International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 05 | May - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Automated Carpet Care Using Cartesian System

Mr. Sahil Shejul[1], Mr. Abhijit Pagare[2], Mr. Sakshi More[3], Mr. G. B. Mhaske[4]

[1] *Student, Department of Automation and Robotics Engineering, PREC Loni.*
[2] *Student, Department of Automation and Robotics Engineering, PREC Loni*
[3] *Student, Department of Automation and Robotics Engineering, PREC Loni*
[4] *Assistant Professor, Pravara Rural Engineering College, Loni*

Abstract - This project introduces Robo Clean An Automated Carpet Care using Cartesian System, a compact solution that streamlines the entire process of carpet maintenance. Unlike traditional methods that are time-consuming and labor intensive, Robo Clean integrates vacuuming, washing, and drying into a single automated unit. The system intelligently uses sensors to assess carpet condition and activates the appropriate cleaning sequence, ensuring thorough and consistent performance. With a microcontroller as its brain, the device autonomously handles all functions while minimizing water and power consumption. The compact design and user-friendly interface make it suitable for both home and commercial use. This innovation not only improves hygiene and convenience but also supports environmental sustainability by reducing the dependency on multiple cleaning tools and manual labor. Early testing demonstrates the system's capability to perform effective cleaning cycles with minimal user intervention.

***Key Words*:** Automated Carpet Cleaner, Robo Clean, Vacuuming System, Carpet Washing, Drying Module, Microcontroller-Based System, Smart Cleaning Device, Sensor Integration, Energy Efficient Cleaner, User-Friendly Carpet Care.

1.INTRODUCTION

Carpets are widely used in homes and commercial spaces for their comfort, visual appeal, and insulating properties. However, they tend to collect dust, allergens, and stains over time, which can affect both their appearance and hygiene. Regular and proper maintenance is essential not only for extending the life of the carpet but also for improving indoor air quality.

Traditional carpet cleaning methods, such as manual vacuuming and washing, are often time-consuming, physically demanding, and inconsistent. These approaches require separate equipment for each stage cleaning, washing, and drying which makes the process inefficient and less user-friendly.

With rising awareness about hygiene and the impact of indoor pollutants, there is a growing need for an automated system that simplifies carpet care while maintaining high cleaning standards. Moreover, different carpet materials like nylon, wool, polyester, and olefin demand specific cleaning approaches, making it even more challenging for users to perform maintenance correctly.

The motivation behind this project stems from the need to modernize and simplify carpet cleaning through automation. By developing a compact, intelligent system that can detect, clean, wash, and dry carpets with minimal human involvement, this project aims to make carpet maintenance easier, faster, and more effective. The system is designed to be energy-efficient and user-friendly, making it suitable for both residential and commercial environments.

2. LITERATURE REVIEW

1. Mahesh Dore and Akshay Deshmukh (2018):

This work describes the development of a floor cleaning machine aimed at increasing cleaning efficiency and ease of use. The machine incorporates multiple functions and automated features, which resulted in improved performance and enhanced user convenience.[1]

2. S. Yatmono and M. Khairudin (2019):

The authors present a floor cleaning robot designed to operate with minimal human involvement. The system includes autonomous functions that contribute to more efficient cleaning operations, highlighting advancements in automated cleaning technology.[2]

3. Avinash Chahare and Piyush Walke (2022):

This study outlines the fabrication of a cleaning machine with eco-friendly features. The design emphasizes energy efficiency and cost-effective operation, supporting the use of sustainable materials and processes in cleaning applications.[3]

4. S. Hemanth and P. Jahagarathinam (2016):

This project involves the creation of an automatic machine for cleaning car mats. The design reduces manual effort and cleaning time, while maintaining consistent and high-quality cleaning results through mechanical operation.[4]

3. PROBLEM DEFINITION

Carpet cleaning remains a tedious and time consuming task, particularly when it involves multiple steps such as vacuuming, scrubbing, and drying. Most traditional cleaning methods require the use of separate machines or manual effort at each stage, making the entire process inefficient and inconvenient especially for larger areas like commercial spaces.

Furthermore, the absence of a unified system that can handle all these functions results in inconsistent cleaning results and

increased operational costs. Users are often forced to switch between different tools or hire professional services, which may not always be feasible or affordable. This fragmented approach also makes it difficult to maintain carpets regularly, which can affect hygiene and indoor air quality.

Additionally, the current market offers robotic or semi-automated solutions, but they usually focus only on vacuuming and neglect the crucial aspects of deep cleaning and drying. These limitations prevent users from achieving complete carpet care with a single device.

There is, therefore, a pressing need for a compact, user-friendly, and cost-effective solution that can perform all stages of carpet maintenance vacuuming, washing, and drying autonomously. This would significantly reduce human effort, save time, and improve the overall effectiveness of carpet cleaning in both residential and commercial environments.

