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FULLY AUTOMATED MULTI TASKING FLOOR CLEANING AND MOPING ROBOT

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Abstract The increasing demand for automated cleaning solutions in various sectors such as commercial, industrial, and domestic has led to the development of advanced robotic systems. This paper presents the design and development of a fully automated multi-tasking floor cleaning and mopping robot that aims to provide efficient and effective cleaning and maintenance.

Index Terms – Realtime navigation, Arduino nano, Automatic moping and vacuuming, C program

I.INTRODUCTION

Cleanliness has always been a vital part of human society, representing not only hygiene and health but also order, discipline, and a sense of well-being. In its most basic form, cleanliness means the absence of dirt, dust, stains, and unpleasant odors. But its implications go far beyond aesthetics. Clean environments play an important role in promoting health, preventing diseases, and ensuring spaces are both functional and welcoming. In this fast world, with standards of hygiene more important than ever, the need to keep places clean, public, private, and industrial is highly regarded. With a focus on cleanliness, technological advancements have become more widely used to address these needs. The rise of automated cleaning systems, such as floor cleaning robots, marks a significant shift towards efficiency and reliability in the maintenance of hygienic spaces. These robots offer various benefits, including a lesser dependence on human labor, higher cleanliness standards, and consistent performance highly suitable for environments that require frequent cleaning, such as hospitals, shopping malls, airports, and homes, where manual cleaning is labor- intensive and time-consuming. Despite these advances, current automated floor cleaning robots still face significant limitations. Most of the models currently existing are designed to perform a single task, like vacuuming, mopping, or rudimentary mopping. Lack of multitasking capabilities severely hampers efficiency, especially in complex and dynamic environments where cleaning needs and obstacles are constantly changing. Moreover, most the robots use elementary navigation mechanisms, which make them mostly inefficient in covering the given area, with some parts going uncleaned and decreasing the cleaning performance. That is why more advanced adaptive solution is urgently needed nowadays to overcome increasing complexity of current cleaning tasks. Dynamic environment conditions additionally worsen those drawbacks. For example, locations with high human activity, movable furniture, or a mix of floor types need cleaning robots that can respond and adapt to changing situations. Dynamic obstacles like humans or pets need to detect and avoid obstacles in real-time to ensure cleaning processes run without interruptions. Also, different types of floors such as wood, tiles, and carpets need to be handled using the right cleaning technique for thorough cleaning in varied environments. To overcome these limitations, this paper proposes the design and development of a fully automated, multitasking floor cleaning robot equipped with advanced mapping and navigation capabilities. Unlike the conventional cleaning robots, the proposed system combines multiple functionalities, enabling it to clean, map, and navigate at the same time. The state-of-the-art mapping algorithms are integrated to ensure efficient and accurate coverage of cleaning areas, while advanced navigation systems allow the robot to identify and avoid obstacles in real time. The most significant advantage of this robot is the adaptability to various kinds of floors and dynamic surroundings. It uses intelligent sensors, machine learning algorithms, to optimize its cleaning strategy and adjust it according to space requirements for effective and exhaustive cleaning. This makes it ideally suited for modern settings where cleaning requirements are diverse and ever-changing. The proposed solution is a tremendous breakthrough development of automatic in the cleaning technology. Through improvement over the current limitations in systems and the inclusion of current cutting-edge advancements, this robot has the capability to revolutionize the cleaning industry. It does not only provide a more efficient and self- sufficient cleaning solution but also ensures reduced operational costs and high user satisfaction.

II.LITERARURE SURVEY

[1] H. S. Srinivas, A. R. B. Sharma, and S. P. Gupta (2022): This paper focuses on the development of an autonomous floor cleaning robot enhanced with AI, specifically deep learning, to detect obstacles and optimize the cleaning process. The robot uses convolutional neural networks (CNNs) to identify obstacles and avoid collisions. The deep learning model allows the robot to adapt to complex environments and improve cleaning efficiency by analyzing the room layout and real-time feedback.

[2] J. G. Patel, K. P. Yadav, and A. R. R. Murthy (2021): The paper discusses the development of an autonomous robotic vacuum cleaner that can be controlled remotely through the Internet of Things (IoT). By integrating IoT, users can monitor and control the robot from a mobile app or web platform, enabling real- time status updates and scheduled cleaning. The system incorporates various sensors such as ultrasonic and infrared for object detection and mapping.

