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An Automatic Floor Cleaner Using LiDAR

[1]Sahil Borikar, [2]Prajwal Kadaskar, [3]Siya Donode, [4]Prashik Chandekar, [5]Prof. M.P Dongare

[1,2,3,4]UG Scholar, Department of Electronics and Telecommunication, Government College of Engineering Chandrapur, Maharashtra, India

[5]Assistant Professor Department of Electronics and Telecommunication, Government College of Engineering Chandrapur, Maharashtra, India

Abstract- *The Automatic Floor Cleaner Using LiDAR Technology is an innovative robotic cleaning system designed to enhance efficiency and automation in floor maintenance. With the increasing demand for smart home and industrial cleaning solutions, this paper leverages LiDAR-based navigation to enable precise, obstacle-avoiding movement, ensuring thorough cleaning with minimal human intervention. The system is built using an Arduino UNO microcontroller, which processes real-time distance data from the VL53L0X LiDAR sensor to direct the cleaner's movement. The L293D motor driver controls the BO motors with wheels, allowing smooth navigation across different surfaces. A suction mechanism efficiently collects dust and dry debris, storing it in a designated container, while a 12V exhaust fan enhances airflow to maintain consistent suction power. By integrating LiDAR-based obstacle detection, autonomous navigation, and an effective cleaning mechanism, this paper provides a cost-effective, energy-efficient, and intelligent alternative to traditional cleaning methods. It holds significant potential for applications in homes, offices, and public spaces, contributing to improved hygiene and reduced manual effort while showcasing the growing impact of robotics in daily life.*

***Index*-Autonomous Navigation, Dust Collection, Suction Mechanism, Embedded Technology.**

I. INTRODUCTION

In today's fast-paced world, automation plays a crucial role in simplifying everyday tasks, and floor cleaning is no exception. Traditional cleaning methods require manual effort and time, making them inefficient for modern households, offices, and public spaces. Robotic floor cleaners have emerged as a smart solution, providing automated and systematic cleaning with minimal human intervention. This paper, Automatic Floor Cleaner Using LiDAR Technology, aims to develop an intelligent cleaning system that leverages LiDAR-based navigation for precise obstacle detection and efficient cleaning. By integrating autonomous movement, this system ensures thorough and systematic floor cleaning, making it a practical and effective alternative to conventional cleaning methods.

The proposed system consists of key components such as the VL53L0X LiDAR sensor, which continuously scans the environment to detect obstacles and adjust the cleaner's path accordingly. An Arduino UNO microcontroller processes the LiDAR data and controls the movement of the robot using an L293D motor driver connected to BO motors with wheels for smooth mobility. A suction pump is employed to collect dust and dry debris, storing it in a designated container, while a 12V exhaust fan helps maintain consistent airflow for effective suction. The system is powered by lithium-ion batteries, ensuring extended wireless operation. By combining LiDAR-based navigation with an efficient cleaning mechanism, this paper demonstrates the potential of automation in household and industrial cleaning, offering a cost-effective, energy-efficient, and user-friendly solution for maintaining cleanliness with minimal manual intervention.

II. LITERATURE REVIEW

Rajesh Kannan et al. offer a thorough examination of state-of-the-art cleaning robots, diving deep into the sensor technologies and intelligent control strategies that power them. The study also highlights the practical challenges of deploying these autonomous cleaners in real-world environments [1].

Molla Rashied et al. present a novel automated floor-cleaning robot designed to overcome the limitations of previous models. Their innovation aims to save both time and cost by minimizing human labor. While many household robots have entered the market recently, few are equipped for wet cleaning. This paper introduces a dual-function robot capable of both vacuuming and wet cleaning, with intelligent area navigation [2].

Vandana Kate et al. detail the design, hardware, and software of a floor-cleaning machine named "Samarjini." Through extensive testing in varied environments, the robot demonstrated effective obstacle avoidance and autonomous navigation, making it a practical tool for modern, fast-paced lifestyles [3].

Pathmakumar et al. propose a unique system that evaluates cleaning quality using an innovative "touch and inspect" audit sensor. The robot employs a dirt-probability-driven exploration method to map dirt density, generating location-specific audit scores and cleanliness benchmarks. These metrics are visualized via kernel density estimation, enabling a mobile audit robot to operate efficiently in both indoor and semi-outdoor settings [4].

Harshvardhansinh et al. introduce a semi-autonomous mopping robot controllable via Android or through sensor-driven automation. It features a mop integrated with a water spray mechanism, powered by a mini pump, and can clean various floor types like polished wood and tiles. The system utilizes an Arduino Mega with Bluetooth communication and IR sensors for obstacle avoidance. Users can switch between manual and automatic modes as per convenience [5].

R. Parween et al. explore the “h-Trihex” platform, a reconfigurable robot capable of adopting three distinct configurations. Each mode alters the robot's kinematics and locomotion behavior. Equipped with encoders, LIDAR, and an IMU, h-Trihex leverages these sensors to implement a cascade control strategy: a robust backstepping controller for motion and a PID controller for speed and wheel orientation adjustments [6].

