AUTOMATED CHALKBOARD ERASER CLEANER

A Research

Presented to the Faculty

of Senior High School of

University of Cebu Lapu-Lapu and Mandaue

Mandaue City

In Partial Fulfillment of the Requirements in

3I – Work Immersion

By

ST12A5

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This research entitled **AUTOMATED CHALKBOARD ERASER CLEANER** prepared and submitted by Glyzel M. Galagar, Akishae B. Labastida, Precious Anne S. Larayos, Nica Jane A. Taneo, and Siem Randee Mañago in partial fulfillment of the requirements for the 3I – Work Immersion has been examined and recommended for acceptance and approval for Oral Examination

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ACKNOWLEDGEMENTS

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To **Mr. Rodrigo Canete**, for the assistance and for teaching the researchers the basic coding that helped them with the functionality of the product.

To **Cebu DIY**, for the guidance and providing the researchers the right materials needed for the product.

DEDICATION

This research is dedicated to all individuals, especially the teachers and learners who experienced the inconvenience of cleaning an eraser. This innovation was produced in the hope to provide an easier method of cleaning a chalkboard eraser. The researchers decided to create a product that targets a specific goal, which is to eliminate the chalk dust particles that suspends in the air and provide convenience to all individuals especially the teachers and students.

ABSTRACT

Title : Automated Chalkboard Eraser Cleaner

Researchers : Glyzel M. Galagar, Akishae B. Labastida, Precious Anne S. Larayos, Nica Jane A. Taneo, and Siem Randee Mañago

Strand : STEM

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Date Completed : May 2023

The conventional technique of cleaning a chalkboard eraser involves tapping it against a surface, which is a time-consuming and inconvenient process, particularly for teachers and students. In light of this issue, the purpose of this study is to design a technology-based product that streamlines the eraser cleaning process. This product incorporates a sealable container and, as a preferred embodiment, a 3D-printed screen that employs motor-powered vibrations to eliminate chalk dust particles from the eraser. Additionally, the product is equipped with a vacuum and a power supply. The primary objective of this study is to assess the efficiency and accessibility of utilizing sophisticated technology to clean chalkboard erasers contaminated with chalk dust particles. The efficacy of the product was examined by testing it on slightly used and overused erasers. The results indicated that the product

could clean the erasers more efficiently and effectively, regardless of the eraser type and when compared to the usual common method.

Keywords: **Eraser, Chalk dust, Cleaner, Automated, Vacuum, Chalk board**

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CHAPTER 1

THE PROBLEM AND ITS SCOPE

INTRODUCTION

Rationale of the Study

Instead of using the traditional board and chalk, teachers used an online board that is a most convenient necessity for them to use online to teach students for almost three years of online classes. With an eraser that is only one click away, the words written on that board will directly vanish however, as Face to face classes gradually resume, the students and teachers are back to the traditional way of using the school necessities, from online blackboard to physical blackboard and from online eraser to physical eraser.

Erasers have been a regular feature in teachers' and students' academic lives. Like they usually say, teachers and chalks go together however, certain problems come with cleaning an eraser, such as the irritating dust particle that remains suspended in the air as we tap the eraser continuously on the wall. According to (Haohua& Zhou, 2020), “chalk dust as a particulate substance, chalk dust will remain suspended in the air intermittently before settling on the floor and body parts of teachers and students." These chalk dust particles

can sometimes stick to the student's uniforms which can sometimes be irritating to clean, and cleaning an eraser itself certainly takes time and effort.

Traditionally, erasers were manually cleaned by tapping them on a wall, which was inconvenient. A new product has been developed that makes eraser cleaning easy by allowing users to place the eraser on the machine and letting it do the work. The product saves time, reduces the workload, and eliminates irritating chalk dust particles by using a vacuum to collect the dust on a filter. The researchers are determined to innovate an automated eraser cleaner using science, technology, and engine engineering to reduce the workload of cleaning chalkboard erasers.

Theoretical Background of the Study

This study is anchored by four theories; Unregulated Power Supply Theory by Wavelength Electronics, Inc (2021), Theory of Vibration by Ahmed A. Shabana (2019), Mechanical Theory by Yenchen Machinery Co. (2013), and

Unregulated Power Supply Theory by Wavelength Electronics, Inc (2021). Unregulated power supplies are often configured to deliver a specified voltage at a specific maximum output load current since they lack built-in voltage regulators. These are typically the AC to tiny trickles of DC block wall chargers that are frequently used for home electronics and other power gadgets**.** Unregulated power supplies have the benefits of being resilient and potentially affordable.

