CHAPTER 1

INTRODUCTION

In traditional educational settings, blackboards remain indispensable tools for facilitating learning, fostering interaction, and conveying information. However, the routine maintenance of blackboards has long been associated with challenges, particularly the pervasive issue of chalk dust accumulation. The conventional methods of erasing, often involving handheld brushes and manual effort, prove time-consuming and can lead to the dispersal of airborne particles, impacting both the cleanliness of the learning environment and the health of occupants.

In response to these challenges, our innovative solution, the "Vacuum Duster for Blackboard," emerges as a transformative approach to blackboard maintenance. This device amalgamates user-friendly design, offering educators and maintenance staff an efficient and convenient tool to address the persistent issues associated with chalk dust and time-consuming cleaning procedures.

The Vacuum Duster for Blackboard embodies a user-centric design, featuring a compact yet powerful vacuum system and soft brushes specifically tailored for blackboard surfaces. The integration of an adjustable handle ensures adaptability to various user heights, enhancing accessibility and ease of use. The device's lightweight and portable nature allow seamless transportation between classrooms, contributing to an ergonomic and practical cleaning solution.

By significantly reducing cleaning time and minimizing chalk dust dispersion, the device not only contributes to the longevity of blackboard surfaces but also enhances the overall teaching and learning experience. Its significance lies in providing educators with a modern, technologically integrated tool that aligns with contemporary standards in educational environments.

The use of chalk pieces in educational settings can present several challenges and problems. Here are some common issues associated with traditional chalk pieces:

Dust Generation: Chalk pieces create dust when used on chalkboards. The airborne chalk dust can lead to respiratory issues, especially for individuals with allergies or asthma.

Health Concerns: Inhaling chalk dust over an extended period can cause respiratory irritation and contribute to respiratory conditions. Some individuals may be more sensitive to the dust particles.

Allergies and Sensitivities: Chalk contains substances like calcium carbonate, which can cause skin irritation or allergic reactions in some individuals, particularly those with sensitivities.

Eye Irritation: Chalk dust in the air can irritate the eyes, causing discomfort and potential eye-related issues. Continuous exposure may lead to dryness, redness, or irritation.

Cleaning Challenges: Chalk dust settles on surfaces, including floors, desks, and other classroom items, requiring frequent cleaning. The cleaning process itself can further disperse dust into the air. Students and teachers may find chalk dust irritating and uncomfortable, leading to distractions and a less conducive learning environment.

Our project can solve all the above mentioned problems. We are designed our project in such a way useful to teachers and students in the educational fields.

CHAPTER 2

LITERATURE REVIEW

1)Sunil R. Kewate et al (2018) disussed the main findings of the paper are the introduction of a design for automated cleaning of blackboards and the survey findings related to the frequency of cleaning school blackboards and the adverse effects of chalk dust on teachers' health .Future research may focus on integrating advanced computer processing techniques, particularly in the areas of information processing and motion control, to further enhance the automation and precision of the intelligent wipe chalk system.

2) Dr.S.Poorna Chandra et al(2018) discussed the intervention in this study is the implementation of an automatic blackboard duster system, which includes components such as a duster mounted on longitudinal movement towards the blackboard, a 12V DC motor, a drive assembly for producing erasing operation, a scrubber to collect dust, a battery of 12V DC supply, a limit switch at both ends of the blackboard, and an Atmel Microcontroller programmed to perform to and fro motion of the duster attached to the chain driven. The intervention aims to automate the process of erasing the blackboard and collecting the dust produced during erasing. It involves mechanical aspects of the mechanical erasing system interfaced with microcontrollers to enhance automation rather than manual operation. The intervention also includes the use of a DC motor to rotate the spur gear wound with the erasing material, and a scrubber placed at the bottom of the erasing material to collect the dust settled at the bottom. The intervention is designed to provide a better solution for board cleaning operation and aims to keep the classroom environment healthy. It is also intended to reduce the untidy environment in the classroom and enable chalk recycling operation.