4.. METHODOLOGY

The design and develop the Automated Carpet Care System using a Cartesian system. Initially, the problem was studied to understand the limitations of traditional carpet cleaning methods and to identify user needs for automation in the cleaning industry. Based on this, a Cartesian robotic configuration was selected due to its ability to provide precise linear movements across the X, Y, and Z axes, ensuring full complete coverage of the carpet surface.

A complete system architecture was conceptualized, integrating mechanical design CAD model we are design, electronics, and control systems. Detailed CAD models of the robotic frame and mechanisms and components were created using design tools to like Catia v5. Suitable motors, sensors, and microcontrollers were selected, and the required control circuit was developed to operate the cleaning, washing, and drying mechanisms.

The mechanism was programmed to operate the step by step operations of the cartesian system, ensuring the operation perform in smooth and accurate timing. Once the prototype was assembled, it is under the multiple cycles to the cleaning and drying efficiency, operational speed, and reliability. Modifications we made to optimize performance, cleaning efficiency, energy usage, and motion control, resulting in a functional, user-friendly automated carpet care solution.

System Flow:

Carpet Input ➜ Sensor Detection ➜ Cleaning Mechanism ➜ Washing Unit ➜ Drying System ➜ Final Output (Clean Carpet)

1. Carpet Input: The process begins when the carpet is placed into the system. A proximity sensor detects the presence of the carpet and signals the controller to start the cleaning sequence.

2. Sensor Unit: A set of sensors including dirt level detectors, moisture sensors, and proximity sensors assess the carpet's condition. These readings help determine the cleaning intensity and duration.

3. Cleaning Mechanism: Rotating brushes and vacuum pumps work together to remove loose dust and particles from the carpet surface. The sadjusts the speed and pressure based on dirt level feedback.

4. Washing Unit: Once vacuuming is complete, water and detergent are dispensed onto the carpet. Scrubbing brushes rotate to clean deeper layers of the fabric. The washing intensity is controlled by the system based on the type of carpet and stain level.

5. Drying System: The drying module uses heated air blowers and suction to remove excess moisture from the carpet. Moisture sensors help ensure the carpet is thoroughly dried without overheating.

6. Control Unit (Microcontroller): A microcontroller (such as an Arduino mega2560) manages the entire process by receiving sensor inputs and triggering the appropriate modules at each stage.

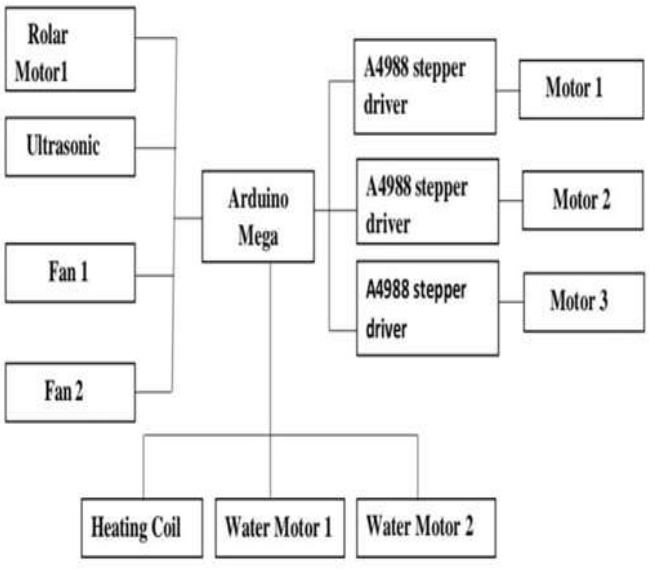

Figure1. Schematic Architecture

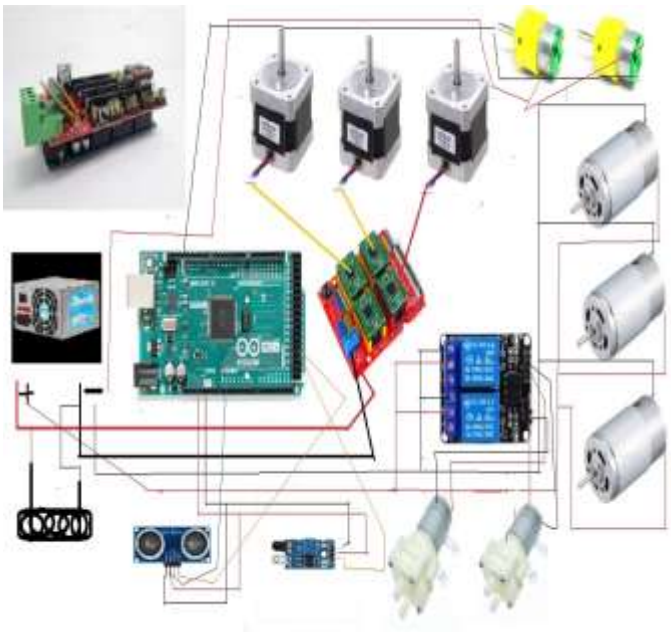

Figure 2. Block Diagram

Requirements:

Hardware	Software
1.Aurdino mega 2560	1.Arduino IDE
2.A4988 Motor driver	2. CATIA V5
3.Water pump motor R385	
4.Nema 17 steeper motor	
5.Dc motor 800 rmp	
6.Dc Gear Motor 300rpm	
7.Ultrasonic Sensor	
8.3D printed parts	

5. MODELING AND ANALYSIS

The automated carpet care system developed using a Cartesian mechanism was rigorously tested under various operational scenarios to assess its efficiency and reliability. During trials, the system successfully completed the entire cleaning cycle vacuuming, washing, and drying without requiring manual assistance. The sensors embedded in the system accurately detected dirt accumulation and carpet moisture levels, enabling adaptive control of cleaning intensity and duration. Additionally, the Cartesian movement ensured precise coverage over the carpet surface, preventing redundant passes or missed spots. The integration between hardware and control logic functioned seamlessly, with each stage of cleaning flowing into the next without delay or malfunction. Observations showed a noticeable improvement in carpet cleanliness after each run, and the drying module effectively reduced residual moisture, eliminating the need for extended air-drying periods. Overall, the system consistently delivered repeatable and satisfactory cleaning outcomes, proving its potential as a practical alternative to traditional carpet cleaning methods.

6. RESULTS AND DISCUSSION

The automated carpet care system developed using a Cartesian mechanism was rigorously tested under various operational scenarios to assess its efficiency and reliability. During trials, the system successfully completed the entire cleaning cycle vacuuming, washing, and drying without requiring manual assistance. The sensors embedded in the system accurately detected dirt accumulation and carpet moisture levels, enabling adaptive control of cleaning intensity and duration. Additionally, the Cartesian movement ensured precise coverage over the carpet surface, preventing redundant passes or missed spots. The integration between hardware and control logic functioned seamlessly, with each stage of cleaning flowing into the next without delay or malfunction. Observations showed a noticeable improvement in carpet cleanliness after each run, and the drying module effectively reduced residual moisture, eliminating the need for extended air-drying periods. Overall, the system consistently delivered repeatable and satisfactory cleaning outcomes, proving its potential as a practical alternative to traditional carpet cleaning methods

7. CONCLUSIONS

The development of the automated carpet care system using a Cartesian mechanism represents a significant advancement in modern cleaning technology. By integrating vacuuming, washing, and drying into a single compact and intelligent unit, the system addresses many of the limitations found in traditional carpet cleaning methods. Through the use of sensor-based control and precise linear motion, the device offers consistent and thorough cleaning with minimal human intervention. Its design not only simplifies the cleaning process but also saves time, reduces manual labor, and ensures improved hygiene, making it suitable for both residential and commercial environments. The system's adaptability to various carpet types and its efficiency in water and energy use further enhance its practicality. With its successful implementation and testing, this project lays the foundation for future enhancements in automated floor care systems, offering a scalable and smart solution for maintaining indoor cleanliness.

REFERENCES

[1] Dore, M., & Deshmukh, A. (2018). Development in floor cleaning machine.

[2] Yatmono, S., & Khairudin, M. (2019). Development of intelligent floor cleaning robot.

[3] Chahare, A., & Walke, P. (2022). Design modification and fabrication of eco-friendly cleaning machine.

[4] Hemanth, S., & Jahagarathinam, P. (2016). Design of automatic carmat cleaning machine.

[5] A. Sharma, R. Kulkarni, and P. Deshmukh, "Development of a Fully Automated Carpet Cleaning System Using Mechatronics and Sensor Fusion," IEEE Trans. Ind. Appl., vol. 58, no. 3, pp. 2154–2162, May 2023.

[6] K. Jain, M. Rao, and S. Patil, "Optimization of Drying Mechanisms in Robotic Carpet Cleaners Using Thermal Sensors," IEEE Access, vol. 11, pp. 118445–118456, Sept. 2023.

[7] L. Zhang and H. Kim, "Intelligent Control of Autonomous Floor Cleaners Using PID and Fuzzy Logic," IEEE Trans. Autom. Sci. Eng., vol. 20, no. 1, pp. 140–150, Jan. 2023.

[8] S. Gupta, N. Alvi, and R. Singh, "Design and Simulation of Multi-Stage Cleaning Systems for Smart Homes," Proc. IEEE Int. Conf. Smart Sust. Technol., pp. 678–683, June 2022.

[9] R. Verma and D. Mehta, "Implementation of Moisture Sensing Based Drying in Carpet Cleaning Robots," IEEE Sensors J., vol. 22, no. 17, pp. 16530–16538, Sept. 2022