The theory implies that the power supply converts the power and delivers it. It supplies power to all of the components of the product and it has the most important role in helping to function every part. The Power Supply is also one of the main components in product making. Without this, the other components will not be able to function.

Theory of Vibration by Ahmed A. Shabana (2019). In vibration theory, which is concerned with the oscillatory motion of physical systems, the motion might be harmonic, periodic, or general, with the amplitude varying with time. The importance of vibration to our comfort and requirements is so extensive that it would be futile to try to enumerate all of the examples that come to mind. As a result, vibrations are encountered in a wide range of applications, including mechanics and machines, musical instruments, buildings, bridges, automobiles, and aircraft. Vibration is classified as either free or forced. There are no external forces acting on the system in free vibration, whereas forced vibrations are caused by external excitations.

Therefore, this theory implies that the vibration is capable of producing oscillatory motions. The theory is aligned with the process of the product. In the product, a motor is used for vibration. One effective method of controlling vibration is through the use of a motor. By adjusting the motor's speed and frequency, the level of vibration can be finely tuned to the desired level. The vibration that is being produced will help the chalk dust be removed.

Mechanical Theory by Yenchen Machinery Co. (2013). The vacuum pump draws in the granules directly, and then the micro powder is collected

by a dust collector after passing through the mixer in a conveying tube. When using a vacuum suction device, dust contamination is not only removed, but labor costs are reduced, energy is conserved, and there is no contamination in the work area.

Therefore, The Mechanical Theory has to do with how the product operates. Chalkdust being drawn out by the motor's vibration will be eliminated by the vacuum pump. The vacuum pump is another essential component for the product's operation.

Review of Related Literature

The published study entitled "Real-Time Automated Blackboard Eraser Using Embedded System" was conducted by Rubhini & Mrunalini (2014). Blackboard erasing is a widespread activity that involves a hand-held instrument called a blackboard eraser which is typically known as a duster, wiping the blackboard with a moist cloth is a method that has been used for a very long time but is only employed when the chalkboard does not need to be used right away. When exposed to higher concentrations, the chemical components in limestone and other components used to make chalk are toxic to human health. They have demonstrated that teachers who work in situations with a lot of chalk dust run a severe risk of having pulmonary function complications (Bakade et. al, 2019). This dust causes the classroom to become disorganized. Dust may still accumulate even when dust-free chalk pieces are made since they still produce a little quantity of chalk dust compared to regular chalk pieces. Consequently, the automatic blackboard eraser can be used to prevent the aforementioned issues and minimize manual labor.

Furthermore, the published study entitled "Design and Fabrication of Vacuum operated Chalk Dust collector" by Prabhakar & Vignesh (2018),

created a vacuum-based duster cleaning apparatus. To clean the blackboard duster with the aid of the motor, they created a vacuum method. The vacuum pump will run on a motor. For stopping the motor and subsequently, the vacuum pump in this setup, a straightforward on/off switch will also have a modest role. Jones (2002), created a chalk dust remover with a box-shaped container that also serves as a chalkboard eraser container. This assembly has a cover and is wall-mounted. This assembly removes chalk dust and cleans the chalkboard eraser. The box's design makes it possible to open it from the top while keeping the remaining bottom, rear, and front closed.

In addition, a published study entitled “Ecofriendly Duster Cleaning Machine " written by Mungle, et al. (2017). The researchers made a machine that will automatically clean chalkboard erasers to lessen human work and prevent any health hazards caused by airborne chalk dust particles that might enter the lungs and can cause respiratory complications and other health issues. There is only one motor used in this product and that is for rotation motion. The rotary motion was moved to the disk which is attached to a large connecting link and that larger link has a duster holder. The vacuum pump and connecting link are driven by a motor, which also creates the suction needed to draw dust particles to the bottom surface of the duster eraser. Dust particles are released from the duster eraser as a result of vibration caused by

the duster's pounding on the metal net sheet. The vacuum pump then draws in the created dust particles through tiny apertures and collects them in a detachable collecting block. According to this study, the machine was able to clean the duster more effectively and efficiently.