Effectiveness of the automated blackboard duster in cleaning the board automatically, collecting chalk dust to reduce untidy environment, and potential for recycling collected chalk dust

3) Jinzan Liu et al (2013) discussed the intervention is the intelligent wipe chalk system which includes automated detection of chalk stains, erasing the font, and keeping the blackboard clean using a mechanism driven by three motors A, B, and C, and controlled by a software platform with easy-to-use, modular, standardize and repeatable development features. The mechanism consists of three guide rails a, b, c, three sliders 1, 2, 3 and a slider-crank mechanism. The process involves the movement of beams and sliders driven by motors A, B, and C to achieve automated cleaning of the blackboard. The control system software is designed using LabView for maintenance and improvement. Additionally, image acquisition and processing are mentioned as important steps in the visual collection, indicating the use of visual data for the intervention.

4) Rubhini B, Mrunalini T et al (2014),discussed the development of a real-time automated blackboard eraser to address health problems caused by chalk dust and to modernize classrooms. The project provides a simple and automatic solution for erasing blackboards.

The intervention involves the use of DC motors for movement, specifically a DC Gear Motor to rotate the roller with erasing material, and a vacuum cleaner to absorb the chalk dust inside the erasing apparatus. The intervention also includes the automatic erasing of the board and collecting the dust from the erasing material due to the rotation of the roller. The specific frequency, duration, or amount of the intervention is not mentioned in the paper.

CHAPTER 3

MATERIALS USED

- Cardboard frame
- Battery
- Vacuum motor
- Storage Compartment
- Sponge
- Filters
- Switch

3.1. BATTERY:

A battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode the terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved to include devices composed of a single cell. The charging voltage for a 12-volt battery typically ranges from 13.8 to 14.4 volts, depending on the battery type. It's essential to use the correct charging voltage to ensure optimal performance and longevity. The battery can either charged using manual charging or using solar charging.

Fig 3.1 – 12v battery.

3.2. VACUUM MOTOR:

DC vacuum motors are electric motors specifically designed to power vacuum cleaners and other similar devices that rely on suction. Unlike traditional AC (alternating current) motors, DC (direct current) motors operate using electrical current that flows consistently in one direction.

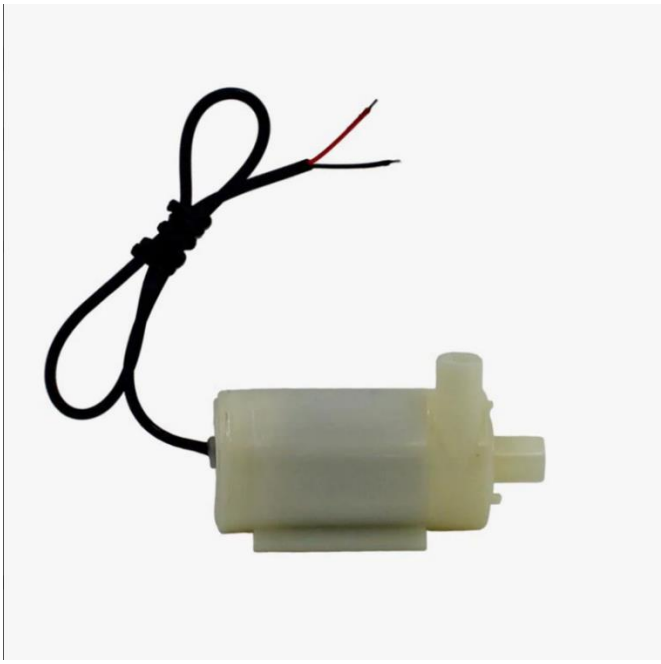

Fig. 3.2 Dc vacuum motor

A DC (direct current) vacuum motor is a type of electric motor used in vacuum cleaners that operates on DC power. DC motors are known for their efficiency, compact size, and ease of control. In the context of vacuum cleaners, DC motors are often used in cordless or battery-powered models.

Here are some key features of DC vacuum motors:

Battery-Powered Vacuums: DC motors are commonly used in cordless vacuum cleaners because they can be easily powered by rechargeable batteries. This allows for greater flexibility and mobility without the constraints of a power cord.

Variable Speed Control: DC motors are known for their ability to be easily controlled, enabling variable speed settings. This feature is advantageous in vacuum cleaners, allowing users to adjust suction power based on the cleaning task or to conserve battery power.

