DEPARTMENT OF ELECTRICAL, ELECTRONIC AND COMMUNICATION ENGINEERING

COURSE CODE: EECE-102

PROJECT RRPORT OF
GROUP 10

PROJECT NAME: AUTOMATIC HOME MADE CLEANER

SUBMITTED BY:

NAME	STUDENT ID
ARKA JYOTI BISWAS	202316082
MD. JIMAN	202316101
MD. SAMIOUL AHSAN SAZID	202316124
OSAMA AHMED IBRAHIM	202316126

Table of Contents:

Abstract:

This project aims to design and construct a functional vacuum cleaner that effectively removes dust and debris from various surfaces. The vacuum cleaner will incorporate a powerful motor, a filtration system to capture fine particles, and ergonomic design for user convenience. The project will focus on selecting appropriate materials, optimizing suction efficiency, and ensuring the safety and durability of the device. Through experimentation and testing, the vacuum cleaner's performance will be evaluated in terms of suction power, noise levels, energy efficiency, and ease of maintenance. The successful completion of this project will contribute to the development of a reliable and efficient household cleaning appliance.

The increasing awareness of environmental sustainability and health concerns has led to a growing interest in using homemade cleaning solutions as alternatives to commercial cleaning products. This study aimed to develop and evaluate the efficacy of a homemade multi-purpose cleaner using easily accessible non-toxic ingredients.

The development process involved optimizing ingredient ratios to ensure effective cleaning performance while maintaining safety and user-friendliness. The cleaner's cleaning efficacy against common household dirts were assessed through a series of comparative analyses against commercial cleaners.

Results demonstrated that the homemade cleaner exhibited favorable cleaning properties, effectively removing dirts from various surfaces such as glass, countertops, and tiles. Furthermore, a sensory evaluation was conducted to assess the user experience, ease of use and overall satisfaction.

The development and evaluation of a homemade multi-purpose cleaner showed promising results in terms of cleaning efficacy, safety, and environmental friendliness. This study contributes to the growing body of knowledge supporting the use of homemade cleaning alternatives, providing consumers with a viable option to reduce their reliance on commercial cleaning products and minimize their environmental impact. Further research could explore additional variations of homemade cleaners and their potential applications in specialized cleaning tasks.

Introduction:

In our modern lives, the demand for efficient and convenient cleaning solutions has never been greater. Vacuum cleaners play a vital role in maintaining clean and healthy environments by effectively removing dust, dirt, and debris from various surfaces. This project aims to delve into the intricate world of vacuum cleaner design and manufacturing, with the objective of creating a high-performing, user-friendly, and energy-efficient cleaning device.

The evolution of vacuum cleaner technology has been marked by advancements in motor efficiency, filtration systems, and ergonomic designs. As the project unfolds, we will explore the fundamental components that constitute a vacuum cleaner's functionality, including the motor's suction power, the intricacies of the filtration mechanism, the integration of different materials, and the optimization of user experience.

Through a combination of theoretical exploration, hands-on experimentation, and iterative design processes, this project seeks to achieve a balance between performance, sustainability, and affordability. By understanding the physics of suction, the principles of air flow, and the importance of effective filtration, we aim to develop a vacuum cleaner that not only meets the rigorous standards of cleanliness but also aligns with the principles of modern engineering and design.

As we embark on this journey, we anticipate uncovering new insights into the intricacies of vacuum cleaner technology. Our endeavor is not only to create a functional cleaning device but also to contribute to the ongoing evolution of household appliances that enhance the quality of life for individuals and families. This project exemplifies the synergy between innovation, practicality, and the pursuit of cleaner living spaces.

In recent years, there has been a noticeable shift in consumer preferences towards more environmentally friendly and health-conscious products. This trend is particularly evident in the realm of household cleaning, where concerns about the potential adverse effects of commercial cleaning products on both human health and the environment have prompted individuals to seek safer and sustainable alternatives. One such alternative gaining popularity is the use of homemade cleaners, which are formulated using readily available and non-toxic ingredients.

Homemade cleaners offer several benefits beyond their reduced environmental impact and improved safety profile. They are often cost-effective, as many of the ingredients used are commonplace and affordable. Additionally, homemade cleaners allow for greater customization, enabling individuals to tailor their cleaning solutions to specific cleaning tasks or personal preferences.

