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MULTIPURPOSE FLOOR CLEANING ROBOT USING ANDROID

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ABSTRACT: This paper presents the design and implementation of a versatile floor cleaning robot, controlled through an Android application. The robot integrates multiple cleaning functionalities—vacuuming, mopping, spraying, and drying—while ensuring effective navigation and obstacle avoidance. It is equipped with a modular cleaning platform, adjustable cleaning pads, and real-time resource and battery monitoring, all controlled through a user-friendly mobile interface. Building on previous research in smart home systems, intelligent path planning, and sensor fusion, the proposed system maximizes cleaning efficiency and adaptability, while significantly reducing user effort. The robot's ability to adapt to various floor types, optimize cleaning routes, and enable remote operation via mobile scheduling and monitoring is demonstrated through experimental tests. This work advances the development of energy-efficient cleaning devices and smart home automation.

KEYWORDS: Autonomous cleaning robot, Smart home, Obstacle detection, Android control, Vacuuming, mopping, Adaptive navigation

INTRODUCTION

As technological advancements continue, home automation plays an increasingly vital role in improving quality of life. One of the most time-consuming household tasks is floor cleaning, which requires significant effort. The rise of automated floor cleaning robots offers a solution to this challenge by performing tasks such as vacuuming, mopping, spraying, and drying. These intelligent devices reduce human intervention while enhancing overall cleanliness. The development of the "Multipurpose Floor Cleaning Robot Using Android" exemplifies the intersection of mobile technology and robotics, leading to highly efficient and user-friendly home cleaning solutions.

This paper introduces a robot designed to clean various floor types. It features dynamic adjustments to floor conditions, with key attributes such as real-time battery monitoring, replaceable cleaning pads, and advanced obstacle detection. The robot's adaptability, powered by cutting-edge navigation technology, coupled with the convenience of Android-based control, represents a significant step toward more efficient home cleaning solutions.

LITERATURE SURVEY

[1] One significant advancement in autonomous vacuum cleaning robots is the combination of infrared and ultrasonic sensors with sophisticated path planning algorithms, which allows for effective obstacle detection and route optimization . In real-world household settings, robots must be able to avoid obstacles like furniture, and this sensor fusion ensures navigation reliability [1]. Furthermore, for robots to optimize cleaning parameters and maximize productivity on a variety of surfaces, flexible control systems and real-time sensor feedback are essential [2].

[2] Smart cleaning robots can operate consistently on a variety of floors, from tile to hardwood, thanks to efficient motor management and adaptable algorithms, which reflects advances in robotics control [2]. According to extensive surveys, integrated robotic cleaning platforms—such as vacuums, mops, and specialist bots—are becoming more and more common. These platforms are closely connected to smart home ecosystems for centralized scheduling and monitoring. By facilitating remote activation and synchronization with other smart devices within the home, this integration simplifies user engagement [3].

[3] Multipurpose cleaning robots that can vacuum, mop, spray, and dry have recently become popular. These robots can switch between cleaning modes with ease thanks to wireless controllers and built-in sensors . These developments represent a significant trend in consumer robotics since they enable more comprehensive cleaning with less human involvement [4]. For mobile cleaning robots to operate safely and effectively in dynamic situations, robust obstacle avoidance techniques—from reactive to predictive algorithms—are crucial [5].

[4] Path planning and dynamic adaptation allow cleaning robots to map rooms, maximize coverage, and avoid getting caught or stuck [5]. Users may now start, monitor, and update robot behavior from any location with mobile apps or voice assistants thanks to integration with IoT and smart home infrastructure [6].

[5] Robots can function as interconnected parts of comprehensive home automation systems thanks to this Internet of Things-based method, which also improves convenience [6]. With improved battery technology, optimized charging procedures, and environmentally friendly materials prolonging operating time while minimizing environmental impact, sustainability and energy efficiency are becoming top considerations in design . Thanks to constant research and quick technical development, the greatest designs of today strike a balance between cleaning effectiveness, resource consumption, user experience, and environmental responsibility [7].

