PROJECT : VACUUM CLEANER

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I would like to thank Professor Virgile AHYI, President of

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Dedication

Dedicates an infinite thank you to my family for their benevolent support and their

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Especially, to my parents for their sacrifices during these long years

So that I can reach this level and for all those who have contributed closely

Or by far to the development of this thesis.

Resume

Dedication

I dedicate this project to Almighty God, whose infinite wisdom and strength have guided me throughout this journey.

I also dedicate it to my beloved family, friends, and mentors for their unwavering support and encouragement.

Certification Page

This is to certify that the project titled:

"DESIGN AND CONSTRUCTION OF A HANDHELD VACUUM CLEANER"

was carried out by **IDRIS OLUWAFERANMI** of the Department of Computer Science, IRGIB Africa

University, under the supervision of:

Mr Uriel and Mr Abraham
(Supervisor’s Name)

(HOD name Mr Uriel)
Head of Department

Date: March 28th 2025

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Abstract

This project focuses on the **design and construction of a handheld vacuum cleaner** using readily available local materials. The purpose of this project is to provide an affordable, efficient, and portable vacuum cleaning device that can be used for household or light industrial cleaning tasks. The project incorporates basic mechanical and electrical principles, combining them with creativity and hands-on engineering to produce a functional vacuum cleaner.

The vacuum cleaner consists of a metallic dust canister, a motorized fan unit housed in a plastic cover, a basic filtration system, and a user-friendly on/off control interface. It operates by creating a suction force through the rotation of the fan connected to a high-speed motor. The air

drawn into the chamber carries dust and debris, which are trapped by the filter while clean air is expelled.

This project demonstrates how innovation and technical knowledge can be used to solve everyday problems through simple yet effective solutions.

Chapter One – Introduction

1.1 Background of the Study

Vacuum cleaners are essential appliances designed to remove dust, dirt, and debris from surfaces. Traditionally, they are produced by large corporations with industrial-grade components, making them costly and sometimes difficult to repair. In developing regions, access to affordable cleaning technology is limited. This project aims to bridge that gap by constructing a cost-effective, efficient, and portable vacuum cleaner from locally sourced materials.

By applying fundamental engineering principles, a functional handheld vacuum cleaner was designed and constructed using an electric motor, fan assembly, and metallic housing. This project not only reflects innovation but also highlights the practical application of theoretical knowledge acquired during the course of study.

1.2 Statement of the Problem

Households and small-scale workshops often face challenges with cleanliness due to the high cost or unavailability of commercial vacuum cleaners. Sweeping may not effectively remove fine particles, and manual cleaning is time-consuming. There is a need for a locally made, low-cost vacuum cleaner that is effective and easy to use.

1.3 Objectives of the Project

- To design and construct a working handheld vacuum cleaner.
- To utilize locally available materials and tools.
- To demonstrate the application of computer science and hardware integration.
- To ensure the device is lightweight, portable, and energy-efficient.

1.4 Scope and Limitation

This project focuses on constructing a small-scale vacuum cleaner primarily for domestic and light industrial use. It does not include smart automation features or wireless connectivity. The suction power is limited to the capacity of the selected motor.

1.5 Significance of the Study

The project is significant in several ways:

- It promotes self-reliance in the creation of household appliances.
- It demonstrates how computer science principles can be applied beyond software to solve real-world hardware problems.
- It provides an opportunity for students to engage in hands-on innovation and contribute to the local economy through manufacturing.

1. Design Planning

- Sketch a basic layout showing the **motor**, **fan**, **filter**, **dustbin**, **light capacitor**, and **power source**.
- Plan for airflow: from the **intake nozzle**, through the **filter**, past the **motor**, and out the **exhaust vent**.

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2. Materials Used

Electronic Components:

- **Motor Type:** 12V DC motor (high-speed, brushed type; common in old DVD players or fans)
- **Light Capacitor:** 450V 2.2µF (used to reduce power surge and stabilize current)
- **Toggle Switches**: 2-way on/off switch for easy control
- **Power Source**: AC adapter (12V) or battery pack
- **Wires**: Copper wire with insulation (AWG 22 or 24)

Mechanical Components:

- **Fan Blade:** Custom made from plastic or aluminum (5–7 blades preferred)
- **Plastic Bottle or Container**: 1.5-liter water bottle or similar for casing
- **Filter Material:** Foam sheet or fabric net
- **Dustbin:** Plastic cup or built-in chamber inside the casing
- **Screws:** Self-tapping screws (length: 1 inch / 2.5 cm) — used to fix the motor and close the casing
- **Rubber Seal or Foam Tape:** To seal gaps and improve suction

Tools Used:

- Soldering iron
- Screwdriver

- Wire cutter/stripper
- Hot glue gun
- Drill (optional)
- Scissors

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3. Assembly Procedure

Step 1: Preparing the Casing

- Cut open the **plastic container** from the side to insert internal components.
- Drill a hole in the front for the **suction inlet** and another at the back for the **exhaust outlet**.
- Smooth the edges with sandpaper or a lighter.

