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Design & Development of Delivery & Greeting Robot for College Campus

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Abstract: ***Autonomous service robots are becoming increasingly useful in smart campuses and modern institutions. This project presents the design and implementation of a GPS-based delivery and greeting robot capable of operating in both automatic and manual modes. The robot is controlled using an ESP32 microcontroller and powered by an inbuilt rechargeable battery with a charging circuit. A GPS module is used for navigation within the campus environment. Ultrasonic sensors help the robot detect and avoid obstacles during movement, ensuring safe navigation. An IR sensor is used to detect the presence of delivery items inside the robot's storage compartment. The robot uses an L298 motor driver and gear motors for movement control, while an I2C LCD display provides system status and greeting messages for users. In automatic mode, the robot navigates to predefined locations for delivery, while in manual mode it can be controlled remotely. This system improves automation, reduces human effort, and enhances smart campus services.***

Keywords: Autonomous Delivery Robot, ESP32 Microcontroller, Global Positioning System, Navigation Obstacle Avoidance, Ultrasonic Sensor, L298 Motor Driver, Embedded Systems, Mobile Robotics Autonomous Navigation

I. INTRODUCTION

The project titled "Design and Development of a Delivery and Greeting Robot for College Campus" presents an innovative approach to automating delivery services within a campus environment. The system is centred around an ESP32 microcontroller, which acts as the brain of the robot by coordinating communication, control, and data processing. A GPS module is used to enable navigation to predefined locations across the campus, allowing the robot to perform autonomous delivery tasks efficiently. Additionally, the robot supports both automatic and manual modes, providing flexibility for different operational requirements. The robot is equipped with multiple sensors to ensure safe and reliable operation. Ultrasonic sensors are used for obstacle detection and avoidance, allowing the robot to move smoothly without collisions. An IR sensor is integrated to detect the presence of items inside the delivery compartment, ensuring secure package handling. The movement of the robot is controlled using gear motors driven by an L298 motor driver, which provides precise control over direction and speed. The system is powered by an inbuilt rechargeable battery along with a charging circuit, enabling continuous and energy- efficient operation.

II. MATERIALS AND METHODS

A. Hardware Components (Materials)

The proposed delivery and greeting robot were developed using:

- ESP32 microcontroller as the main controller
- Global Positioning System module for navigation
- Ultrasonic sensor for obstacle detection

B. System design and integration

The robot was designed by integrating navigation, sensing, motor control, and display modules into a single embedded system.

- ESP32 processes sensor inputs and controls robot operations.
- GPS guides the robot to predefined campus locations.
- Ultrasonic sensors detect obstacles and help avoid collisions.

C. Software and Control Method

The robot was programmed using Arduino IDE with Embedded C.

Method followed:

- Initialize sensors and controller
- Read GPS coordinates for navigation
- Detect obstacles and perform avoidance

D. Testing and Performance Evaluation

The developed robot was tested under campus- like conditions for:

- Navigation accuracy
- Obstacle avoidance performance
- Package detection reliability

The system showed effective delivery operation, safe movement, and proper coordination among hardware and software modules.

III. RESULTS

Operation	Time(sec)
Average Obstacle Response Time	2-3 sec
Package Detection Time	1 sec
Navigation Setup Time	8 sec
Delivery Completion Time	20 sec
Object Recognition Accuracy Time	1.5 sec

Table I: Comparison Of Navigation Time Using Traditional Method And Operation

Average Time

- Traditional Time: 115 sec
- Proposed Delivery Time: 40 sec

The system reduced navigation time by approximately 65.2%.

IV. DISCUSSION

Obstacle detection tests showed reliable response within **2–3 seconds**, improving safety during robot movement. The IR sensor successfully confirmed package presence, increasing delivery reliability. The dual-mode operation (automatic and manual) improved flexibility and usability.

Compared with traditional methods, the proposed system offers:

1) Reduced delivery time
2) Lower human intervention
3) Improved delivery accuracy
4) Safe navigation through obstacles
5) Better user interaction through greeting and status display

V. CONCLUSION

The “Design and Development of a Delivery and Greeting Robot for College Campus” project successfully demonstrates the implementation of an intelligent and autonomous system for campus delivery applications. The robot effectively integrates GPS navigation, sensor-based obstacle avoidance, and dual-mode operation to perform delivery tasks with minimal human intervention. The use of the ESP32 microcontroller ensures efficient control and coordination of all system components, resulting in smooth and reliable performance.