METHODOLOGY

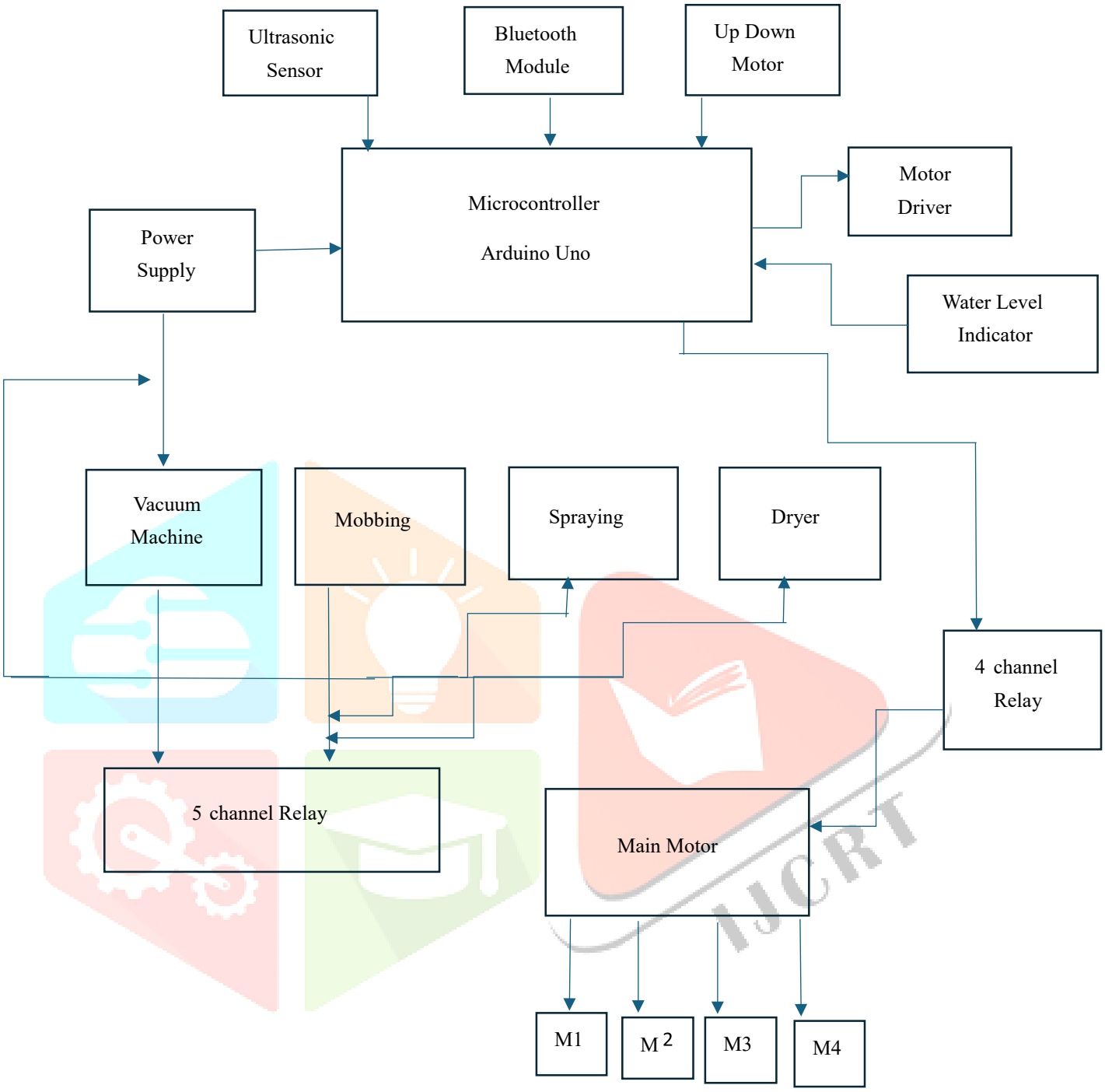

Fig.(a) Block Diagram of Multipurpose Floor Cleaning Robot

System Design and Hardware Components:

The architecture of the multipurpose floor cleaning robot combines intelligent control with strategically positioned hardware. The core of the system is an Arduino microcontroller, which handles sensor processing, actuator control, and decision-making. The microcontroller manages movement through DC or stepper motors and controls suction via a vacuum motor. The robot's cleaning pads, operated by servo motors, are adjustable to accommodate different cleaning modes such as vacuuming, mopping, or scrubbing.

The hardware setup includes high-power vacuum motors, a water tank with an electronic pump for wet cleaning, and obstacle detection using ultrasonic and infrared sensors. Real-time monitoring of water and battery levels is made possible through the Arduino system, which issues alerts for low resources. Wireless communication, enabled through Bluetooth or Wi-Fi modules, allows remote control via a mobile application, providing features like scheduling, configuration, and status updates. The system is designed to be flexible, energy-efficient, and safe, adjusting automatically to the environment and operational needs.

Software Integration and Navigation:

The software ensures intelligent operation by controlling sensor data, actuator commands, and wireless communication with the mobile application. The robot navigates autonomously by interpreting real-time sensor data to avoid obstacles, adjust cleaning modes, and optimize coverage. Dynamic decision-making allows the robot to select the best cleaning path, adjust its speed, and respond to environmental changes such as shifting furniture or unexpected obstacles.