The current invention relates to an eraser cleaner system for a chalkboard, such as a blackboard, that includes a closable container and, in a preferred embodiment, an electrically powered beater for cleaning or removing chalk dust from the eraser. It is recommended that teachers use black-and-green and chalkboards during class. Hand-operated erasers have been available for many years to remove the information that has been written in chalk from the boards. Naturally, as a result, the erasers eventually become saturated with chalk dust, necessitating cleaning before use. It used to be standard procedure for the pupils to clean the erasers by slamming them against one another or a wall in order to launch the chalk dust into the air and therefore remove it from the erasers. Clearly, this has been an extremely disorganized, time-consuming, and inadequate strategy (U.S. Pat. No. 3,395,41 to Dalton et. al).

The Problem

Statement of the Objective

The main objective of this study is to assess the effectiveness and accessibility of using advanced technology in cleaning a chalkboard eraser. This study aims to create a compelling and accessible technology-based product to lessen the work of people. Basically, it aims to

- To visually evaluate the product's effectiveness in removing chalk dust particles from the following types of erasers:
    a. Slightly-used Eraser
    b. Overused Eraser
- To know the product’s accessibility.
- To determine the exact time duration in removing the chalk dust in the eraser.
- To identify the exact intensity of the DC motor in order to effectively clean the eraser.

Statement of Hypothesis

Hypothesis A: The automated chalkboard eraser cleaner will remove the chalkdust.

Hypothesis B: The chalkdust will be sucked out by the chalkboard cleaner.

Null Hypothesis: The automated chalkboard eraser cleaner is not effective in removing the chalk dust in the eraser.

Significance of the Study

This study will prove its significance and relevance to the following:

STUDENT- The information presented will be very beneficial to all students. It will enable them to understand advanced technology's use and importance in everyday life.

RESEARCHER- The researchers especially in the STEM strand will be able to build an inexpensive innovation using advanced materials and this will also apply their knowledge in Science, Technology, and Engineering.

FUTURE RESEARCHERS- The ideas in this study may be used as a reference in conducting other studies.

SCHOOL- The school will be able to use advanced technology in cleaning erasers without having a hard time and make their lives easier.

RESEARCH METHODOLOGY

This chapter will contain the research design, research environment, product design, and experiment research. On behalf of the previous literature and studies that are used as a review.

Research Design

This study is conducted in order to invent an automated chalkboard eraser cleaner made from advanced materials. Thus, in order to achieve the success of this study, the researchers will utilize the experimental type of study which according to Sacred Heart University Library (2020) is a detailed plan of action that helps the researcher to maintain control over all variables that can impact an experiment's outcome. In doing so, the researcher makes an effort to ascertain or foretell what might happen. When there is a time priority in a causal link (cause before effect), consistency in a causal relationship (a cause always leads to the same effect), and a significant correlation, experimental research is frequently used. This design is fitted to this present study since it adheres to the procedures provided in order to verify and prove the hypothesis.

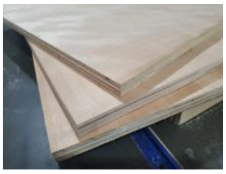
Research Environment

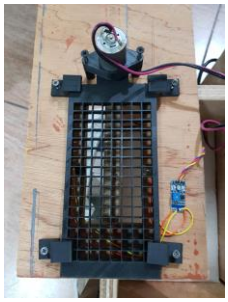
This study will be conducted inside the classroom at the University of Cebu Lapu-Lapu and Mandaue (UCLM) located at A. C. Cortes Ave, Mandaue City, Cebu. The school is a perfect choice as a research environment as it can provide the occurrences needed in testing the product's efficacy and accessibility. With this, the researcher can instantly accumulate results and hypotheses that can be forwarded upon the anticipated time.

Materials and Equipment

The equipment and materials that are needed to make an Automated Chalkboard Eraser Cleaner are listed in tables 1.1 and 1.2

1.1

Materials	Image	Quantity	Unit Price	Total
Local Marine Plywood 30 cm x 60 cm ¾”		2 pcs.	Recycled	
DC 12V 60RPM		1 pc.	Php. 150.00	Php. 150.00
5mm LED		2 pcs.	Php. 5.00	Php. 10.00
Arduino Uno R3 Board Atmega328P		1 pc.	Php. 700.00	Php. 700.00

Centralized Power Supply 12V		1pc.	Php. 370.00	Php. 370.00
3D Printed Part		1 pc	Php. 480.00	Php. 480.00
Katcha Fabric		1 meter	Php. 80.00	Php. 80.00
0.75 mm Copper Wire		10 meters	Php. 15.00	Php. 150.00
Wood Screw Flat Head 1/2		100 pcs	Php. 120.00	Php. 120.00