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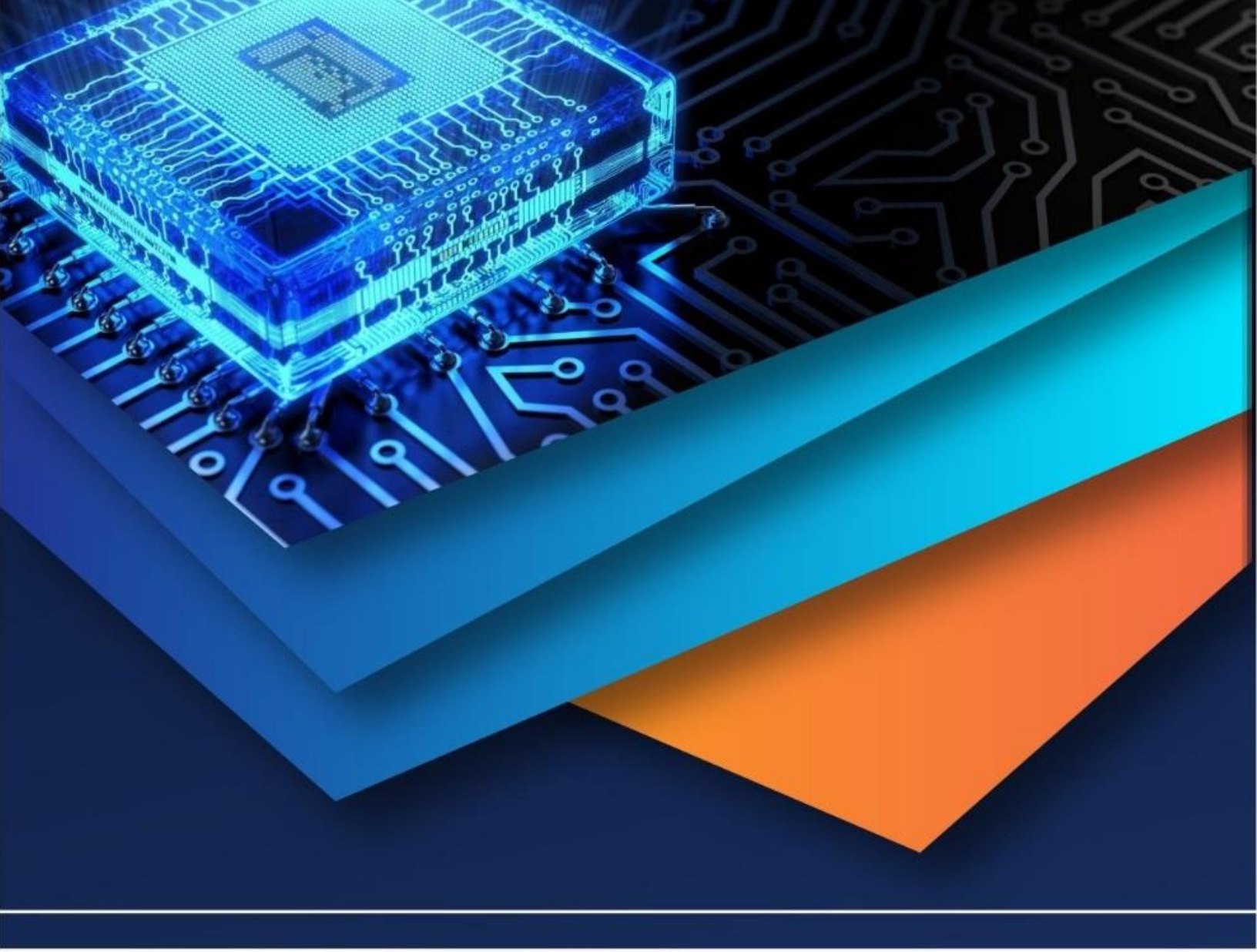

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