HA Shakhawat Hossen et al. develop a functional floor-cleaning prototype that combines Arduino Mega and Raspberry Pi to support autonomous mapping and cleaning. A standout feature of this robot is its integration of a GPS module, enabling spatial awareness and directional movement. Human intervention is limited to waste disposal and maintenance tasks [7].

Andrea et al. delve into Simultaneous Localization and Mapping (SLAM), a critical technique for enabling robots to map unknown environments while estimating their own position. The paper outlines multiple visual-based SLAM approaches, offering guidance for newcomers navigating this complex yet foundational aspect of robotics [8].

J. Frolizzi et al. recognize the time constraints of urban living and propose an autonomous floor-cleaning robot capable of both suction and mopping. Equipped with obstacle detection and automatic water spraying, it can also operate in manual mode. The entire system is managed via an Atmega 328 microcontroller [9].

III. RESEARCH METHODOLOGY

The Automatic Floor Cleaner utilizes a VL53L0X LiDAR sensor to accurately measure the distance of nearby objects, enabling efficient movement control. The Arduino UNO microcontroller processes this distance data and controls the L293D motor driver, which powers four BO motors attached to wheels, ensuring smooth navigation. The system is powered by three lithium-ion batteries, providing a reliable and wireless cleaning operation. A suction mechanism is incorporated to effectively collect dust and dry garbage, which is then stored in a designated container. To enhance suction efficiency, a 12V exhaust fan is strategically placed, creating a strong airflow that aids in pulling debris into the storage compartment. This fully automated system ensures efficient floor cleaning with minimal human intervention. In the given block diagram, the Arduino UNO is used as a microcontroller. In the input device we have used the VL53L0X LiDAR sensor and three lithium-ion batteries power the system. In output devices, the L293D motor driver and four BO motors are used.

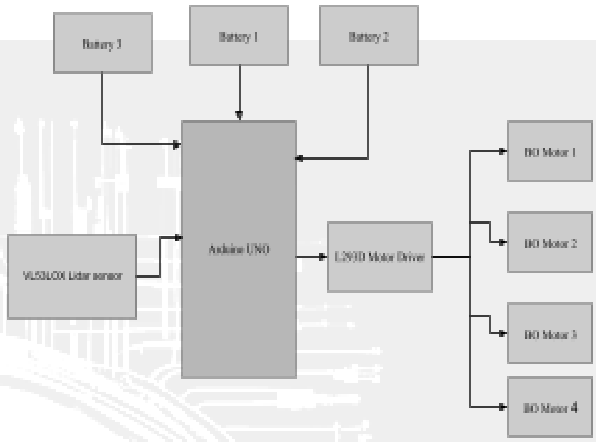

Fig 1 shows the block diagram

DESCRIPTION

In the given block diagram, the Arduino UNO is used as a microcontroller. In the input device we have used the VL53L0X LiDAR sensor and three lithium-ion batteries power the system. In output devices, the L293D motor driver and four BO motors are used.

