Development of a Robotic Vacuum Cleaner

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Introduction

The growing demand for automation in household chores has led to increased interest in robotic cleaning systems. Traditional manual cleaning methods are time-consuming and labor-intensive, motivating the need for smart, autonomous alternatives. Robotic vacuum cleaners offer a practical solution by automating the removal of dust and debris from floor surfaces. This paper focuses on the development of a robotic vacuum cleaner using locally available materials and accessible electronic components. The design leverages microcontroller-based control systems to execute intelligent navigation and cleaning strategies

Methodology

The robotic vacuum cleaner was developed using an Arduino Uno microcontroller, serving as the control center. Core components include:

- **Vacuum motor** (12V DC) for suction
- **Side spinning brushes** for edge cleaning
- **Ultrasonic, bumper, and cliff sensors** for obstacle avoidance and surface edge detection
- **High-speed DC motors** for mobility
- **Blower fan** with 38 CFM rating for airflow optimization
- **Battery-powered system** ensuring portable, cordless operation

The robot receives input from sensors to determine its surroundings, which is processed by the Arduino to issue commands to actuators. The suction mechanism is designed with multidirectional air intake for enhanced particle capture. A lightweight chassis with four 10 cm wheels provides balance and mobility.

Results

The robotic vacuum cleaner demonstrated effective performance during controlled testing. It successfully navigated a laboratory environment, avoided collisions and drop-offs, and performed consistent suction and sweeping functions. The integration of the vacuum and sensor systems enabled the robot to operate with minimal human intervention. Figures showing the front and rear views of the prototype supported the successful construction of the system. The chosen motor and blower combination achieved sufficient airflow for basic household dust and debris removal.

Conclusion

The development of this robotic vacuum cleaner illustrates the feasibility of using accessible components to build an efficient, low-cost automated cleaning solution. The project contributes to the growing field of domestic robotics and demonstrates the practical application of mechatronic principles. Future improvements may include enhanced obstacle mapping, machine learning-based navigation, and integration with smart home platforms. The device has strong potential for use in residential environments, reducing manual cleaning efforts and enhancing indoor hygiene.

Keywords: Automation,Arduino, Cleaning, Mechatronics, Robotic Vacuum Cleaner, Smart Home