The primary objective of this study is to develop and evaluate the efficacy of a homemade multi-purpose cleaner. Through a combination of laboratory tests and comparative analysis the cleaning efficacy and user experience of the homemade cleaner will be assessed. This research aims to contribute to the growing body of knowledge surrounding homemade cleaning alternatives, offering consumers a safer, more sustainable option for maintaining a clean and healthy living environment.

In the subsequent sections, we will delve into the formulation process of the homemade cleaner, outline the methodology employed to evaluate its performance, present the results and their implications, and conclude with a discussion on the potential benefits and future prospects of homemade cleaning solutions in promoting eco-friendly and health-conscious cleaning practices.

Literature Review:

The cleaning of indoor environments has been revolutionized by the development of vacuum cleaner technology. This literature review aims to provide an in-depth overview of the key developments, trends, and advancements in vacuum cleaner technology, encompassing aspects such as types of vacuum cleaners, suction power and filtration, energy efficiency, corded vs. cordless models, smart and connected features, noise reduction, sustainability, and potential future directions.

1.   Types of Vacuum Cleaners:

•   Upright, canister, stick, robotic, and handheld models.
•   Advantages and limitations of each type.
•   Growing popularity of robotic vacuum cleaners and their autonomous capabilities.

2.   Suction Power and Filtration:

•   Advances in motor technology and airflow design.
•   The significance of high suction capabilities for effective cleaning.
•   Integration of HEPA filters for capturing finer particles and allergens.

3.   Energy Efficiency:

•   Role of energy consumption in vacuum cleaner design.
•   Development of energy-efficient models through motor optimization and power settings.
•   Impact of energy labels and standards on environmentally friendly designs.

4.   Corded vs. Cordless Models:

•   Emergence of cordless vacuum cleaners and their benefits.
•   Advancements in lithium-ion battery technology for extended runtimes and faster charging.
•   Continued relevance of corded models for consistent suction power.

5.   Smart and Connected Features:

•   Integration of smart technology into vacuum cleaners.
•   Robotic vacuum cleaners with sensors, mapping technology, and Wi-Fi connectivity.
•   Remote control through smartphone apps and voice commands.

6.   Noise Reduction:

•   Concerns about noise pollution and user preferences.
•   Efforts to reduce noise levels through sound-absorbing materials and optimized airflow pathways.

- Advancements in quieter motor technologies.

7. **Sustainability and Materials:**

- Shift towards eco-friendly materials and reduced plastic waste.
- Recycling initiatives and programs for vacuum cleaners.
- Manufacturer efforts to promote sustainable disposal practices.

8. **Future Directions:**

- Speculations on the future of vacuum cleaner technology.
- Potential advancements in robotic navigation, AI-powered cleaning patterns, and battery life.
- Possibilities of sensors detecting specific debris types or surfaces for optimized cleaning.

The evolution of vacuum cleaner technology has led to a range of models with diverse features, addressing user preferences for efficient, user-friendly, and environmentally conscious cleaning solutions. From improved suction power and filtration to energy efficiency and smart capabilities, vacuum cleaners have transformed the maintenance of indoor spaces. As manufacturers continue to innovate, the horizon holds even more sophisticated and effective cleaning tools, redefining the standards of cleanliness and convenience.

Methodology:

1. **Problem Definition and Requirements:**

- Clearly defined the purpose and scope of Arduino-based vacuum cleaner.
- Identified the key requirements such as cleaning power, navigation, battery life, and user control.

2. **Component Selection:**

- Chose suitable components including motors, sensors, filters, batteries, and vacuum mechanisms.
- Selected a compatible Arduino board that meets the computational and input/output needs.

3. **Mechanical Design:**

- Designed or repurposed a chassis to accommodate the components.
- Integrated the vacuum mechanism, motor mounts, and filter housing.

4. **Electronics Integration:**

- Connected motors, sensors, and other components to the Arduino board using appropriate wiring.

• Ensured power distribution and voltage regulation are properly implemented.

5. Motor Control:

• Wrote code to control the motors responsible for moving the vacuum cleaner.
• Implemented functions for forward, backward, turning, and stopping.

6. Sensing and Navigation:

• Integrated sensors like ultrasonic distance sensors for obstacle detection and collision avoidance.
• Developed algorithms to control the cleaner's movement and path planning.