Efficiency: DC motors are generally more energy-efficient than some other types of motors, contributing to longer battery life in cordless vacuum cleaners.

Brushless DC Motors: Some high-end vacuum cleaners use brushless DC motors. These motors offer improved efficiency, durability, and reduced maintenance compared to traditional brushed DC motors.

It's important to note that the specific design and features of a DC vacuum motor can vary among different vacuum cleaner models and brands. The choice of motor depends on factors such as the intended use, power requirements, and desired features of the vacuum cleaner.

3.3. SPONGE

Absorbency: Sponges are known for their absorbent properties. They can soak up liquids, making them suitable for cleaning tasks that involve spills or wet surfaces.

Softness: Sponges are often soft and flexible, making them suitable for cleaning delicate or sensitive surfaces without causing damage.

Porosity: The porous nature of sponges allows them to trap and hold liquids and particles effectively. This can be advantageous in tasks where both wet and dry cleaning are required.

Durability: The durability of a sponge can vary based on its composition. Some sponges are designed for single-use, while others are more robust and can withstand multiple uses.

Cleaning and Scrubbing: Sponges may have scrubbing surfaces or textures that aid in removing dirt or stains from surfaces. This feature is beneficial in tasks where mechanical agitation is necessary

Size and Shape: Sponges come in various sizes and shapes to suit different cleaning needs. Some may be designed as attachments for vacuum cleaners to address specific cleaning challenges

CHAPTER 4

DESIGN

The dimensions of the vacuum duster are listed follows;