Step 2: Fan and Motor Setup

- Attach the **fan blade** tightly to the **shaft of the 12V DC motor**.
- Ensure it's centered to avoid wobbling. Test spin it briefly with a 9V battery.
- Fix the motor inside the casing using **1-inch screws** and reinforce with hot glue if needed.
- Position the motor behind the filter and aligned with the airflow path.

Step 3: Filter and Dustbin Installation

- Place the **filter material** between the suction inlet and the motor.
- You can sandwich the foam between plastic rings or glue it flat against the wall.
- Insert the **dustbin** (a cup or chamber) right under the intake to collect particles.
- Make sure it can be removed easily for cleaning.

Step 4: Wiring and Capacitor Connection

- **Solder wires** from the motor to the switch and power input.
- Connect the **light capacitor (2.2µF, 450V)** in **parallel** with the motor terminals:
  - One leg to the positive wire.
  - The other leg to the negative wire.
- This will stabilize voltage and reduce flickering or power spikes.
- Use heat shrink or insulation tape to protect connections.

Step 5: Switch and Power Integration

- Mount the **toggle switch** on the body where it's easy to reach.

- Connect to the power input and motor so it turns the motor on/off.
- If using AC power, make sure the circuit is safe and that the capacitor is AC-rated.

Step 6: Final Assembly

- Align all parts in the casing: motor, fan, filter, dustbin, wiring.
- Use **self-tapping screws** to close the plastic casing securely.
- Seal all joints with hot glue or rubber foam to ensure no air leaks.

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4. Testing and Troubleshooting

Test Procedure:

- Power on the device and place it over small debris (crumbs, paper, dust).
- Feel for suction at the intake nozzle.
- Check for vibrations (re-center the fan if needed).
- Listen for unusual sounds (loose motor = tighten screws).

Chapter Two – Literature Review

2.1 Overview of Vacuum Cleaners

A vacuum cleaner is a device that uses suction to remove dirt from surfaces such as floors, upholstery, and draperies. It collects dirt into a bag or dustbin for disposal. Modern vacuum cleaners come in various forms including upright, canister, robotic, and handheld.

2.2 Types of Vacuum Cleaners

- **Upright Vacuums:** Powerful and best for carpet cleaning.
- **Canister Vacuums:** Easier to maneuver; ideal for hardwood and tiles.
- **Handheld Vacuums:** Portable and best for quick clean-ups and small spaces.
- **Robotic Vacuums:** Automated and programmable.
- **Central Vacuums:** Installed into buildings, with ports in each room.

2.3 Historical Development

The first motorized vacuum cleaner was invented by Hubert Cecil Booth in 1901. Over time, advancements in electric motors, plastics, and filtration technologies have led to compact, powerful devices. Recent trends include smart vacuums integrated with sensors and AI.

2.4 Existing Technologies

Some key components in modern vacuums include:

- High-efficiency particulate air (HEPA) filters
- Cyclonic separation
- Bagless dust collection
- Cordless battery-powered systems

This project adopts the basic principles of suction and filtration, simplifying the design to suit the available resources while maintaining efficiency.

CHAPTER THREE: METHODOLOGY

3.1 Materials Used

The materials were carefully selected to ensure affordability and ease of availability. They include:

- **Electric Motor** – A small, high-speed DC motor
- **Fan Blade** – Plastic or aluminum blades mounted on the motor shaft
- **Dustbin** – A small metal or plastic container
- **Filter Material** – Foam, cloth, or netting to trap dust particles
- **Plastic Casing** – Used to house the entire setup
- **Switches** – Two toggle switches for power control
- **Power Source** – Electrical cable or battery connection
- **Wires and Soldering Components** – For proper electrical connection
- **Screws, Bolts, and Nuts** – For mechanical assembly
- **Rubber Gaskets or Seals** – To ensure airtight connections

3.2 Tools Used

- Screwdriver
- Soldering Iron
- Hot Glue Gun
- Cutter/Utility Knife
- Pliers
- Multimeter
- Drill

3.3 Design Process

The design process started with brainstorming and sketching the internal layout. Once a basic prototype was imagined, materials were gathered and tested for size and compatibility. The key

design concern was ensuring effective airflow and a sealed chamber for suction. The motor had to be firmly mounted to minimize vibration.

3.4 Construction Procedure

1. The plastic container was cleaned and drilled to create holes for airflow.
2. The fan blade was attached to the motor shaft and balanced properly.
3. The motor was fixed to the lid of the container using screws and glue.
4. A dust filter was added near the intake path to prevent dust from entering the motor area.
5. Electrical wiring was completed with toggle switches for power control.
6. A test was conducted to check motor rotation and suction power.
7. The housing was sealed and the vacuum was reassembled.