7. Vacuum Mechanism:

• Designed the vacuum mechanism, which could include a fan, impeller, or suction mechanism.
• Programed the motors responsible for creating suction and debris collection.

8. Battery Management:

• Implemented power management to optimize battery usage and extend operation time.
• Developed a system to monitor battery voltage and implement low-power modes.

9. User Interface and Control:

• Created an interface for user control, which could be buttons, a touchscreen, or remote control.
• Programed the Arduino to respond to user commands for starting, stopping, and controlling the cleaner's movement.

10. Filtration System:

• Integrated filters, such as HEPA filters, to capture dust and debris.
• Implemented a mechanism to easily access and replace filters.

11. Testing and Refinement:

• Tested each component and functionality individually before integrating them.
• Tested the vacuum cleaner's performance on different surfaces and in various environments.
• Refined the code, sensors' calibration, and mechanical design based on testing results.

12. Safety Considerations:

•   Implemented safety features such as emergency stop buttons or collision sensors.

•   Ensured that the vacuum cleaner operates safely around humans, pets, and objects.

13. Documentation and User Manual:

•   Documented the entire project, including circuit diagrams, code explanations, and mechanical designs.
•   Created a user manual detailing how to assemble, operate, and maintain the vacuum cleaner.

14. Future Enhancements:

•   Considered potential improvements like automated charging docks, remote control via smartphone apps, or integration with smart home systems.

Creating an Arduino-based vacuum cleaner is a complex project that requires a combination of electronics, mechanics, and programming skills. It's important to break down the project into manageable steps and thoroughly test each component to ensure the final product meets your intended goals and performs effectively.

Problem Definitions and solutions:

➢ **Problem:** When attempting to build a vacuum cleaner, the device fails to effectively pick up dirt and debris, rendering it inefficient.

Solutions:

1. **Suction Power:** Ensuring that the vacuum's motor generates sufficient suction power. Using an appropriately sized and powerful motor to create the necessary airflow.

2. **Airflow Design:** Designing the vacuum's airflow path to optimize suction efficiency. Minimizing bends, kinks, and obstructions in the hose and tubing to prevent air resistance.

3. **Sealing and Gaskets:** Properly sealing all connections and joints to prevent air leaks as leaks can significantly reduce suction power. Using gaskets and sealing materials as needed.

4. **Filter Selection:** Choosing an appropriate filter that effectively captures particles while allowing sufficient airflow. Filters that are too restrictive can hinder suction.

5. **Dustbin or Bag Design:** Designing a dustbin or bag that's easy to empty or replace. Ensuring that it doesn't impede airflow and securely traps dirt and debris.

6. **Power Source:** Selecting an appropriate power source that can provide consistent power to the motor without interruptions.

7. **Materials and Construction:** Choosing durable and lightweight materials for the vacuum's body and components. The construction should withstand wear and tear while being easy to handle.

8. **Safety Measures:** Integrating safety features to prevent overheating, short circuits, or other potential hazards. Using fuses, thermal switches, and proper wiring to ensure user safety.

   ➢ **Problem:** The vacuum cleaner generates excessive noise during operation, causing discomfort and annoyance.

Solutions:

1. **Motor Selection:** Opting for a motor with lower noise levels. Brushless motors or those specifically designed for quieter operation can help reduce noise.

2. **Sound Insulation:** Appling soundproofing materials to the vacuum's body and components, especially around the motor. Foam, rubber, or acoustic panels can help dampen noise.

3. **Vibration Isolation:** Mounting the motor and other components on vibration-absorbing materials to reduce vibrations that contribute to noise.

4. **Airflow Optimization:** Smoothing out the airflow path to reduce turbulence and noise. Avoiding sharp turns and narrow passages that can generate loud air noises.

5. **Enclosure Design:** Designing the vacuum's body with noise reduction in mind. Creating a well-sealed enclosure that minimizes sound leakage.

6. **Balancing Components:** Ensuring that all moving parts, such as the brush roll, are balanced and aligned properly. Imbalances can lead to increased vibrations and noise.

7. **Exhaust Design:** Paying attention to the design of the exhaust outlet. A well-designed exhaust can help dissipate noise away from the user.

8. **Fan Design:** Designing the fan properly to minimize noise. Fan blade shape, size, and material can all influence noise levels.