[3]T. M. Supriya, R. N. S. Kumar, and A. R. Patel (2021): This paper introduces a vision- based autonomous floor cleaning robot, which uses camera systems for navigation and obstacle detection. The system applies computer vision techniques to detect obstacles and create a map of the environment. The robot is capable of avoiding obstacles dynamically while performing its cleaning tasks.

[4]P. S. Yadav, S. N. R. Bhat, and M. K. Iyer (2021): This paper presents a model for an energy-efficient autonomous floor cleaning robot. The system incorporates a scheduling algorithm that optimizes energy consumption by planning the cleaning tasks based on the battery status. The robot adjusts its cleaning strategy based on battery levels, cleaning priorities, and the time available to perform tasks. the goal is to balance effective cleaning with minimal energy usage, prolonging battery life and enhancing efficiency.

[5]A. S. M. A. Kadir. M. S. Islam, and M. S. I. Faruk (2020): This paper presents a design methodology and implementation of an autonomous floor cleaning robot that incorporates sensors to navigate and perform cleaning tasks effectively. The robot uses a set of sensor, including ultrasonic and IR sensor, for distance measurement and obstacle detection. Experimental validation of the robot's performance is done in real- world environments.

[6]N. P. Patel, R. S. Verma, and P. M. Choudhury (2021): This research paper focuses on using fuzzy logic control for autonomous floor cleaning robots. Fuzzy logic allows the robot to make decisions in dynamic, unstructured environments by mimicking human-like reasoning. The paper provides a detailed algorithm for controlling the robot's actions, such as when to stop, turn, or change direction based on sensory inputs.

[7]M. S. S. Ali, R. K. Kumar, and S. M. Jain (2020): This paper describes an AI-powered autonomous floor cleaning robot that utilizes reinforcement learning (RL) to optimize cleaning paths. The robot's AI system learns from its environment and adjusts its cleaning patterns based on obstacles, room layout, and

battery status. By continuously improving its cleaning strategy, the robot becomes more efficient over time.

[8]X. Q. Li, Y. P. Wang, and L. W. Zhang (2020): This paper addresses real time obstacle avoidance for autonomous floor cleaning robots using LIDAR (Light Detection and Ranging) sensors. LIDAR allows the robot to create a 2D map of its surroundings and identify obstacles in real- time. The paper discusses how LIDAR- based data is integrated with algorithms for path planning, enabling the robot to navigate complex environments efficiently.

[9]A. N. Meena, G. D. K. Srikanth, and V. R. P. Karthik (2021): This research presents a smart autonomous cleaning robot equipped with advanced sensors, real-time communication features, and autonomous charging capabilities. The robot is designed to perform in various indoor environments like homes and offices. The paper also discusses the integration of a wireless charging system that allows the robot to recharge itself autonomously when needed.

