International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Solar Powered Unmanned Cleaning Robot

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Abstract: ***Automated floor cleaning machines have been widely utilized in developed nations for many years due to the high cost of labor, time, and effort, as well as their affordability. However, this concept has not gained much popularity in developing or emerging economies, primarily due to the machine's cost and operational expenses, such as power tariffs. To address this issue, we have developed an innovative semi-automatic floor cleaning machine that can function on solar energy, battery, or electricity. This multifunctional machine can perform various cleaning tasks, including scrubbing, mopping, and wiping. It offers several benefits, including reduced energy consumption and operational costs, decreased human effort, environmental friendliness, and ease of handling. The project is based on the utilization of renewable energy, which is abundant in most countries, to have less environmental impact and enable future commercial scale construction.***

Keywords: Automation, SPUCR, Renewable, Cleaning Robot, Android Application

1. Introduction

Cleaning machines are highly beneficial in cleaning floors and outdoor areas in various settings, such as hospitals, houses, auditoriums, shops, bus stands, and public places. In modern times, interior and exterior cleaning play a vital role in our lives, as proper waste disposal is crucial for our health and reduces the need for manual labor. Although numerous floor cleaning machines are available, our machine's design is simple and user-friendly, making it suitable for anyone to operate. It is highly useful in hospitals and large areas, as it requires minimal time and cost for cleaning and maintenance.

Several types of machines are widely used for this purpose, but in our project, we have created a fully mechanical machine with a minimal number of electrical components. This floor cleaner's simple construction allows for easy operation without prior training, ensuring safety in any setting, including hospitals, hotels, and bus stands.

After analyzing various research papers on floor cleaning machines, we have identified certain limitations that need to be addressed. For instance, current cleaning machines can only clean dry surfaces, making them suitable for summer and winter but not during the rainy season when the surface contains moisture or a small amount of water. Hence, we are developing a machine that can work in both dry and wet conditions to overcome this issue.

2. Literature Review

MOHSEN AZADBAKHT ETAL [2014] "Design and fabrication of a tractor powered leaves collector machine equipped with suction-blower system"- "The authors explained about the fabrication of leaves collector machine by tractor powered blower. He has framed the machine by using chassis, pump, blower, gearbox, hydraulic jack. They concluded total power consumption of that machine is around 14634 W which can cover up to 20m range in distance".4

MANREET KAUR [2014] "Design and fabrication of floor cleaner robot (manual and automatic).the author designed a robot to clean floor in both automatic mode as well as manual mode. His robot was equipped with ir sensors for obstacle detection, four motors and water pump. He concluded with convenience of dual mode operation of easy floor cleaning."

M RANJIT KUMAR (2016) "The regular floor cleaning machines is most generally utilized as a part of airplane terminal stages, railroad stages, healing centers, transport stands, and shopping centers and in numerous other business places. These gadgets require an electrical vitality for its activity and not easy to use. In India, particularly in summer, there is control emergency and most of the floor cleaning machine isn't utilized successfully because of this issue, especially in transport stands. In this work, demonstrating and investigation of the floor cleaning machine was finished utilizing appropriate financially accessible programming. From the limited component investigation, we watch that the feeling of anxiety in the physically worked floor cleaning machine is inside as far as possible."

SANDEEP. J. MESHRAM ET AL [2016] "Design and Development of Tricycle Operated Street Cleaning Machine" – He has developed the street cleaning machine by tricycle operated. In this research article. He framed a model especially for rural area. He concluded that the cleaning is less effective in streets."

MANYAJAIN, PANKAJ SINGH RAWAT (2016) "This project is used for domestic and industrial purpose to clean the surface automatically. When it is turned on, it sucks in the dust by moving all around the surface (floor or any other area) as it passes over it. In the modern era, the automatic floor cleaner is required. Thus, the cleaner is designed in

such a way that it is capable of cleaning the area reducing the human effort just by starting the cleaning unit".

SAHIL BHARTI, S.R. SANDHAVE (2016) "To develop an automated cleaning assistance this helps in cleaning flat surface with the ease of remote control with greater efficiency at work. The surface cleaning machine that is proposed in this project is the device that helps in cleaning of surface. There are many functions that have to co-ordinate for the motion control."

AKASH NAGTODE (2017) "Solar operated floor cleaning machine. He had made a project on cleaning system based on solar power. For this he has used Pv panel which convert particle of energy (photons) into electricity. He uses this clean energy to power his cleaning machine."

Dr. J. HAMEED HUSSIAN (2017) "This module of automatic floor cleaning machine by micro controller is run to clean the floor and sweeps the dust away. In this the module a remote-controlled car has gear motor is attached at front axis in between the front wheels, this motor is attached with a cleaning brush at front, and the gear motor is connected to 12volts battery and the remote car is attached with 9volts battery. The remote car is controlled by the micro controller."