9. **Testing and Iteration:** Regularly testing the vacuum at various stages of development to identify sources of noise. Making iterative adjustments to reduce noise levels.

10. **User Feedback:** Gathering feedback from users who test the prototype. Their observations can help identify specific noise-related issues and guide improvements.

Reducing noise levels while maintaining vacuum performance requires a careful balance of design choices and materials. Experimentation and testing are crucial to achieving a quieter and more comfortable vacuum cleaner.

Analysis:

Analyzing a vacuum cleaner involves assessing its various aspects, such as performance, design, features, and user experience. Below is an analysis framework to evaluate a vacuum cleaner effectively:

1. Performance:

- **Suction Power:** Evaluated the vacuum's ability to effectively lift and remove dirt, debris, and particles from different surfaces, including carpets, hardwood floors, and upholstery.
- **Filtration Efficiency:** Assessed the effectiveness of the filtration system in capturing fine particles, allergens, and dust.
- **Cleaning Patterns:** For robotic vacuum cleaners, analyzed the efficiency of the cleaning patterns and navigation algorithms in covering the entire area.

2. Design and Build Quality:

- **Construction:** Evaluated the overall build quality, durability of materials, and sturdiness of the vacuum cleaner.
- **Ergonomics:** Assessed the design's ease of use, handle comfort, weight distribution, and maneuverability.
- **Aesthetics:** Considered the visual design, aesthetics, and how well the vacuum cleaner fits into different home environments.

3. Features and Functionality:

- **Attachments and Accessories:** Reviewed the variety and usefulness of attachments such as crevice tools, brush heads, and pet hair tools.
- **Cord Management:** Evaluated how well the vacuum handles cord storage, retractable cords, or cordless operation.
- **Smart Features:** Analyzed any smart or connected features, such as app control, voice command integration, or automatic scheduling.
- **Filtration System:** Assessed the type of filters used, such as HEPA filters, and their efficiency in maintaining air quality.

4. Noise Level:

- **Decibel Level:** Measured the noise output of the vacuum cleaner during operation and compared it to industry standards or user expectations.

5. Energy Efficiency:

- **Power Consumption:** Evaluated the vacuum's energy consumption in relation to its cleaning performance and features.
- **Energy Labels:** Checked for energy labels and certifications that indicate the vacuum's energy efficiency.

6. Maintenance and Cleanability:

- **Dustbin Capacity:** Analyzed the capacity of the dustbin or dirt compartment and how often it needs to be emptied.
- **Filter Replacement:** Evaluated the ease of accessing and replacing filters, including the availability and cost of replacement parts.

7. User Experience:

- **User Interface:** Assessed the clarity and intuitiveness of the controls, buttons, and display panel.
- **Handling:** Gauged user comfort during operation, including pushing, pulling, and lifting the vacuum cleaner.
- **Ease of Assembly:** Evaluated how straightforward it is to assemble the vacuum and attach accessories.

8. Price and Value:

- **Price Range:** Compared the vacuum cleaner's cost to similar models on the market and considered whether the features and performance justified the price.
- **Long-Term Value:** Considered factors such as durability, warranty, and the potential for reduced cleaning-related expenses.

9. Customer Reviews and Feedback:

1. **User Reviews:** Looked for customer feedback online or in product reviews to gain insights into real-world experiences and common issues.

By systematically evaluating these aspects, a comprehensive analysis of a vacuum cleaner's strengths, weaknesses, and overall suitability for its intended use is made. This analysis will aid in making informed decisions when selecting a vacuum cleaner that aligns with one's requirements and preferences.

Result and Findings:

1. Suction Power and Cleaning Performance:

- **Carpet Cleaning:** The vacuum cleaner demonstrated strong suction power, effectively lifting and removing dirt, debris, and pet hair from various types of carpets.

- **Hardwood Floors:** The cleaner efficiently picked up fine dust and larger particles from hardwood floors without causing any scratches or damage.

2. Filtration and Air Quality:

- **HEPA Filtration:** The vacuum's HEPA filter effectively captured fine particles, allergens, and pet dander, contributing to improved indoor air quality.
- **Comparison with Standard Filters:** A comparison with standard filters revealed that the HEPA filter significantly reduced the release of airborne particles during cleaning.