III.METHODOLOGY

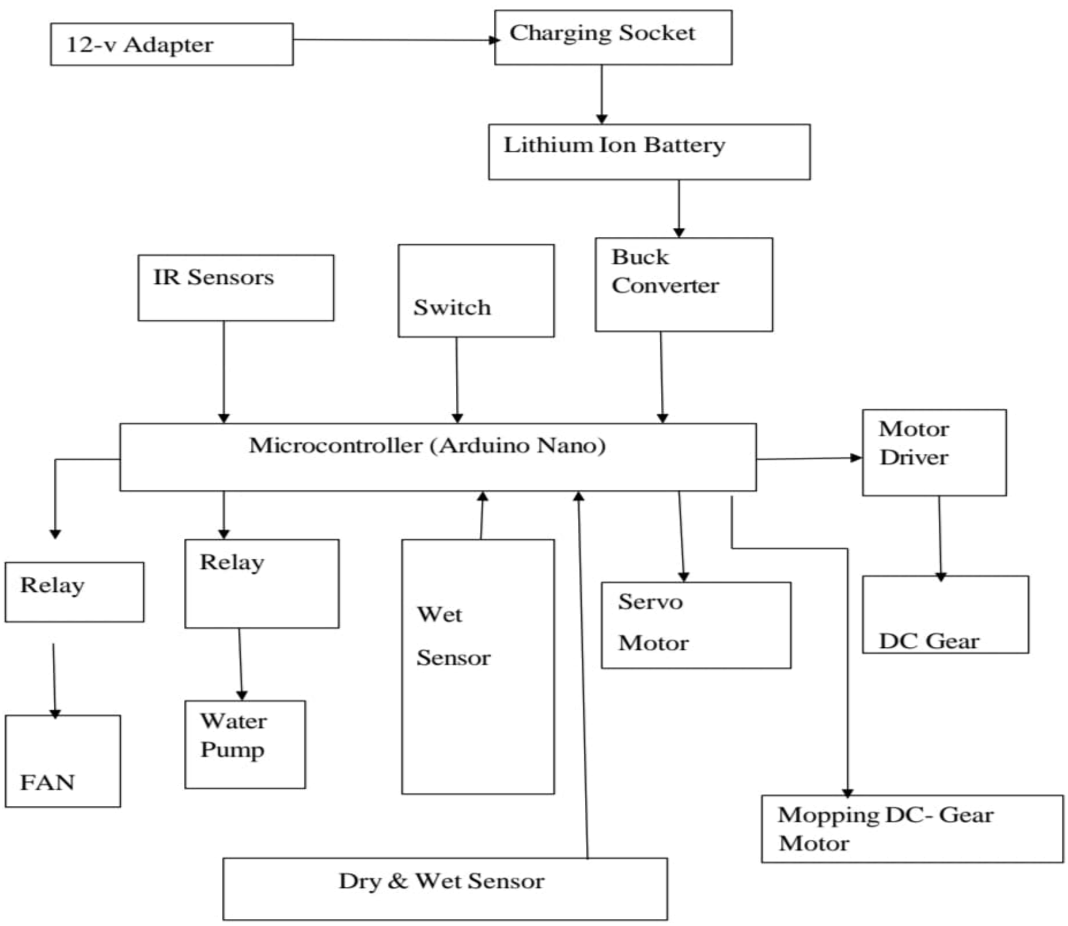

Figure: 3.1 Block diagram of fully automated multitasking floor cleaning and moping robot

- The diagram shows the working of fully automated multitasking floor cleaning and mapping robot that can also perform waste segregation. The Arduino Nano microcontroller acts as the brain of the system, controlling the robot's actions.
- The robot is powered by a rechargeable battery, providing the necessary energy for its motors, sensors, and systems to function smoothly during cleaning tasks.
- The operating switch allows the user to select between mopping and vacuuming mode or automatic mode.
- The Arduino Nano Microcontroller initializes and reads the input from sensors and switches.
- The robot sprays water onto the floor using a controlled water pump.
- A motorized mop pad rotates or moves linearly to clean the floor.
- The vacuum motor creates suction to collect dirt and debris.
- Collected waste is stored in onboard dustbin, which can be emptied manually.
- The robot features an automatic switching system that activates the mopping mode when it senses water on the floor. Using water detection sensors, the robot identifies wet areas and sends a signal to its controller. The mopping mechanism, including a mop motor, turns on and operates for 12 seconds. After this duration, the system automatically deactivates mopping to conserve power and water.
- Moisture sensors detect whether the waste is wet or dry. Based on this data, the Arduino Nano controls a DC motor through the L298 motor driver. The motor operates a flap mechanism, directing the waste into the correct bin—wet or dry— for proper segregation and disposal.
- The IR sensor helps the robot avoid obstacles by detecting objects in its path. When an obstacle is identified, the sensor sends a signal to the controller, which instructs the robot to adjust its direction.
- The robot runs on a rechargeable battery or an external power source, providing the energy needed for its operations. This power supply ensures the smooth functioning of the motors, sensors, and the Arduino Nano controller, enabling the robot to perform its tasks efficiently without interruptions.
- After the robot completes its tasks, some maintenance is required to keep it running efficiently. For mopping, the mop pad might need to be cleaned or replaced, especially if it has picked up a lot of dirt. In the vacuuming mode, the dustbin should be emptied regularly to ensure proper suction and storage for collected debris. In the waste segregation unit, the separate bins for wet and dry waste need to be emptied when they are full. Performing these simple tasks ensures the robot remains effective and ready for the next cleaning session without any disruptions.