One Channel Relay		1 pc	Php. 149.00	Php. 149.00
IR Proximity Sensor		1 pc	Php. 129.00	Php. 129.00
Buck Converter		1 pc	Php. 150.00	Php. 150.00
Bearing		1 pc	Php. 85.00	Php. 85.00
AC Electric Pump		1 pc	Php. 200.00	Php. 200.00
L293D Motor Driver		1 pc	Php. 400	Php.400.00
Door Hinge		1 pair	Php.15.00	Php.15.00

Magnetic Door Lock		1 Pair	Php.48.00	Php.48.00
Door Handle		1 pc	Php.20.00	Php.20.00

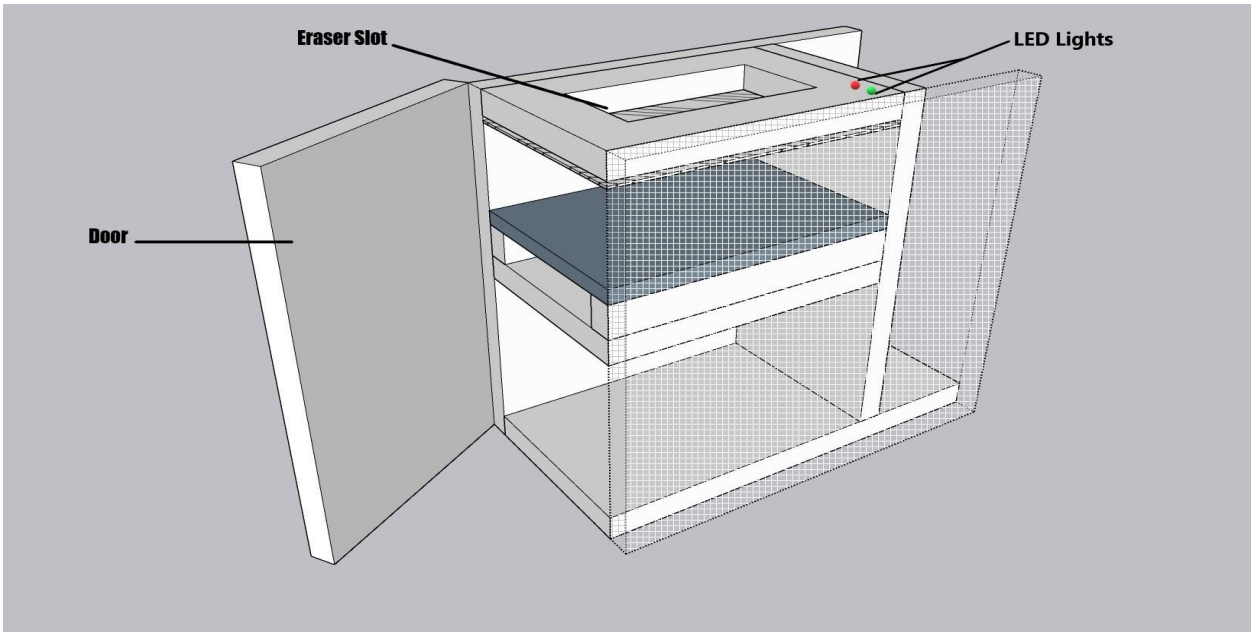
1.2

Equipment	**Image**
Philip Screw Driver	
Electric Drill	
Wire Cutter	
Measuring Tape	
Grinder	

