultrasonic sensor is integrated to detect nearby obstacles and provide voice alerts using a DF Player Mini and 8-ohm speaker.

Additionally, the system incorporates a Neo-6M GPS module for real-time location tracking of the vehicle. An emergency tactical switch is also included to send immediate notifications to an administrator during critical situations. By combining voice control, obstacle detection, GPS tracking, and emergency communication, the proposed system offers a reliable, intelligent, and safety-oriented robotic solution suitable for modern smart applications.

LITERATURE SURVEY

J. Borenstein and Y. Koren (1988), “Obstacle Avoidance with Ultrasonic Sensors,” IEEE Journal of Robotics and Automation.

This paper presents one of the foundational approaches for obstacle detection and avoidance using ultrasonic sensors in mobile robots. The authors discuss real-time distance measurement, sensor limitations such as noise and reflection errors, and methods to improve navigation accuracy. The work highlights techniques for safe robot movement in dynamic environments. This study is highly relevant to the proposed system, as it supports the integration of an ultrasonic sensor for real-time obstacle detection and safe navigation.

K. K. Lee, "Voice Controlled Robot Using LabVIEW,"
This paper demonstrates the implementation of a voice-controlled robotic system using speech recognition integrated with a control platform. The system converts spoken commands into motion instructions for robotic movement such as forward, backward, left, and right. The research emphasizes real-time processing and command accuracy. This work is directly related to the proposed project, which also relies on voice commands for directional control of DC motors.

Real-Time Obstacle Avoidance for Fast Mobile Robots:
This study focuses on designing real-time navigation algorithms for mobile robots operating at higher speeds. It discusses sensor fusion techniques, rapid decision-making algorithms, and efficient motor control mechanisms to prevent collisions. The paper highlights the importance of low-latency processing for safe robot operation. This is relevant to the proposed system, where timely obstacle detection and motor control through the L298N driver are essential for safe movement.

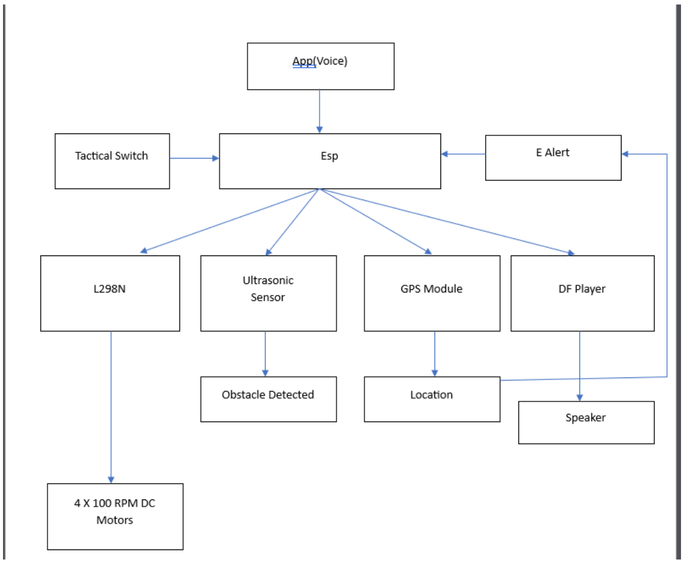
Speech Control Robot Using NodeMCU (ESP8266-basedSystem):
This paper explains the design of a speech-controlled robotic system using NodeMCU (ESP8266) as the main controller. The system receives voice commands via wireless communication and translates them into motor control signals. It demonstrates the practicality of using ESP-based microcontrollers for low-cost and efficient voice-controlled robotic applications. This closely relates to the proposed project, which utilizes an ESP-based controller for implementing voice-based navigation.

Voice Controlled Wheelchair / Assistive Robot System:
This research presents a voice-controlled assistive mobility system designed for physically challenged individuals. The system allows users to control movement using simple speech commands and integrates safety mechanisms to prevent accidents. The paper highlights improved accessibility, ease of use, and enhanced safety features. This is relevant to the proposed smart robotic vehicle, which also integrates voice control, obstacle detection, and emergency alert functionality for improved safety and assistive applications.

METHODOLOGY

The system operates with the ESP microcontroller as the central processing unit. Voice commands are given through a mobile app and transmitted to the ESP, which interprets the commands and controls the movement of the vehicle through the L298N motor driver and four 100 RPM DC motors. At the same time, the ultrasonic sensor continuously monitors the surroundings. If an obstacle is detected, the ESP processes the signal and triggers an audio warning using the DF Player module and speaker.
The GPS module continuously provides the real-time location of the vehicle. In case of an emergency, the tactical switch sends a signal to the ESP, which generates an E-Alert along with the location details. Thus, the system integrates voice-controlled navigation, obstacle detection, audio feedback, location tracking, and emergency alert functionality into a single smart robotic platform.