ABHISHEK PANDEY (2020) "This Paper reviewed the requirement of a residence Cleaning Automatic robot. For keeping time there is a requirement of programmed system that cleans alone without person interventions. Also, they considered how precisely to help those that have physical disabilities. Because that they had to induce this done, they needed a cleaning system that may add accordance from what we are saying, thus supporting a physically someone."

3. Problem Identification

Maintaining cleanliness in a household requires daily chores like dusting and sweeping, which can sometimes be harmful. To mitigate such problems, various machines are designed to simplify complex and tedious cleaning tasks. However, these cleaners are often bulky, heavy, and complex, making it difficult to move and clean. Moreover, they consume a considerable amount of electricity, leading to higher electricity bills and the risk of overheating and motor burnout.

Manual dusting and sweeping can also be hazardous to respiratory health as certain particles in the air can cause respiratory problems. Although several machines are available in the market that utilizes mechanical and electrical systems to ensure cleanliness, they make cleaning tasks more challenging as they require physical presence for mobility. To address these issues, our project aims to create a low-cost device that utilizes local resources and serves the purpose of sweeping and dusting from a specific location. The device's design will minimize physical efforts required for cleaning tasks, reducing the risk of health hazards and making cleaning more accessible to everyone.

4. Future Scope

If the high-wattage panel is used, the machine can be utilized for garden or room lighting during nighttime by storing more power. The excess power stored in the battery can be used for this purpose. Additionally, a valve can be added to the pipe to use the machine for gardening, such as watering plants. A box-type carrier can also be attached to the machine to transport files, books, or other items from one place to another in an office or any other location.

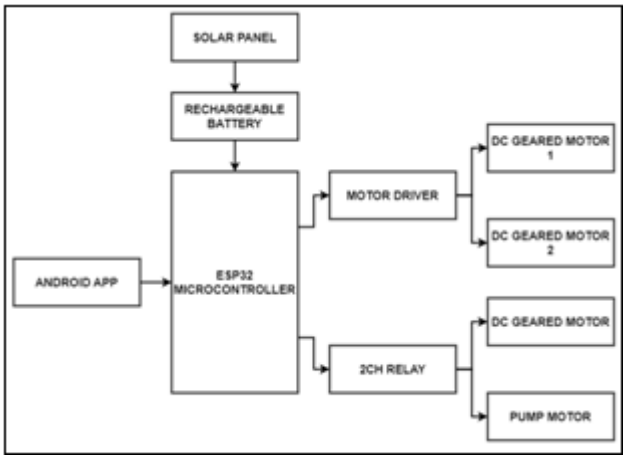
The goal of our project is to develop a machine that simplifies and expedites cleaning tasks while reducing human effort, time, and cost. Our machine aims to prevent injuries caused by slips and trips on level floors, which are a significant cause of accidental injury or death. Proper cleaning practices are crucial to avoiding such accidents. Our machine's purpose is also to remove grit and sand that may scratch or wear down the floor surface and to eliminate allergens, especially dust.

5. Proposed Methodology

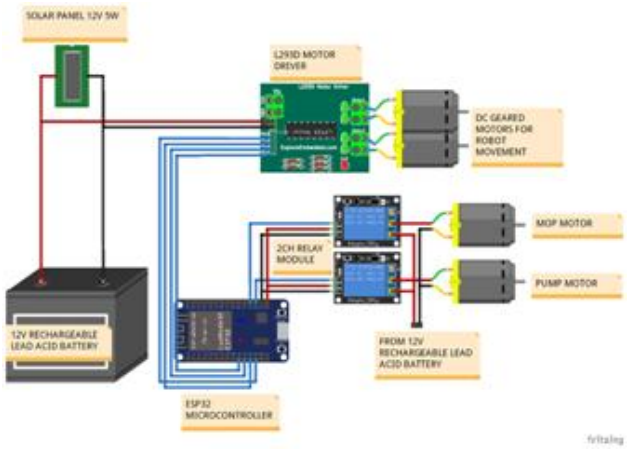
a) The proposed system will utilize the ESP32 microcontroller as its main control unit.
b) The robot's motors will be driven using an L293D motor driver, with only 2 of the 4 wheels being powered, while the other two will be dummy wheels.
c) The robot will be powered by rechargeable batteries.
d) Control of the robot will be facilitated through an Android app developed using MIT App Inventor 2.
e) A sprayer nozzle attached to a pump motor will be utilized to dispense liquid, with the help of a relay.
f) Mopping functionality will be achieved through the use of a DC geared motor.

6. Design

a) Block Diagram



b) Circuit Diagram



c) Components

1) ESP32 Microcontroller Board
ESP32 is a low-cost, low-power system on a chip (SoC) microcontroller that features Wi-Fi and Bluetooth connectivity. It is designed for use in Internet of Things (IoT) applications and can be programmed using the Arduino IDE or other programming environments such as Micro Python, JavaScript, or C++. One of the key features of the ESP32 is its low power consumption, which makes it suitable for use in battery-powered devices. It also supports multiple sleep modes, which can be used to further reduce power consumption when the device is not in use.