IV.CIRCUIT DAIGRAM

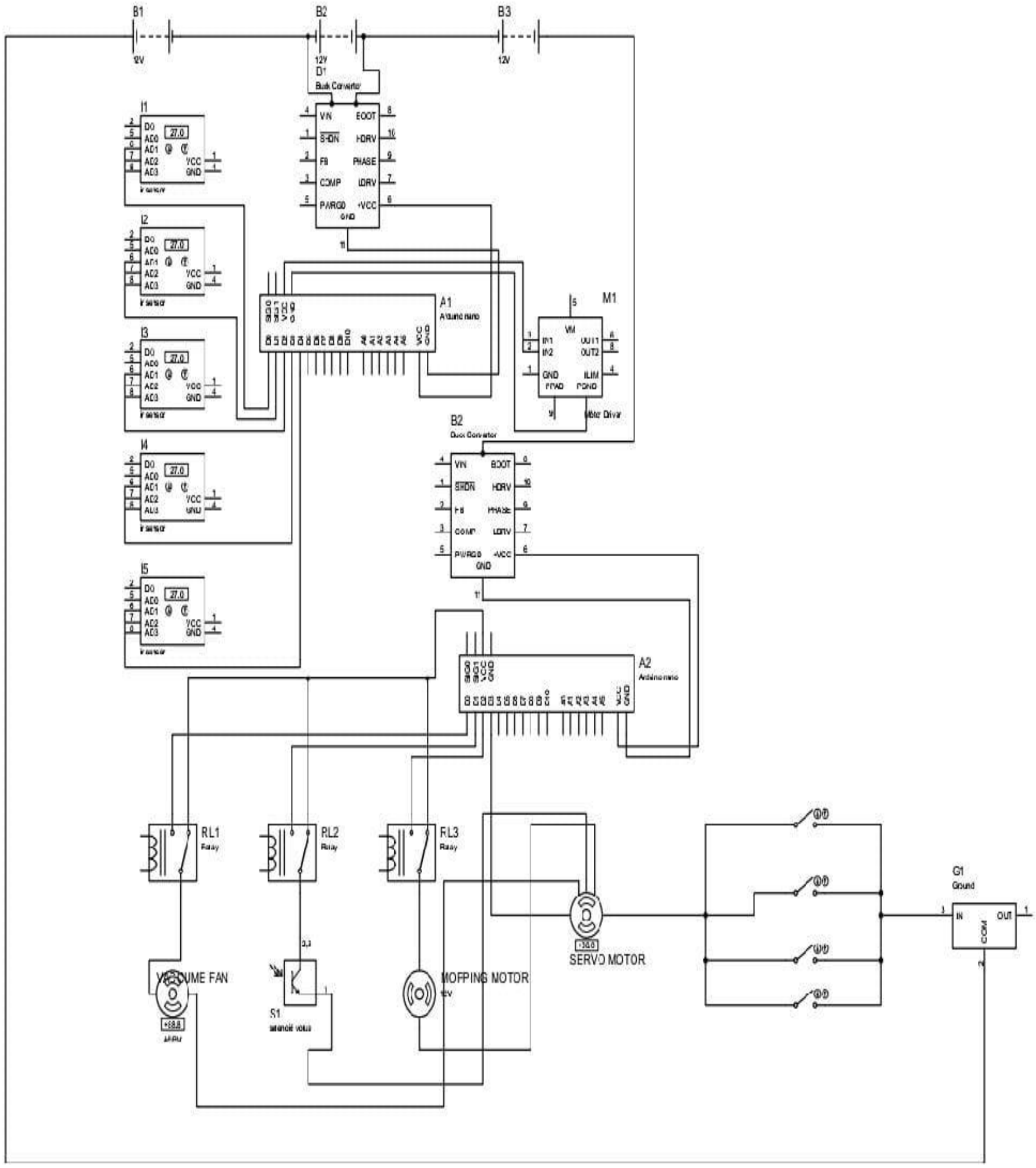

Figure: 4.1 Circuit diagram of fully automated floor cleaning and moping robot.