3.5 Safety Considerations

- Wires were properly insulated to avoid electrical hazards.
- The motor was tested at intervals to prevent overheating.
- Components were tightly fastened to avoid internal detachment during operation.
- No sharp edges were left exposed to ensure safe handling.

Chapter Four – Results and Discussion

History of Handheld Vacuum Cleaners

Early Origins of Vacuum Technology

The concept of vacuum cleaning dates back to the mid-19th century. Before electricity was widely used, people relied on manual carpet sweepers and brushes to clean surfaces. The first mechanical cleaning device was invented by **Daniel Hess** of Iowa in 1860. It used bellows to generate suction and had rotating brushes. Though it was not powered electrically, it laid the foundation for vacuum cleaning devices.

In 1901, a British engineer named **Hubert Cecil Booth** invented a motorized vacuum cleaner. Booth's device was large, horse-drawn, and powered by an engine. It was not portable, but it introduced the principle of using a powered fan to suck dust through a filter—a concept still used in modern vacuum cleaners.

Introduction of Electric Vacuum Cleaners

By 1908, **James Murray Spangler**, a janitor from Ohio, invented the first portable electric

vacuum cleaner. His model used a rotating brush and suction motor housed in a simple casing. Spangler later sold the patent to **William Hoover**, who commercialized the product and founded the Hoover Company—now a globally recognized name in vacuum technology.

As electricity became more accessible, vacuum cleaners became a staple in homes and industries. However, the early models were bulky and required two hands or large storage space. They were effective for cleaning large floor areas but not suited for smaller tasks like cleaning furniture or car interiors.

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Birth of the Handheld Vacuum Cleaner

The **handheld vacuum cleaner** was developed to address the need for **portability, precision cleaning**, and ease of use in tight or small spaces. In **1979**, **Black & Decker**, an American tool manufacturer, introduced the first cordless handheld vacuum cleaner known as the **DustBuster**. It was compact, battery-operated, and easy to carry, making it an instant success in households.

The DustBuster was initially based on technology developed by Black & Decker for NASA's space missions. Its motor design was lightweight but powerful—perfect for short bursts of suction. The release of the DustBuster marked the beginning of the **consumer-focused handheld vacuum market**.

Throughout the 1980s and 1990s, improvements in battery life, motor efficiency, and ergonomics led to the development of various handheld vacuum models. Brands such as **Dyson, Shark, Bissell, and Hoover** entered the market, each offering innovative features such as cyclonic suction, bagless dustbins, HEPA filters, and wall-mounted charging stations.

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Modern Innovations and DIY Trends

In recent years, handheld vacuums have evolved to include smart features like **touch controls, lithium-ion batteries, HEPA filtration, USB charging, and smart sensors**. Some are integrated into **2-in-1 systems** that function as both upright and handheld vacuums. Despite these advancements, many people—especially students, engineers, and hobbyists—have begun making **DIY handheld vacuum cleaners** using recycled parts.

These handmade models, like the one developed in this project, often use motors from old electronics, plastic containers for casing, and simple wiring systems. The goal is to promote **innovation, learning, and sustainability**, particularly in communities with limited access to

expensive appliances.

4.1 Testing

The vacuum was tested on surfaces like tiled floors, car mats, and workbenches. It successfully picked up dust, paper bits, and small particles.

4.2 Performance Analysis

- **Suction Power:** Adequate for small-scale cleaning.
- **Noise Level:** Moderate, typical of compact motors.
- **Weight:** Light and easy to carry.
- **Durability:** Good; metal container adds strength.

4.3 Challenges Encountered

- Difficulty in finding a suitable motor.
- Overheating during continuous use.
- Balancing the fan blade.
- Ensuring air-tight sealing for effective suction.

4.4 Solutions Implemented

- Selected a used motor from a discarded fan.
- Installed air vents to help cooling.
- Carefully aligned and balanced the fan.
- Used rubber seals and tape to seal joints.

Chapter Five – Conclusion and Recommendations

5.1 Summary

This project aimed at creating a low-cost handheld vacuum cleaner from readily available materials. The project successfully met its objectives. The vacuum cleaner works well in small-scale cleaning tasks and demonstrates the value of practical innovation.

5.2 Conclusion

The successful construction of this vacuum cleaner shows that with creativity and basic engineering skills, effective appliances can be built locally. It further proves that computer science students can integrate hardware and software knowledge for real-world applications.

5.3 Recommendations

- Future versions could include rechargeable batteries.
- Digital control with Arduino or IoT features.
- Lighter casing using 3D-printed parts.
- Improved filtration with HEPA material.

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Appendix A: Photos of the Construction Process

Appendix B: Bill of Materials

Item	Quantity	Source
Electric motor	1	Salvaged fan
Metal container	1	Local market
Plastic cover	1	Repurposed appliance
Fan blade	1	Fabricated/Repurposed
Filter material	1	Foam/Fabric
Switches	2	Electronics store
Screws, nuts, bolts	As needed	Workshop
Power cable	1	Electronics store