- Length 20 cm
- Breadth 8 cm
- Height 10 cm

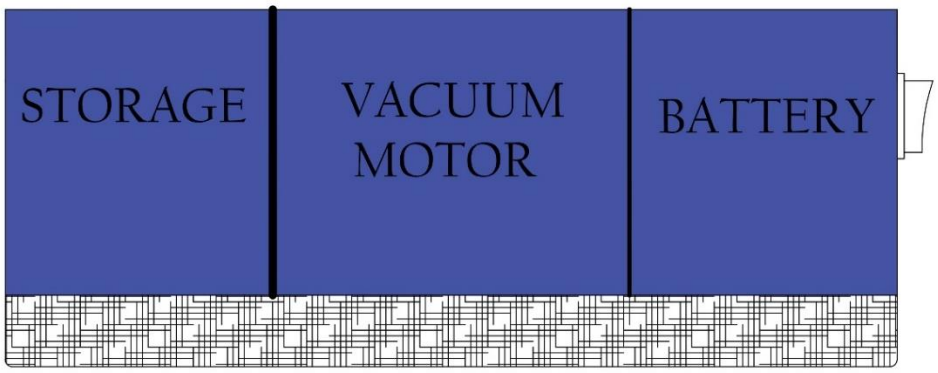

Fig. 4.1 Outline of vacuum duster

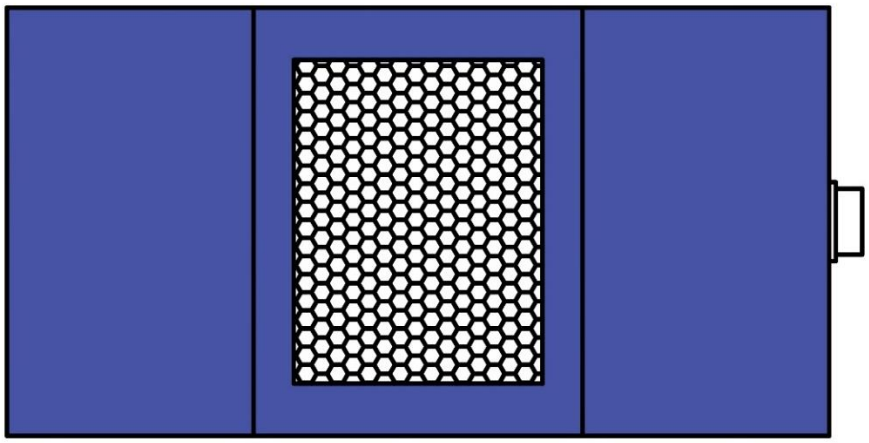

Fig. 4.2 Top view

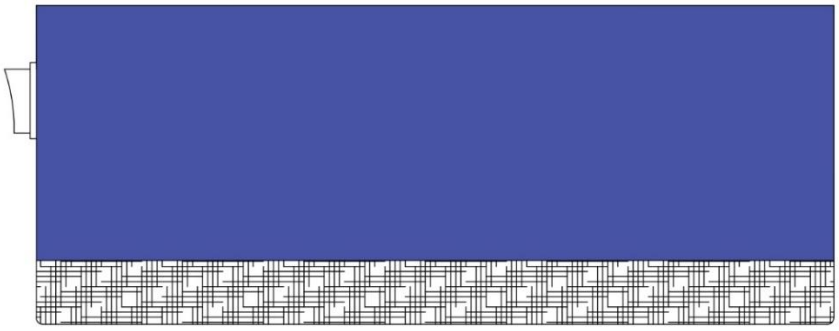

Fig. 4.3 Front view

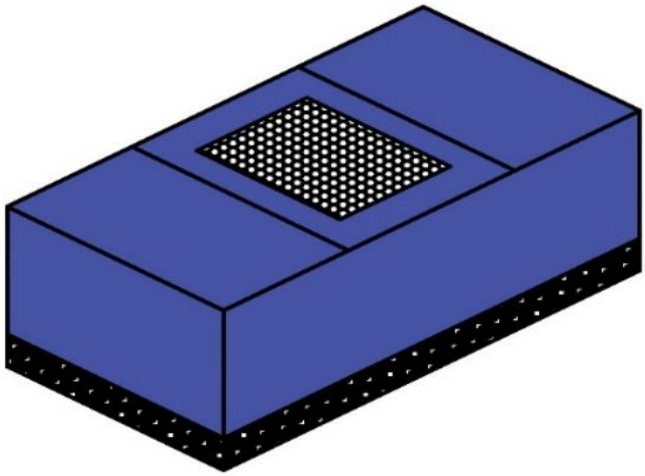

Fig. 4.4 Isometric view

The outer frame was designed using a cardboard sheet. This cardboard was used because of its well mechanical properties like hardness, light weight, low cost, ecofriendly etc,. The overall Duster was divided into three compartments. First compartment was used for Battery, The next compartment was used for the vacuum and the final compartment was allotted for the storage of chalk dust which is the fine particles.

CHAPTER 5

WORKING PRINCIPLE

Vacuum duster work because of Bernoulli's Principle, which states that as the speed of air increases, the pressure decreases. Air will always flow from a high-pressure area to a low-pressure area, to try to balance out the pressure. A vacuum duster has an intake port where air enters and an exhaust port where air exits. A fan inside the vacuum forces air toward the exhaust port at a high speed, which lowers the pressure of the air inside, according to Bernoulli's Principle. This creates suction – the higher pressure air from outside the vacuum rushes in through the intake port to replace the lower-pressure air. The incoming air carries with it dirt and dust from our sponge. This dirt is trapped in the filter bag, but the air passes right through the bag and out the exhaust. When the bag is full of dirt, the air slows down, increasing in pressure. This lowers the suction power of our vacuum, which is why it won't work as well when the bag is full.

5.1. USES:

- It is used in educational institute for its efficient dust removal.
- It is used by teachers of training centers, as it is time-saving cleaning tool.
- It is used in the where the blackboard is available.

5.2. ADVANTAGES:

- Efficient Dust Removal
- Time-Saving
- User-Friendly Design
- Quiet Operation
- Eco-Friendly Options

CHAPTER 6

CONCLUSION

Compared with manually wipe, smart wipe has a good effect and runs smooth with good reaction speed. The rate of rotation of the motor can be set in accordance with the requirements of the wiping speed to suit the requirements of different occasions. The smart eraser has a simple structure, easy to operate, easy to obtain raw materials, manufacturing equipment simple process. Its Control functions, and less susceptible to interference, high reliability, ease of use, can make products with high performance and low cost. The product is suitable for large, medium and small institutions, the promotion of certain significance

CHAPTER 7

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COST ESTIMATION

Components	**Cost(Rs)**	**Total(Rs)**
Vacuum motor	900	900
Cardboard Frame	410	410
Battery(12v)	800	800
Sponge	200	200
Other expenses	800	800
	Total(Rs)	3110