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Design and Development of Multifunction Floor Cleaning Robot

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***Abstract*— In response to the pressing challenges posed by the high cost of labour, time, and effort in developing countries, there has been a longstanding reliance on Multifunction Floor Cleaning Robot. Recognizing the need for more affordable and sustainable solutions, our innovative project focuses on the design, development, and manufacturing of a multifunction floor cleaning robot. This robot operates efficiently on battery, or electricity, providing flexibility and accessibility in diverse environments. The key objectives of this paper revolve around minimizing energy consumption, reducing both robot and operational costs, alleviating human effort, promoting environmental sustainability, and ensuring ease of handling. This not only contributes to an eco-friendlier approach but also facilitates the feasibility of constructing the robot on a commercial scale in the future.**

Keywords— regenerative braking, BLDC motor, inverter, battery.

I. INTRODUCTION

Cleaning has become an essential aspect of our lives, both inside our homes and in public spaces like hospitals, auditoriums, shops, and bus stands. To meet this growing demand for cleanliness, various floor cleaning machines/robots are available in the market.

However, our developed Multifunction Floor Cleaning Robot stands out for its simplicity, efficiency, and widespread usability.

In today's modern era, the need for both interior and exterior cleaning has become increasingly crucial. Cleanliness is not just a preference but a necessity for our overall wellbeing. A key aspect of this is cleanliness management, which significantly impacts our health and reduces the reliance on manual labour.

While there are many floors cleaning robot in the market, our innovation is distinguished by its straightforward design and easy operability. The robot has been engineered to be user-friendly, ensuring that anyone, regardless of their expertise, can operate it with ease. This characteristic is particularly advantageous in environments like hospitals and large public spaces, where a diverse range of individuals may need to handle cleaning duties.

Furthermore, our Multifunction Floor Cleaning Robot aligns with the evolving needs of society, where environmental consciousness and resource efficiency are gaining prominence. By reducing the manpower requirement and ensuring low maintenance costs, our robot is designed to not only meet current cleaning needs but also to contribute to a sustainable and cost-effective approach to maintaining hygiene.

II. PROBLEM IDENTIFICATION

The development of a multifunction floor cleaning robot, combining mopping, water dispensing, and drying functionalities, is driven by the pressing need for advanced and efficient solutions in the domain of automated household cleaning. The existing challenges in traditional floor cleaning methods, including time consumption, manual effort, and limitations in achieving thorough cleanliness, underscore the importance of developing an innovative robotic solution.

Firstly, the conventional mop-and-bucket approach is time-consuming and labour-intensive. Individuals often find it challenging to allocate time for comprehensive floor cleaning amid busy schedules. The multifunction robot aims to alleviate this challenge by automating the cleaning process, enabling users to initiate mopping, water dispensing, and drying with a single device and minimal effort.

Secondly, the incorporation of water dispensing addresses the limitations of dry mopping alone, especially when dealing with stubborn stains or spills. The robot's ability to dispense water in a controlled manner enhances its cleaning efficacy, ensuring a more thorough and efficient removal of dirt and grime.

Additionally, the drying functionality is crucial in overcoming the issue of wet floors post-cleaning. Traditional mopping methods often leave floors damp, requiring additional time for drying. The multifunction robot addresses this concern by incorporating a drying feature, promoting quick and effective drying of the cleaned surfaces, making them ready for use promptly.

III. PROPOSED SYSTEM

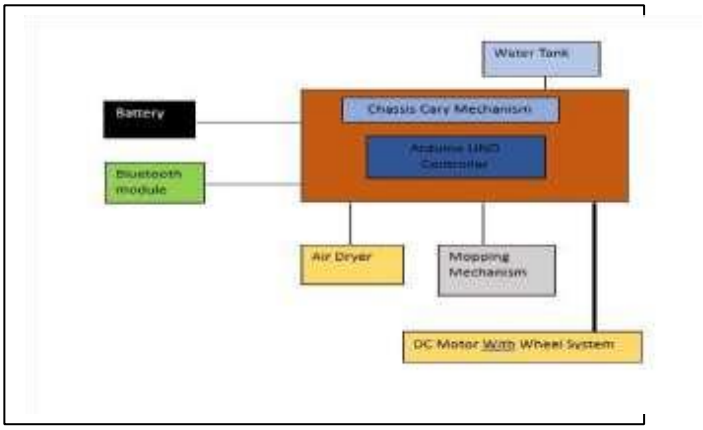

Fig. 1. Block Diagram of system

IV. WORKING:

When a 12V adapter is applied, electric energy is stored in the battery. The 12V DC battery supply is directed to the electrical switchboard of the machine. The primary supply from the electrical board is then distributed to the mopping, with DC being supplied to both the moping and the solar panel, battery, and adapter during operation.

The vacuum cleaner plays a crucial role in the cleaning operation by removing dust. Two DC motors are employed, one to rotate the mop for cleaning the central surface covered by the chassis.

The DC motor responsible for rotating the mop operates at a higher torque than the motor used for driving the machine. Two additional DC motors, with high RPM, facilitate the movement of the robot in the forward direction. Simultaneously, an air dryer is utilized to quickly dry the floor.

During the summer season, the front cleaner machine removes uneven particles collected on the floor's surface, while the mopping action cleans the floor through the middle slots. In dry cleaning mode, the water supply is disconnected.