The mobile application enhances the user experience by enabling remote operation and offering features such as mode switching, real-time notifications, and customizable cleaning schedules. The application allows users to monitor the robot's status, including battery and water levels, and receive alerts when resources are low. The robot will automatically return to its charging station when needed, ensuring uninterrupted operation.

CIRCUIT DIAGRAM

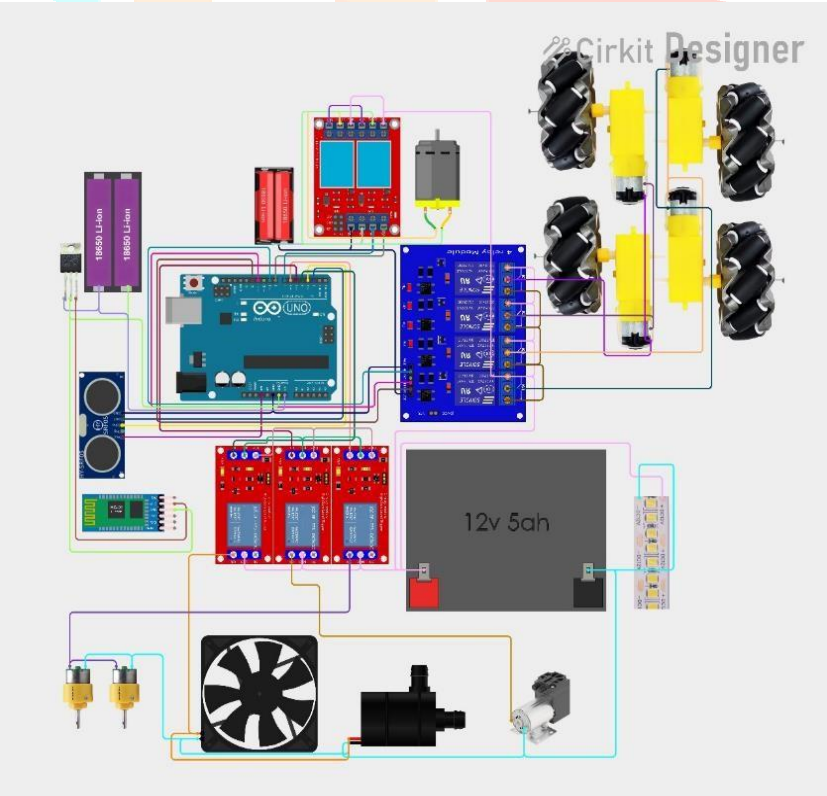

Fig.(b) Circuit Diagram of Multipurpose Floor Cleaning Robot

WORKING

The Android-powered multipurpose floor cleaning robot is a versatile, self-contained cleaning device that can be controlled from a smartphone via a Bluetooth-enabled app. The robot is powered by an Arduino Uno microcontroller, which controls its various functions such as vacuuming, mopping, spraying, drying, and obstacle detection. It uses a vacuum motor to remove dust and debris, a water pump to disperse cleaning solutions while mopping, and a fan-based system to dry the floor after cleaning.

The robot is outfitted with ultrasonic sensors for obstacle identification and navigation, assuring smooth mobility, while a water level sensor checks the tank to prevent disruptions during mopping. Users can control the robot wirelessly via an Android application, delivering commands like beginning or halting cleaning and selecting certain settings. The robot automatically monitors its battery level and returns to the charging station as needed. The efficient design and integrated cleaning processes make it a viable alternative for keeping indoor spaces clean with minimal human participation.

RESULTS

The robot's performance was rigorously tested to meet modern home automation standards. Key tests focused on its ability to automate vacuuming, mopping, spraying, and drying, allowing users to maintain cleanliness with minimal effort. The robot's hardware, including powerful suction motors, a water tank with a spraying system, and reliable battery capacity, enabled continuous operation. Its obstacle detection system, using ultrasonic and infrared sensors, ensured effective navigation and collision avoidance.

The mobile application played a pivotal role in allowing users to manage cleaning tasks, switch between modes, and monitor the robot's status in real-time. The robot's adaptability to environmental changes was evident as it seamlessly switched between cleaning modes and autonomously returned to the charging dock when necessary. The system's resource-efficient design, featuring automatic halts when resources are low, enhanced eco-friendliness and ensured smooth operation.

