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Floor Bot-Floor Vacuum Cleaning Robot

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Abstract: ***Floor sweeping is a task we need to do every day, sometimes more than twice. It's an important part of maintaining a healthy and clean lifestyle. However, it can be a difficult task for many; it can take hours to clean properly, especially when there is a lot of dust that doesn't just go away with sweeping. Vacuum cleaners were a great innovation that simplified the cleaning process, and we have vacuum cleaners everywhere because of their functionality. However, they still require manual operation, as we need to do it ourselves. This project aims to create a simple floor-cleaning vacuum robot that can efficiently vacuum the floor using a vacuum pump mechanism as its main component, along with some sensors: ultrasonic sensors to detect obstacles, and infrared sensors to detect proximity and avoid falling down steps. It will also include a wheel mechanism for movement.***

Keywords: Ultrasonic Sensor, Infrared Sensor, Vacuum Pump Mechanism.

I. INTRODUCTION

A smart and efficient method always contributes to our betterment, even for simple tasks like cleaning. In this busy world, our lives are becoming increasingly hectic. We have adapted to various technologies as part of improving our lifestyle, and we must continually upgrade and update ourselves accordingly. There is no stopping the development of technology; if we don't keep up, we risk being left behind.Various technologies exist to make human life easier, and IoT (Internet of Things) is one such technology, alongside robotics. These innovations aim to replace many manual tasks; most mechanical work can be integrated into new technologies to make processes smarter, allowing humans to focus on more intelligent work. Technology is growing rapidly and becoming more integrated into our daily lives [1].

This project is about creating a vacuum-cleaning robot that, unlike traditional vacuum cleaners, can navigate while avoiding obstacles and cleaning our homes intelligently. While many vacuum-cleaning robots are commercially available, they tend to be costly and bulky. This automatic cleaning robot will save time on floor cleaning by utilizing Arduino, along with sensors like ultrasonic and infrared sensors, a vacuum pump mechanism, and wheels for efficient cleaning.

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II. LITERATURE REVIEW

"Development of Intelligent Floor Cleaning Robot"- S Yatmono, M Khairudin, H S Pramono and a Asmara, published on 2019, Electrical Engineering Education department, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia [1].

Floor Cleaning can be a hectic task so people like to find a way to make it easier. We have many commercially available floor cleaners like ROOMBA, but considering the cost of these they are not that popular among household as it should be. This paper is based on development of a floor cleaning robot composed of robotic and mechanical components that controls its master and slave subsystem It consists of Arduino, sensors, motor drivers, control components. Master block controls motor mechanisms and slave block controls cleaning and polishing mechanisms.

Dust cleaning is a very difficult task and many of us don't clean properly because of many reasons. so, coming to the history of automatic floor cleaners, a smart tool like ROOMBA, a floor cleaning robot was developed in United States in the year 2002. It consists of many sensors that help it to do the floor cleaning efficiently. ROOMBA can detect obstacle and change direction and can detect dirty stains on the floor. It also had many limitations but still that was an innovative technology for making our lives better

"Arduino based dry & wet automatic floor cleaner"- Akanksha Vyas, Satyam Chourasia, Shubham Antapurkar, Raghvendra Prasad, published on April 2020, Medi-caps University, Indore [2].

This paper is about making a floor cleaning robot that can perform Ultraviolet sterilization using Ultraviolet lamp and performs dry and wet cleaning. The application of making Arduino floor cleaner more compact and practical is by using sensors like IR and ultrasonic ones or LIDAR, proximity sensors, along with a vacuum mopping mechanism, wheel mechanism. All these things make it a possible way towards such technologies using IoT.

"hTetro-Infi: A Reconfigurable Floor Cleaning Robot With Infinite Morphologies" - S.M.Bhagya P. Samarakoon, M. A. Viraj J. Muthugala, Anh Vu Le, Mohan Rajesh Elara, Published on 2020 [3].

This floor-cleaning technology can be incorporated with various other morphologies to expand the area coverage of the robot's functionality. By integrating different navigation patterns and complex algorithms, it achieves better energy efficiency and time management, enabling it to manage very large and complex areas [2]. The robot uses four cleaning modules with hinges that allow it to move and reconfigure into different morphologies, along with a 2D LIDAR sensor and an Intel Compute Stick for path planning [3].

The development of this technology has advanced significantly, with various companies creating different

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styles of floor-cleaning robots featuring unique functionalities. For example, these robots can map the entire area and clean accordingly without missing any spots. They can perform both dust cleaning and liquid cleaning, map their way back to a specially designed charging station, and be controlled via smartphones for remote operation and assistance.

III. NEED OF THE STUDY

Considering why we need a floor-cleaning robot, we can draw several conclusions. Whenever an innovation is made for the betterment of humanity, we as humans need to respect, support, and contribute to it. This collaborative effort fosters the development of new and innovative ideas, which become the foundational basis for future advancements in that technology.

Floor sweeping is a task we must perform every day, often more than twice, as it's an essential part of maintaining a healthy and clean lifestyle. However, it can be a challenging task for many, taking hours to clean properly—especially when there is a lot of dust that doesn't simply go away with sweeping. Vacuum cleaners were a significant innovation that simplified the cleaning process, and we have them everywhere due to their functionality. However, they still require manual operation.

A floor-cleaning robot can address this issue, as it automates the task. We can identify many problems with traditional floor-cleaning methods. This issue is not confined to homes; it also affects offices, business institutions, educational institutions, and essentially anywhere with floors. Many of these places require additional labor for sweeping tasks. All of these factors highlight the need for this study and the importance of this concept.

