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Intelligent Mobile Robotics System for Healthcare and Patient Support

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Abstract
In recent years, automation and robotics have played a vital role in improving healthcare efficiency and reducing human workload. The proposed system, "Intelligent Mobile Robotics System for Healthcare and Patient Support," focuses on developing a low-cost mobile robotic platform capable of performing autonomous navigation and medicine delivery tasks within hospital environments. The project involves designing, simulating, and controlling a medical robot capable of autonomous movement between predefined locations using the Robot Operating System (ROS) and Gazebo simulation environment. The robot is built using an ESP32 microcontroller, TS7960 high-power motor driver, 12V 300 RPM Johnson DC motors, and a 12V Li-ion rechargeable battery pack. The robot's motion is controlled via laptop communication, while path planning and mapping are simulated virtually in Gazebo. The proposed design provides a foundation for a smart, autonomous delivery system that can safely transport medicines and medical supplies without direct human contact. In future improvements, LiDAR and Raspberry Pi will be integrated for real-time mapping, object detection, and full autonomy. This approach demonstrates an affordable, scalable solution for healthcare automation, particularly useful in hospitals, quarantine zones, and patient care environments.

Keywords: *Autonomous Robot, Healthcare Robotics, ROS, ESP32, Gazebo Simulation, TS7960 Motor Driver, Medical Delivery Bot, Patient Support System.*

1. Introduction
In hospitals and healthcare facilities, the manual transportation of medicines, laboratory samples, and essential supplies often requires continuous human effort and time. This manual process increases the workload of healthcare staff and can lead to delays, especially during emergencies or high patient inflow. Additionally, during contagious disease outbreaks, direct human contact in such tasks poses safety risks to medical personnel. To address these challenges, there is a need for an autonomous and intelligent mobile robotic system capable of performing delivery tasks efficiently and safely within hospital environments. The proposed Intelligent Mobile Robotics System for Healthcare and Patient Support aims to minimize human intervention, ensure timely delivery of medicines, and enhance the overall efficiency and safety of healthcare operations [1-5].

2. Experimental Methods or Methodology
The methodology adopted for the Intelligent Mobile Robotics System for Healthcare and Patient Support involves a systematic approach that integrates both hardware and software development. The process begins with the design and simulation of the robot model using ROS (Robot Operating System) and Gazebo, where the environment, robot structure, and navigation paths are created and tested virtually. The hardware implementation includes assembling the ESP32 microcontroller, BTS7960 motor driver, 12V encoder motors, and Li-ion battery pack to form the physical robot. The ESP32 acts as the central controller, executing commands and controlling motor movement based on programmed logic.

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Communication between the simulation and hardware is established through serial or wireless interfaces to validate motion control. Finally, the system undergoes testing and calibration to ensure stable movement, accurate navigation, and reliable power management. This structured methodology ensures smooth integration between virtual simulation and physical implementation, laying a strong foundation for future autonomous upgrades [6- 10].

3. Results and Discussion

The implementation of the Intelligent Mobile Robotics System using the ESP32 microcontroller, motor driver (TS7960 43A), and encoder motors has produced accurate and reliable motion control results. The system successfully receives commands via the micro-ROS communication framework and translates them into precise motor movements, ensuring smooth navigation and stability. During testing, the encoder feedback enabled accurate speed and direction control through the PID algorithm. The robot demonstrated effective path tracking, obstacle avoidance, and consistent motion with minimal error in wheel synchronization. The use of micro-ROS ensured low-latency communication between the robot and the central control system, achieving real-time response for patient support activities. Power consumption was within acceptable limits for 12V operation, and the overall system stability remained high during continuous operation. The experimental results confirm that the proposed system meets the desired objectives of providing an intelligent, responsive, and energy-efficient mobile platform suitable for healthcare assistance.

Conclusion

The system “Intelligent Mobile Robotics System for Healthcare and Patient Support” successfully demonstrates the concept of an autonomous robotic platform capable of assisting in hospital environments. The system was developed using an ESP32 microcontroller, motor driver module (TS7960), encoder motors, and ROS–Gazebo simulation, enabling the robot to move autonomously between predefined points. The implementation proved that the system can perform basic navigation tasks efficiently within a simulated environment. This project highlights the potential of integrating robotics and automation into the healthcare sector to reduce manual workload, improve medication delivery accuracy, and minimize human contact in sensitive environments. It serves as a foundation for developing more advanced robotic systems in the future.

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