

**REPUBLIQUE DU BENIN**

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**MINISTERE DE L’ENSEIGNEMENT SUPERIEUR ET DE LA RECHERCHE SCIENTIFIQUE**

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**DIRECTION GENERALE DE L’ENSEIGNEMENT SUPERIEUR**

**DIRECTION DES ETABLISSEMENTS PRIVES D’ENSEIGNEMENT SUPERIEUR**

**UNIVERSITÉ INTER-REGIONALE DU GÉNIE INDUSRTIEL, DES**

**BIOTECHNOLOGIES ET SCIENCES APPLIQUÉES**

**(IRGIB-AFRICA UNIVERSITY)**

**REGIONAL INSTITUTE OF INDISTRUAL ENGENEERING, BIOTECHNOLOGIES**

**AND APPLIED SCIENCES**

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**ETABLISSEMENT D’ENSEIGNEMENT SUPÉRIEUR DELOCALISÉ**

***SELON LE PROTOCOLE : N°31/05/RIT***

**SUMMARY OF WORK FOR OBTAINNING THE BACHELOR IN COMPUTER**

**SCIENCES**

**(**

**LICENCE PROFESSIONNELLE**

**)**

**THEME**

**VACUUM CLEANER**

**Filière : CIT Domaine : Science et Technologies**

**Réalisé par l’élève -ingénieure : IDRIS Oluwaferanmi**

**Année universitaire : 2024 - 2025**

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**Dedication**

I dedicate an infinite thank you to my family for their benevolent support and their Encouragement for this thesis, as in all circumstances. Plus 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

I

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II

**Summary**

This project involves the design and construction of a functional handheld vacuum cleaner made entirely from locally sourced and recycled materials. The device was created to demonstrate the application of basic electrical and mechanical principles using affordable components. The vacuum cleaner operates with a 12V DC motor connected to a custom fan blade that generates suction. A 450V, 2.2µF light capacitor is included to stabilize the motor and reduce electrical fluctuations. The air suction system is housed inside a plastic container, with a built-in filter to trap dust and a dustbin for collecting debris. The system is controlled by a toggle on/off switch, powered by either a battery pack or an AC adapter. The components are securely fixed using 1-inch screws, hot glue, and sealed to prevent air leakage. The vacuum is lightweight, portable, and capable of cleaning small surfaces such as desks, keyboards, car seats, and tiled floors. This innovative build not only meets basic cleaning needs but also reflects creativity, problem solving, and a practical understanding of electronics and engineering. The project emphasizes sustainability, cost-efficiency, and hands-on learning, making it ideal for students, hobbyists, or anyone interested in DIY electronic.

III

**Abstract**

Ce projet porte sur la conception et la construction d’un aspirateur à main utilisant des matériaux locaux facilement disponibles. Le but de ce projet est de fournir un appareil d’aspirateur abordable, efficace et portable qui peut être utilisé pour des tâches de nettoyage domestiques ou industrielles légères. Le projet intègre des principes mécaniques et électriques de base, en les combinant avec de la créativité et une ingénierie pratique pour produire un aspirateur fonctionnel. L’aspirateur se compose d’une cartouche à poussière métallique, d’un ventilateur motorisé logé dans un couvercle en plastique, d’un système de filtration de base et d’une interface de commande marche/arrêt conviviale. Il fonctionne en créant une force d’aspiration grâce à la rotation du ventilateur relié à un moteur à grande vitesse. L’air aspiré dans la chambre transporte la poussière et les débris, qui sont piégés par le filtre tandis que l’air propre est expulsé. Ce projet démontre comment l’innovation et les connaissances techniques peuvent être utilisées pour résoudre des problèmes quotidiens grâce à des solutions simples mais efficaces.

IV

**Outline**

Introduction……………………………………………………………………………………..1

Chapter1: Literature review………………………………...…………………….......................3

1.1 Introduction ……………….………………………….….……………………..……..…....4

1.2 Statement of the problem……………………………………………………………………5

1.3 Objective of the project……………………………………………………………………..6

1.4 Scope and limitation…………………………………………………………………………6

1.5 History……………………………………………………………………………………….7

Chapter 2: Research and Methodology …………..…………………………………..…………8

1.1 Electronic component………………………………………………………………………...9

1.2 Mechanical component……………………………………………………………………….9

Chapter 3: Assembly Procedure ………………………………………………………………..10

1.1 Material Used…….……………………………………………………………………….....11

1.2 Tool Used ……………………………………………………………………………………11

1.3 Construction Process…………………………………………………………………………11

1.4 Safety Consideration………………………………………………………………………….11

Chapter 4: Result and Discussion…………………………………………………………………12

1.1 Testing…………………………………………………………………………………………12

1.2 Performance Analysis…………………………………………………………………………..12

Chapter 5: Conclusion and recommendation…………….………………………………………….13

1.1 Conclusion……………………………………………………………………………………….14

1.2 Diagram………………………………………………………………………………………….15

**Chapter One – Literature Review**

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 dem ons tr ate integration. the app li cat io n ofc omp ute r sc ie ncea nd h ard war e • 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.

**Chapter 2: Research and Methodology**

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 ⸻ 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. ⸻ 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 • Cycl oni c se par • Bagl essd ati on ust col le cti on • Cord le ss b att ery-po wer ed s yst ems 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 • Scre wdr iv • Sold er eri ng I ron • Hot Gl ue G un • Cutter/Utility Knife • Pli ers • Multimeter • Dril l 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. 2. 3. 4. The plastic container was cleaned and drilled to create holes for airflow. The fan blade was attached to the motor shaft and balanced properly. The motor was fixed to the lid of the container using screws and glue. A dust filter was added near the intake path to prevent dust from entering the motor area. 5. 6. 7. Electrical wiring was completed with toggle switches for power control. A test was conducted to check motor rotation and suction power. The housing was sealed and the vacuum was reassembled. 3.5 Safety Considerations • Wires were properly insulated to avoid electrical hazards. • The mo tor wast est ed a t in ter val s top rev ent ove rhe ati ng. • Components were tightly fastened to avoid internal detachment during operation. • No sha rp e dge s we re l eft exp ose Chapter Four – Results and Discussion History of Handheld Vacuum Cleaners Early Origins of Vacuum Technology d toe nsu re s afe han dli ng. 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. ⸻ 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. ⸻ 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