IV. SCOPE OF THE STUDY

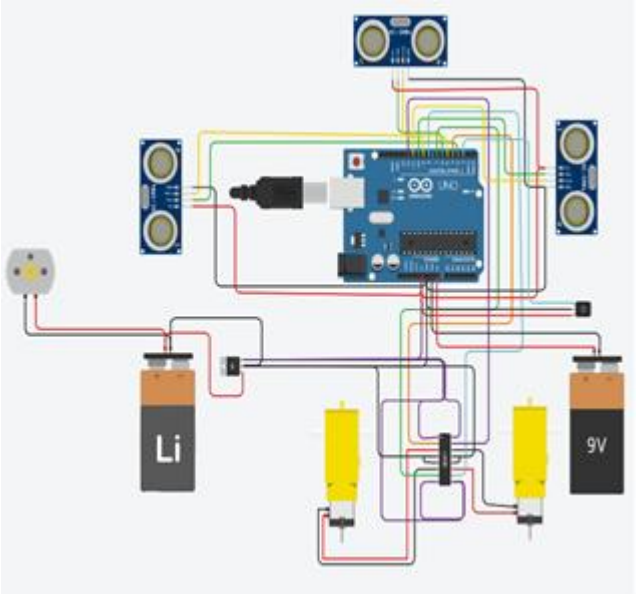
The main scope of this project is to explore new possibilities for smart cleaning using robotics and other technologies, such as the Internet of Things. The future of this concept is vast and in high demand; it represents a basic need of the present that, while available, is not yet widely popular. Floor-cleaning robots are set to become an integral part of our future, making it so that humans won't need to worry about sweeping their households, offices, shops, etc. There may come a time when people wonder if brooms ever existed, but that future is still a long way off. Projects like this can serve as foundational building blocks. In the future, we will see more advanced versions of these technologies with enhanced functionalities and developments.

V. OBJECTIVE OF THE STUDY

The main objective of this project is to create a simple floor-cleaning robot that can efficiently clean the floor using a vacuum pump mechanism as its primary component, along with sensors that detect obstacles and proximity to avoid falls downstairs. The robot will incorporate a wheel mechanism for movement. This is an IoT and Arduino-based project, which will contribute to making it smarter. One of the primary batteries used for the project is a lithium-ion battery, which is rechargeable and flexible enough to sometimes be solar charged with the use of a solar panel. However, this may present limitations, such as the need for regular maintenance (e.g., manually emptying the dustbin) and potential issues with power and speed. The overall goal is to improve the robot despite these limitations, while also ensuring it is cost-effective, eco-friendly, and not bulky [2].

VI. METHODOLOGY

For this project we have generic components and each of them needs to be assembled accordingly. The main components for this project include Arduino UNO, HC-SR04 ultrasonic sensor, IR sensor, L293D IC chip, 7805 voltage regulator [4]. The circuit (Fig 1) shows the connections where the TRIG, ECHO pins of the left, right and top Ultrasonic modules are connected to the digital pins-3,10,6 . Pins 5,11,9 of the Arduino UNO, and all the VCC's are connected together. All GND pins are grounded and the IR's Output connected to pin D2 , VCC connected to pin D12 then grounded. Motors are connected to the battery, and they are controlled using the L293D IC and 7805 voltage regulators. This is the basic set up and we can add extra modules accordingly [5]. Vacuum pump is an important component in this project, and it contains mainly three parts one is a dustbin area to store dust [6]. The other portion contains motor, fan along with a filter and battery socket area. In this project, we will be connecting the motor and fan to our external battery and connect the components according to the circuit diagram [7]. We can solder them or just use a breadboard and wires to connect the sensors (fig 2).



[Fig.1: Circuit Diagram]

We need to build the chassis and body for the vacuum-cleaning robot [8]. For this, we can use materials such as wood, cardboard, foam sheets, or MDF [9]. We can choose any of these materials to create a circular or preferred shape, ensuring that the vacuum mechanism is connected inside. Space will be allocated on the board for the wheels on the preferred sides [10].

Next, we need to attach the motors at the base; these can be PMDC motors, stepper motors, or servo motors controlled by an L293D IC, followed by the sensors. We should also place

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the IR module on the underside
near the front, and then fix the ultrasonic module to the front part, ensuring it does not face downwards [11]. Finally, add the switch to the outside of the chassis and glue the chassis parts together to complete the cover.

[Fig.2: Prototype]

VII. WORKING

The floor-cleaning vacuum robot will have ultrasonic sensors positioned on the left, right, and center, along with one infrared sensor. The ultrasonic sensors are used to detect obstacles by measuring the distance with an Arduino UNO. When an object is detected as an obstacle, the ultrasonic sensor transmits ultrasonic waves, which are reflected back by the obstacle. The time taken for the wave to travel to the obstacle and back is measured, allowing the Arduino to calculate the distance and detect the obstacle [5]. The infrared sensor is used to detect stairs. It contains an IR LED that emits infrared light, which is reflected and received by a photodiode [6]. When a flat surface is detected, the IR sensor's output goes low; when stairs are detected, it goes high, preventing the device from falling. The vacuum pump mechanism consists of a DC motor with a fan that collects dust, along with a filter. The L293D motor driver chip connects the two wheels, and a 7805-voltage regulator is used to regulate the voltage.

VIII. EQUATION

The equation for calculating the distance using the sensors;
Distance = (Time x Speed of Sound) / 2 (1)
We divide by 2 because the ultrasonic wave travels back and forth. The Speed of sound in air is 343 m/s.

IX. CONCLUSION

This is a simple project that contributes towards new possibilities of cleaning smartly even with some limitations by using robotics and other technologies like Internet of things. It employs Arduino to create an automatic floor-cleaning vacuum robot that can randomly clean floors. The robot utilizes ultrasonic and infrared sensors for obstacle and stair detection, making it a cost-effective device that is simple and easy to manage, understand, operate, and maintain, without any complex mechanisms.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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