The mopping robot is an autonomous cleaning system that integrates several electronic components, including sensors, motors, and actuators controlled by an Arduino Nano. The Arduino Nano is the heart of the system, responsible for control and coordination, decision-making, and PWM signal generation to control motor speed. IR sensors, comprising light-dependent resistors, aid in obstacle detection and navigation by measuring changes in light intensity. The robot uses DC motors connected to motor drivers for movement, with differential steering enabled by controlling the speed of the left and right motors. A buck converter regulates power supplied to the robot's components, efficiently converting higher battery voltages to lower voltages required by the Arduino, motors, and sensors. The mopping mechanism includes a water tank and pump system to distribute water evenly onto the mop as it moves across the floor. The Arduino controls the pump to release water based on movement speed and area coverage, preventing excessive water usage. The vacuum system, comprising a small vacuum motor and dustbin, collects dust, dirt, and debris as the robot moves. The robot's power management system relies on a rechargeable battery, with a buck converter ensuring efficient voltage regulation to extend battery life. The robot's components are selected to minimize energy consumption, allowing for long cleaning sessions of 1-2 hours. When the battery runs low, the robot can be recharged via a charging dock or port. The robot's navigation and obstacle avoidance capabilities are enabled by multiple IR sensors providing spatial feedback, allowing the robot to make decisions about turning or adjusting speed when detecting obstacles. The Arduino's control algorithm determines the robot's movement based on sensor data, ensuring efficient cleaning and navigation. Overall, the mopping robot is a versatile cleaning solution that combines mopping and vacuuming capabilities with autonomous navigation and obstacle avoidance. The robot's components work in tandem to provide a comprehensive cleaning solution. With its advanced sensors and efficient power management, the mopping robot can navigate complex spaces and adapt to different cleaning tasks. Whether it's mopping, vacuuming, or both, the robot's capabilities make it an ideal solution for maintaining cleanliness in various environments. By leveraging the Arduino Nano's processing power and the precision of its sensors and motors, the robot delivers reliable performance and convenience.

V.RESULT

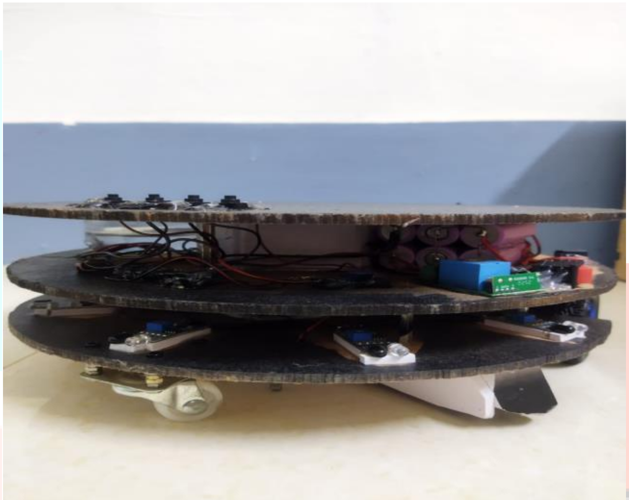

Figure 5.1: Base Mechanism

IR sensors are vital for automated floor cleaning robots, enabling them to "see" their surroundings. they allow the robot to avoid obstacles like furniture and walls, prevent falls from stairs by detecting drop offs, and potentially follow specific cleaning paths marked on the floor. This simple yet effective technology is crucial for safe and efficient

Figure 5.2: Vacuum fan &Moping Mechanism

We can observe a fan unit, likely the vacuum fan, positioned within the robot's body. This fan would generate suction, enabling the robot to pick up dust, debris, and small particles from the floor surface. Adjacent to or integrated with the vacuuming system is the mopping mechanism. While the exact details of the mopping component aren't entirely clear from this single view, we can infer the presence of a pad or cloth that would come into contact with the floor. This pad would likely be dampened with cleaning solution, allowing the robot to wipe and clean the floor after or in conjunction with the vacuuming process.

Fig.5.3: Final model

A fully automated floor cleaning and mopping robot delivers exceptional cleaning results with minimal effort, leaving floors spotless and sparkling clean. With its advanced vacuuming system and precision mopping capability, the robot effectively removes dirt, dust, debris, and stubborn stains, ensuring a thorough cleaning. Its automated system expertly maneuvers around furniture and obstacles, detecting dirt and stains to adjust its cleaning path accordingly. The result is a remarkably clean floor that requires minimal effort and time, making it an ideal solution for busy homes and offices seeking a convenient and efficient cleaning solution.

VI.CONCLUSION

This project presents a fully automated multi- tasking floor cleaning and mopping robot that integrates advanced navigation, mapping, and cleaning technologies to provide efficient and effective floor cleaning and mopping services. The robot's performance was evaluated in various scenarios, demonstrating its ability to efficiently clean and mop floors, navigate through complex environments, and adapt to changing cleaning tasks. With its advanced navigation and mapping capabilities, multi- tasking functionality, and efficient cleaning algorithms, this robot has the potential to revolutionize the cleaning industry by providing automated, efficient, and effective cleaning services.

VII.REFERENCE

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