All operations are controlled through a wired remote. The system components include a remote control, motor driver, DC motor, DC pump, air dryer, etc.

V. COMPONENTS USED :

- Adapter
- Battery
- Power supply unit
- Bluetooth module
- Arduino controller
- LCD Display
- Motor Driver
- DC Motor
- Relay Board
- Dc water pump
- Wheels
- Frame
- Mop
- Air Dryer • Others

VI. COMPONENTS SPECIFICATION:

- ***Arduino Uno* (12V)**

The Arduino Uno is a user-friendly microcontroller board widely used for beginners and hobbyists in electronics projects. It features easy-to-use inputs and outputs, making it ideal for programming and controlling various devices..

- ***LCD Display (5V)***

An LCD is a thin, flat screen that shows things like words, pictures, and videos using special liquid crystals. It's like a modern display that's taking the place of old-style LED displays in many devices.

- ***Relay Board (12V)***

A relay is like a remote control switch that turns on or off when it gets a signal from electricity. It's used a lot because it's simple, lasts a long time, and is very reliable in different jobs.

- ***DC Water Pump***

It runs on a 12V power source and uses clever technology to keep the voltage and water flow steady, making it perfect for folks who want a consistent water flow, even when dealing with changes in voltage or load..

- ***12V Battery***

A strong 12-Volt, 2-Amp battery can handle all tasks well. Its main job is to grab power from the solar panel and share it with different parts to make sure everything works smoothly for specific tasks..

- ***Bluetooth module (HC-05)***

The HC-05 is like a magic gadget for your projects that lets things talk wirelessly both ways. It helps your Arduino or other devices chat with each other, and can even connect with stuff like phones or laptops using Bluetooth.

- ***DC motor***

A DC motor is like an electric gadget that turns electricity into spinning power. It usually makes things go round, and it works best when you give it straight and steady electric power.

- ***Motor Driver IC (L293D)***

The L293D is like a traffic cop for motors in electronics. It helps small signals control big movements by boosting the power needed to drive motors in gadgets and robots. It's like having two mini power boosters inside to guide and power things smoothly..

VII. Circuit Diagram :

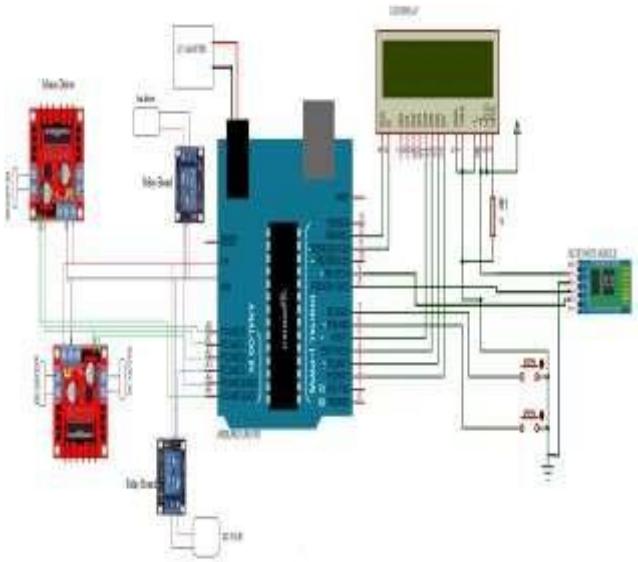

Fig. 2. Circuit Diagram

VIII. Advantages

- The floor cleaning machine incorporates an electric work system, reducing the need for manual effort in surface cleaning.
- Utilizing motorized brushes and a mop, the machine decreases operating time, enabling faster and more efficient cleaning.
- Simultaneous cleaning and polishing are achieved by incorporating a mop, allowing for both dirt removal and floor polishing.
- With the use of a low-voltage electric DC motor, the machine ensures reduced power consumption.
- The maintenance cost for this machine is low.
- Easy control of the cleaning solution supply is achieved through a controlled valve in the machine.
- The versatility of this machine extends beyond rough surfaces, making it suitable for various places.
- Further modifications can be implemented to enable automatic drive or movement for enhanced functionality.

IX. Applications

1. Hospitals: Both dry and wet cleaning is done in hospitals using floor cleaning devices. to achieve a sanitary surface.
2. Computer centres: To keep the surface polish of cleaning at the intended level.
3. Colleges: Its primary use is to remove accumulated dust from surfaces.
4. Train station: You may use the platform at the train station in any season. 5. Malls & Auditoriums
6. Theatres.

X. CONCLUSION

In our project, we have introduced a floor cleaning robot designed for mopping tasks, aiming to address cleanliness concerns in society. The project encompasses various applications, including cleaning pipes, mopping surfaces for thorough floor cleaning, dust and dirt removal from roads, and implementing a pick-and-place mechanism to eliminate obstacles. This project holds significant importance for society and contributes significantly to the overall cleanliness of the country. However, there are a few areas of improvement, such as the non-detachable motor and the vibration caused by the high RPM, which can be addressed through modifications for enhanced performance. Despite these considerations, the automated floor cleaning system proves to be a successful product suitable for Indian households. The design of this automated system is versatile, allowing it to clean various remote locations effectively. Additionally, the selected motors consume minimal power, contributing to both power and cost savings.

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