2) Single Channel Relay Module
A single channel relay module is an electronic device that allows you to control the switching of a single circuit or load using a low-voltage signal. It typically consists of a relay, a control circuit, and a set of terminals for connecting to the load and the control signal. Single channel relay modules are commonly used in home automation, industrial control systems, and robotics. They are particularly useful for controlling high-voltage or high-current devices, such as lights, motors, and heaters, from a low-voltage control signal.

3) Pump Motor
A pump motor is an electric motor that is designed to power a pump, which is a device that moves fluids, such as water, oil, or chemicals, from one place to another. Pump motors are commonly used in a wide range of applications, including in industrial processes, water treatment, irrigation, and HVAC systems.

4) L293D Motor Driver
The L293D motor driver is a popular integrated circuit (IC) that is commonly used to control the speed and direction of small DC motors. It is designed to provide bidirectional control of two DC motors or a single stepper motor, and can be used in a wide range of applications, including robotics, automation, and hobby projects. The L293D motor driver can operate on a wide range of voltages (from 4.5V to 36V) and can supply a maximum current of 600mA per channel, making it suitable for driving small motors.

5) 12V DC Geared Motor
A 12V DC geared motor is an electric motor that operates on a direct current (DC) power source and is equipped with a gearbox that reduces the motor speed while increasing the torque output. The motor is commonly used in a wide range of applications, including robotics, automation, and hobby projects. A 12V DC geared motor typically operates at a voltage range between 6V and 12V, and can deliver a wide range of output speeds and torque values depending on the gear ratio of the gearbox.

6) 12V Rechargeable Battery
A 12V rechargeable battery is a type of battery that is designed to provide a reliable and portable power source for a wide range of applications. The battery is typically made of one or more cells that are connected in series to provide a total voltage output of 12V. The 12V rechargeable battery can be recharged using a charger that is specifically designed for it. It can be used in a wide range of applications, including powering electronic devices, portable lighting, camping equipment, and small appliances. The capacity of a 12V rechargeable battery is typically measured in ampere-hours (Ah), which is the amount of current the battery can supply over a certain period of time. The capacity of the battery depends on the specific type and size of the battery, as well as the discharge rate and operating temperature.

7) Zero PCB
A zero PCB (Printed Circuit Board) is a type of circuit board that is designed to be as small as possible, with minimal components and no additional wiring. It is commonly used in applications where space is limited and a compact, low-profile design is required. A zero PCB typically consists of a small, single-sided board with surface-mount components that are soldered directly onto the board. The board is designed to minimize the amount of wiring needed, with most of the connections made using small traces and vias. The small size and minimal components of a zero PCB make it well-suited for applications such as wearable technology, IoT (Internet of Things) devices, and small electronic gadgets. They are also commonly used in mobile phones, cameras, and other portable electronics.

8) Connecting Wires
Connecting wires are insulated wires that are used to connect electronic components or circuits together. They come in a variety of lengths, gauges, and colors, and are typically made of copper or another conductive material. Connecting wires are used in a wide range of applications, including building electronic circuits, wiring components to a printed circuit board (PCB), and creating wiring harnesses for machines or vehicles.

9) Jumper Wires
Jumper wires are a type of connecting wire used in electronics to make temporary connections between components, modules, or devices. They are usually made of insulated wire with pins or connectors on either end, allowing them to be easily inserted and removed from breadboards, connectors, or other components.

10) Male Headers (Burg Strips)
Male headers, also known as burg strips, are a type of electrical connector used in electronics to connect circuit boards, modules, and other components together. They are

typically made of plastic with rows of pins or terminals on one side, which can be inserted into a female header or socket.

11) Female Headers (Burg Strips)
Female headers, also known as burg strips, are a type of electrical connector used in electronics to connect circuit boards, modules, and other components together. They are typically made of plastic with rows of sockets or terminals on one side, which can accept male headers or pins. Female headers are commonly used in PCBs to connect cables, displays, and other components. They are also used in prototyping and breadboarding to make temporary connections between components using jumper wires.

12) USB
USB (Universal Serial Bus) is a widely used interface standard for connecting devices to computers and other electronic devices. It was developed in the mid-1990s and has since become the standard for connecting peripherals such as keyboards, mice, printers, cameras, and storage devices to computers and other devices. USB allows for fast and reliable data transfer between devices and provides power to connected devices. USB cables come in various shapes and sizes, including Type-A, Type-B, Micro-USB, Mini-USB, and USB-C.

7. Conclusion

Our project involves the development of a floor cleaning machine, with a key focus on promoting cleanliness in society. With multiple applications, the machine offers a wide range of functions to meet various cleaning needs. By using solar power, our project promotes environmentally-friendly practices, while the innovative technology incorporated into the design significantly reduces the effort and time required for the cleaning procedure. This leads to more efficient floor cleaning, which in turn enhances overall cleanliness and supports the well-being of individuals. These technological advancements serve as small but impactful steps towards a cleaner and healthier future.

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