FLOW CHART

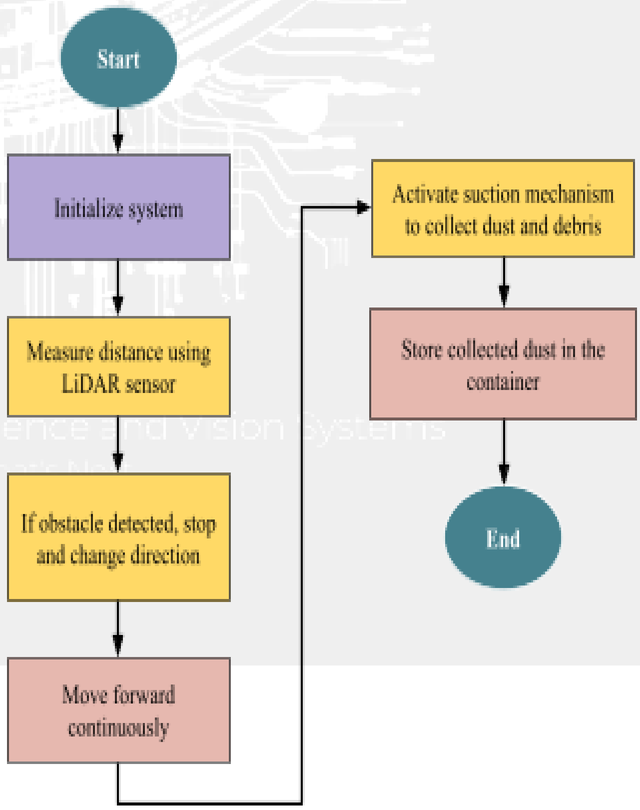

Fig 2 shows the flowchart

CIRCUIT DIAGRAM

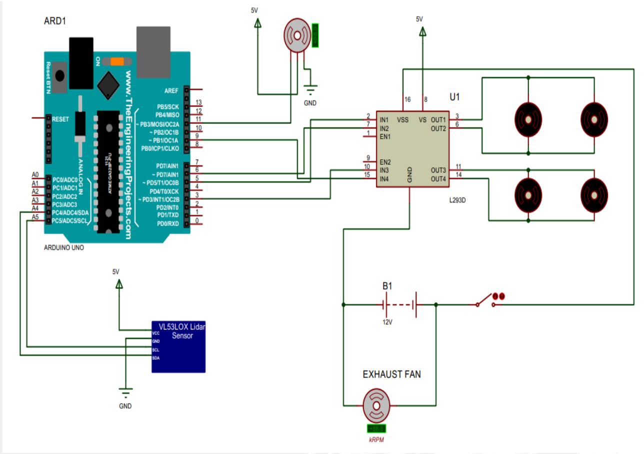

Fig 3 shows the circuit diagram

WORKING

The Automatic Floor Cleaner functions by using a VL53L0X LiDAR sensor to measure distance, allowing the system to detect obstacles and adjust its movement accordingly. The Arduino UNO microcontroller processes this distance data and sends commands to the L293D motor driver, which powers the BO motors to propel the cleaner forward. As the device moves, a suction mechanism efficiently collects dust and dry debris, storing it in a dedicated container. To enhance suction efficiency, a 12V exhaust fan creates a controlled airflow, ensuring effective debris intake. The system continuously monitors its surroundings and changes direction when necessary, ensuring seamless cleaning. It is powered by three lithium-ion batteries.

IV. SYSTEM REQUIREMENT

HARDWARE REQUIREMENT

1) Arduino UNO microcontroller
2) VL53LOX Lidar sensor
3) L293D motor driver
4)BO motors *4
5) Lithium ion battery *3
6) Wheels *4
7) 12V Exhaust fan

SOFTWARE REQUIREMENT

1) Arduino IDE
2) Proteus

V. EXPERIMENTAL SETUP & RESULT

EXPERIMENTAL SETUP

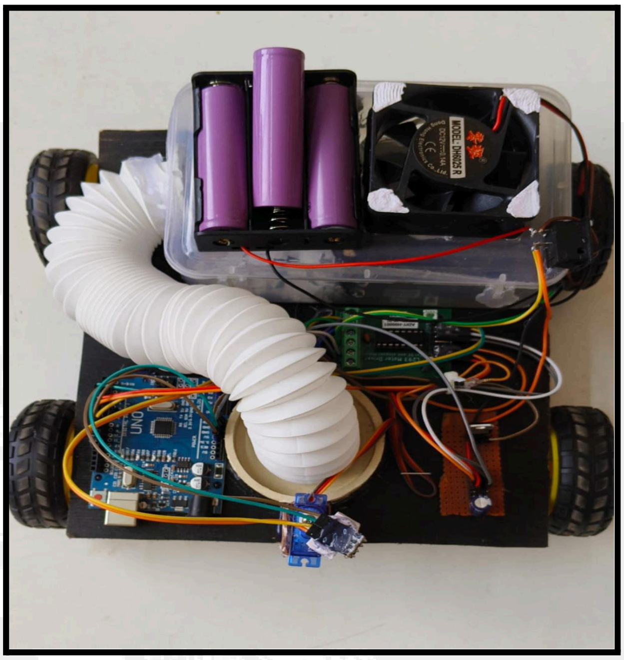

Fig.4 shows the Experimental Setup of the system

RESULT

The results of the Automatic Floor Cleaner Using LiDAR Technology demonstrate its ability to efficiently clean floors with minimal human intervention. The VL53L0X LiDAR sensor accurately measures distances, allowing the system to navigate obstacles smoothly and adjust its movement accordingly. The Arduino-controlled motor system enables stable and precise motion, ensuring complete floor coverage. The suction mechanism, enhanced by a 12V exhaust fan, effectively collects dust and dry debris, storing it in a designated container. The system operates wirelessly with lithium-ion batteries, providing a portable and autonomous cleaning solution. Overall, the results validate the system's efficiency in automated floor cleaning, proving it to be a reliable, cost-effective, and smart alternative to traditional cleaning methods.

VI. CONCLUSION

The Automatic Floor Cleaner Using LiDAR Technology is an innovative and efficient solution designed to automate the cleaning process while minimizing human effort. By utilizing the VL53L0X LiDAR sensor, the system accurately measures distances, allowing smooth navigation and effective obstacle avoidance. The Arduino UNO microcontroller, in combination with the L293D motor driver, ensures precise control of the BO motors, enabling seamless movement. The suction mechanism, supported by a 12V exhaust fan, efficiently collects dust and dry debris, ensuring thorough cleaning. With its autonomous functionality, the device can navigate and clean without manual intervention, making it ideal for homes, offices, hospitals, and other indoor environments.

VII. REFERENCE

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