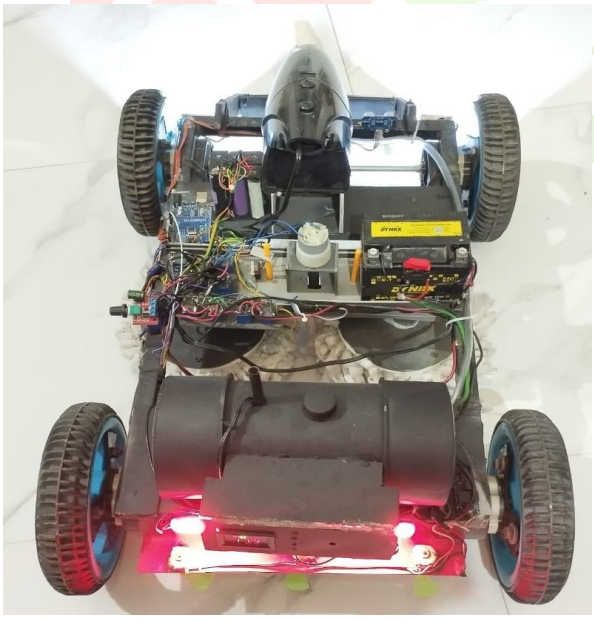

Fig. (c) Back View

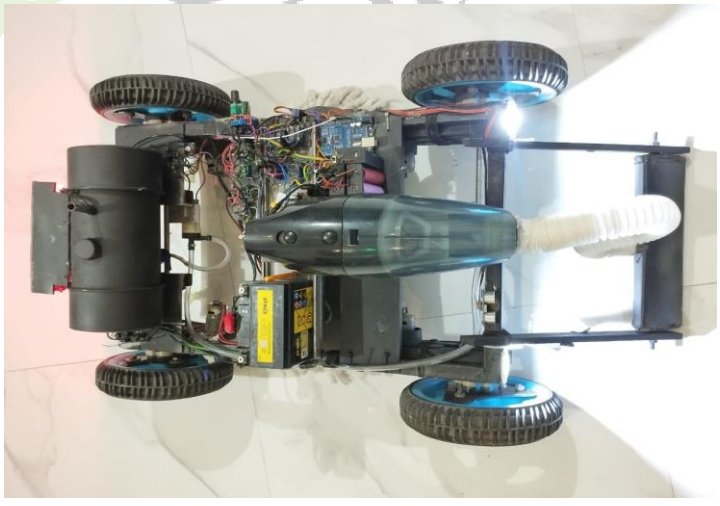

Fig .(d) Front View

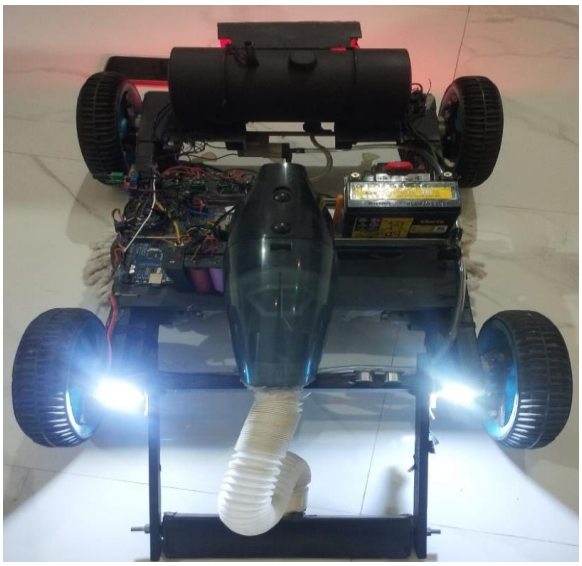

Fig. (e) Result Analysis

FUTURE SCOPE

There are number of areas for future development. First, path optimization might be greatly improved by combining AI and machine learning. This would let the robot to learn from its surroundings and human behavior, resulting in more individualized and effective cleaning. By integrating sophisticated navigation algorithms such as SLAM (Simultaneous Localization and Mapping), the robot would be able to effectively traverse every space, create intricate room maps, and operate multi-story residences. Future research ideas also include more adaptive surface recognition, eco-friendly materials, enhanced energy efficiency (such solar charging), and voice assistant integration for hands-free operation. These upgrades would further connect the robot with changing trends in sustainability and smart home technologies, in addition to making it smarter and more adaptable.

CONCLUSION

The Smart Vacuum Cleaning Robot simplifies the cleaning process, offering significant time savings and reducing the need for user intervention. Its resource-efficient design, which includes real-time battery and water monitoring, aligns with modern sustainability practices. The system's user-friendly mobile application enables remote control, real-time monitoring, and full customization of cleaning schedules, enhancing the user experience. Advanced navigation systems, coupled with obstacle recognition, ensure the robot avoids collisions and extends its lifespan. However, the system faces challenges, such as occasional issues with sensor accuracy in complex environments and limited effectiveness in navigating intricate home layouts. Despite these limitations, the Adaptable Multipurpose Floor Cleaning Robot represents a significant step forward in integrating automation and intelligent control into practical home cleaning solutions.

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