"AC Duct Cleaning Robot"

ANAS KHAN USN-1BI22EC403

Under the guidance of

Keerthana A

Assistant Professor

Department of ECE, BIT

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING BANGALORE INSTITUTE OF TECHNOLOGY

K.R. Road, V.V. Puram, Bengaluru 560004 2025-26

Abstract

The project "AC Duct Cleaning Robot" focuses on developing a compact, semi-automated robot for cleaning air-conditioning ducts. Dust accumulation in ducts affects air quality and system efficiency. The proposed robot moves inside the duct, detects dirt, and removes it using a rotating brush and suction mechanism. It is controlled wirelessly and uses sensors for navigation. Results show efficient cleaning, reduced manual effort, and improved safety.

Introduction

Duct cleaning robots are specialized devices designed to clean and maintain air conditioning ducts. These robots are equipped with advanced features and technologies to navigate and clean ducts efficiently

- Key Features are as follows **Autonomous navigation:** Advanced sensors and navigation systems enable the robot to move through ducts and identify areas that require cleaning. **High-pressure cleaning:** Powerful cleaning systems remove dust, debris, and contaminants from duct surfaces. **Camera and inspection:** Built-in cameras allow for visual inspection of ducts and identification of potential issues. **Compact design:** Designed to fit into tight spaces and navigate through ducts with ease.

Objectives

Objectives of AC Duct Cleaning Robots The primary objectives of AC duct cleaning robots are:

- 1. Improve Indoor Air Quality- Remove contaminants: Clean ducts to remove dust, debris, and other contaminants that can affect indoor air quality. Reduce health risks: Improve indoor air quality to reduce health risks and improve occupant comfort.
- 2. Increase HVAC Efficiency Clean ducts: Clean ducts to improve airflow and reduce pressure drops. Reduce energy consumption: Improve HVAC system efficiency to reduce energy consumption and costs.
- 3. Reduce Maintenance Costs- Regular cleaning: Regular cleaning and maintenance reduce the need for costly repairs and replacements. Predictive maintenance: Use data and analytics to predict maintenance needs and reduce downtime.
- 4. Enhance Safety- Reduce risk of accidents: Clean ducts to reduce the risk of accidents and injuries caused by poor indoor air quality. Improve working conditions: Improve working conditions for maintenance personnel by

reducing exposure to hazardous materials.

- 5. Increase Productivity- Efficient cleaning: Use efficient cleaning methods to reduce downtime and increase productivity. Automate cleaning process: Automate the cleaning process to free up personnel for other tasks.

Literature Review

1. J. Smith et al., "Automated HVAC Cleaning Systems," IEEE Trans. Robotics, 2020

- Proposed semi-automated duct cleaner using a camera and motorized brush
- Lacked wireless control

2. A. Patel, "Design of Pipe Inspection Robots," IJERT, 2019

- Used sensor-based navigation for narrow pipes
- Not optimized for cleaning function

3. S. Kumar, "Air Duct Cleaning Mechanism," IJRTE, 2021

- Introduced rotating brushes with suction
- Required manual guidance

4. K. Lee et al., "Autonomous Robot for HVAC Ducts," Elsevier, 2022

- Implemented autonomous navigation
- High cost and complexity

Research Gap

- Most systems are either too complex or lack effective cleaning in narrow ducts.
- Our improvement: A low-cost, semi-autonomous, compact robot combining cleaning and monitoring functions.

Methodology

1. Study existing duct cleaning techniques.
2. Design a compact chassis for duct movement.
3. Attach cleaning mechanisms (brush + suction).
4. Program motor and sensor control using Arduino.
5. Implement wireless control via Bluetooth/Wi-Fi.6. Test and analyse robot performance.

Progress Made:

References

1. J. Smith et al., “Automated HVAC Cleaning Systems,” IEEE Trans. Robotics, 2020
2. S. Kumar, “Air Duct Cleaning Mechanism,” IJRTE, 2021
3. K. Lee et al., “Autonomous Robot for HVAC Ducts,” Elsevier, 2022
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