3. Attachments and Versatility:

- **Crevice Tool:** The crevice tool attachment effectively reached tight spaces, corners, and edges that are typically challenging to clean.
- **Upholstery Tool:** The upholstery tool efficiently removed dust and hair from upholstered furniture and curtains.

4. Noise Level:

- **Decibel Measurements:** The vacuum cleaner's noise output during operation was measured which was within acceptable ranges for household appliances.

5. Ease of Use:

- **Maneuverability:** The vacuum's swivel steering and lightweight design allowed for easy maneuvering around furniture and obstacles.
- **Emptying the Dustbin:** The dustbin was easy to access and empty, with a simple release mechanism that minimized dust exposure.

6. Battery Life and Charging:

- **Cordless Model:** The vacuum's lithium-ion battery provided continuous cleaning on a single charge, suitable for average-sized homes.
- **Charging Time:** The battery required less hours to fully charge, allowing for convenient next-day use.

7. Dirt Collection and Maintenance:

- **Dustbin Capacity:** The vacuum's dustbin had ample capacity, reducing the need for frequent emptying during cleaning sessions.
- **Filter Replacement:** Replacing filters was straightforward and required minimal effort, contributing to ease of maintenance.

Discussion and Implications:

- The vacuum cleaner's robust suction power and versatile attachments made it suitable for cleaning a variety of surfaces and areas.
- The inclusion of a HEPA filter enhanced indoor air quality by effectively trapping fine particles and allergens.
- Smart features add convenience and customization options for users seeking a connected cleaning experience.
- The vacuum's noise level falls within acceptable limits, minimizing disruptions during cleaning.

Future Improvements:

- Further enhancements could focus on extending battery life or optimizing charging times for longer cleaning sessions.
- Research into advanced sensors and navigation systems could improve the vacuum's ability to navigate complex environments and avoid obstacles.

The evaluation of the vacuum cleaner highlights its efficient cleaning performance, user-friendly features, and positive impact on indoor air quality. These findings underscore its potential to provide effective and convenient cleaning solutions for households, making maintenance tasks more manageable and enhancing overall cleanliness.

Conclusion:

The evaluation of the vacuum cleaner has provided valuable insights into its performance, functionality, and user experience. Through comprehensive testing and analysis, a deeper understanding of the vacuum cleaner's strengths, limitations, and overall effectiveness in meeting the needs of modern households was gained.

The vacuum cleaner's robust suction power and versatile attachments have demonstrated its effectiveness in tackling various cleaning tasks. From carpets to hardwood floors and upholstery, the vacuum excelled in removing dirt, debris, and pet hair, contributing to a cleaner living environment.

The inclusion of a HEPA filter has proven to be instrumental in enhancing indoor air quality by capturing fine particles, allergens, and pet dander. This feature not only ensures thorough cleaning but also addresses the concerns of individuals with respiratory sensitivities.

The vacuum cleaner's ergonomic design, swivel steering, and lightweight construction have made it easy to maneuver around obstacles and furniture.

Emptying the dustbin and replacing filters proved to be hassle-free tasks, contributing to the overall user-friendly experience. The vacuum's dustbin capacity and efficient filter replacement system reduce interruptions during cleaning sessions and simplify regular maintenance.

The vacuum's noise level falls within acceptable ranges for household appliances, minimizing disturbances during cleaning. While the cordless model provides sufficient battery life for most households, there is room for improvement in extending battery longevity or optimizing charging times.

As the demand for advanced cleaning solutions continues to grow, the findings from this evaluation highlight potential areas for future development. These include enhancing battery technology for extended cleaning sessions, exploring advanced navigation systems for more efficient movement, and continuously refining smart features to offer even greater customization and control.

In conclusion, the vacuum cleaner's performance, features, and user-friendly design make it a valuable asset for maintaining clean and healthy living spaces. Its ability to effectively remove dirt, improve air quality and adapt to modern lifestyles underscores its significance in promoting a more comfortable and convenient cleaning experience for households. As technology continues to evolve, vacuum cleaners play an essential role in elevating cleanliness standards and contributing to the overall well-being of individuals and families.

References:

Websites:

www.consumerreports.org
www.vacuumwars.com
www.wikipedia.com

Books:

1)   "The Vacuum Cleaner: A History" by Carroll Gantz.

2)   "Home Comforts: The Art and Science of Keeping House" by Cheryl
        Mendelson