BLOCK DIAGRAM



OBJECTIVE

1. To design and develop a voice-controlled robotic vehicle using an ESP microcontroller for directional movement.
2. To implement an obstacle detection system using an ultrasonic sensor to ensure safe navigation.
3. To integrate a GPS module for real-time location tracking of the vehicle.
4. To develop an emergency alert mechanism using a tactical switch for immediate assistance.
5. To provide audio feedback and warning messages using a DF Player Mini and speaker for improved user interaction.

PROBLEM DEFINATIONS

Traditional robotic vehicles rely on manual control and often lack integrated safety features such as obstacle detection, real-time location tracking, and emergency alert systems. This can lead to accidents, limited accessibility, and reduced reliability in critical situations. Therefore, there is a need for a smart robotic system that combines voice-based control, obstacle detection, GPS tracking, and an emergency alert mechanism to improve safety, automation, and ease of use.

FUCTIONAL REQUIREMENTS

1. The system must accept and process voice commands to control the movement of the vehicle (forward, backward, left, right).
2. The system must control four DC motors through the L298N motor driver based on the received commands.
3. The ultrasonic sensor must detect obstacles and notify the controller when an object is within a predefined distance.
4. The system must provide audio alerts using the DF Player Mini and speaker when an obstacle is detected.
5. The system must obtain real-time location data using the GPS module and generate an emergency alert when the tactical switch is pressed.

NON FUCTIONAL REQUIREMENTS

1. **Performance:** The system should respond quickly to voice commands and sensor inputs with minimal delay.
2. **Reliability:** The system should operate consistently without frequent failures during movement and alert operations.
3. **Safety:** The obstacle detection mechanism should reduce the risk of collisions during navigation.
4. **Security:** GPS location and emergency alert data should be transmitted securely to prevent unauthorized access.
5. **Usability:** The system should be simple to operate, allowing users to easily control movement and activate emergency alerts.

CONCLUSION

The proposed Voice Controlled Smart Robotic Vehicle successfully integrates voice-based navigation, obstacle detection, GPS tracking, and an emergency alert mechanism into a single embedded system. By using an ESP microcontroller as the central unit, the system ensures coordinated control of motors, sensors, and audio feedback components. The integration of safety features such as obstacle detection and emergency alerts enhance reliability and user protection. Overall, the system demonstrates an efficient, low-cost, and intelligent solution suitable for assistive mobility, smart monitoring, and robotic applications.

REFERENCES:

1. J. Borenstein and Y. Koren, “Obstacle Avoidance with Ultrasonic Sensors,” IEEE Journal of Robotics and Automation, vol. 4, no. 2, pp. 213–218, Apr. 1988.
2. K. K. Lee, “Voice Controlled Robot Using LabVIEW,” IEEE International Conference on Industrial Electronics and Applications (ICIEA), pp. 1023–1028, 2018.

3. S. R. Kumbhar and S. V. Kulkarni, “Design and Implementation of Voice Controlled Robotic Vehicle,” IEEE International Conference on Communication and Electronics Systems (ICCES), pp. 456–460, 2019.
4. P. Singh, R. K. Gupta, and S. K. Soni, “Ultrasonic Sensor Based Obstacle Avoiding Robot,” IEEE International Conference on Advances in Computing and Communication Engineering (ICACCE), pp. 112–116, 2020.
5. M. A. Rahman, M. S. Islam, and N. Hossain, “GPS-Based Real-Time Vehicle Tracking System Using Embedded Platform,” IEEE International Conference on Electrical, Computer and Communication Engineering (ECCE), pp. 1–5, 2019.
6. R. Sharma and A. Kumar, “Design of IoT-Based Emergency Alert and Tracking System,” IEEE International Conference on Smart Technologies for Power, Energy and Control (STPEC), pp. 321–326, 2021.
7. H. Kim and J. Park, “Development of a Voice Recognition Based Mobile Robot Control System,” IEEE International Conference on Consumer Electronics (ICCE), pp. 215–218, 2018.
8. V. R. Balaji, S. Karthik, and R. Prakash, “Design of Smart Obstacle Avoidance Robot Using Ultrasonic Sensor and Microcontroller,” IEEE International Conference on Intelligent Systems and Green Technology (ICISGT), pp. 87–91, 2019.
9. A Verma and P. Singh, “IoT-Based Vehicle Tracking and Emergency Alert System Using GPS and GSM,” IEEE International Conference on Computing, Communication and Automation (ICCCA), pp. 102–107, 2020.
10. L. Zhang, Y. Wang, and T. Chen, “Embedded System Design for Smart Robotic Vehicle with Wireless Control,” IEEE International Conference on Robotics and Automation Sciences (ICRAS), pp. 144–149, 2021.