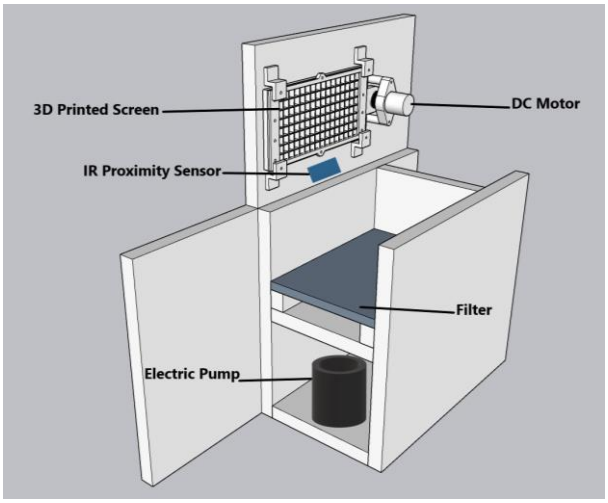
Jigsaw	

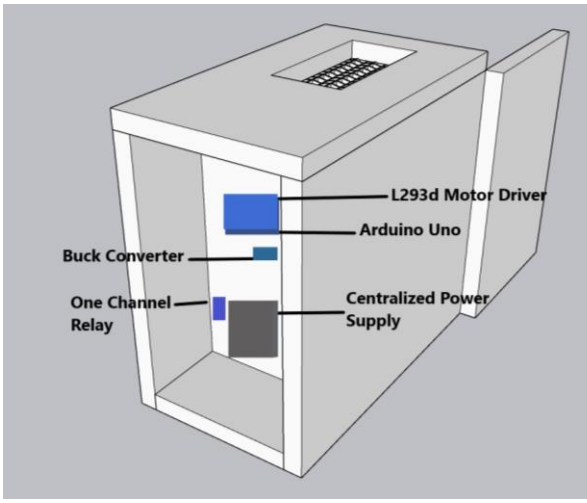
Product Design (Internal and External)

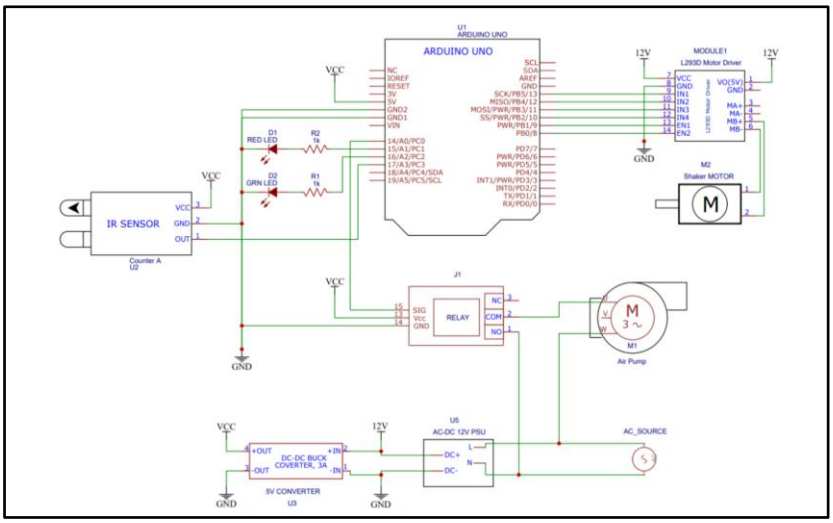
External



Internal







Procedures in Creating the Product

For the Base

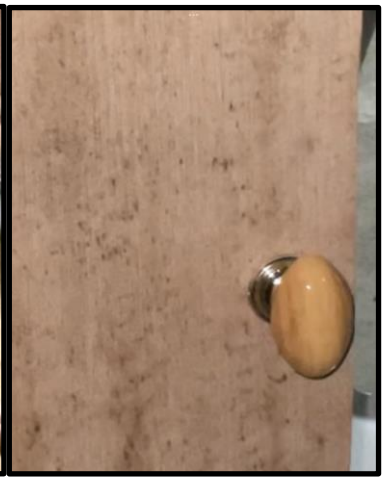
1. Materials and tools were gathered.

2. The plywood was measured using a ruler and was cut out using a Jigsaw.

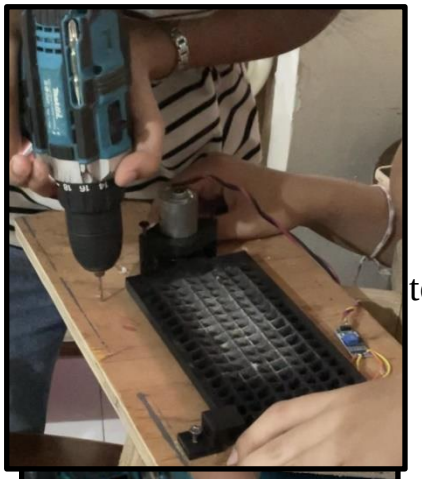

3. To smoothen the surfaces of the cut plywood, a grinder was used.

4. An electric drill and screws were used to assemble the plywoods, door, and eraser slot.


5. Door hinges, magnetic lock, and a handle were attached to the door.

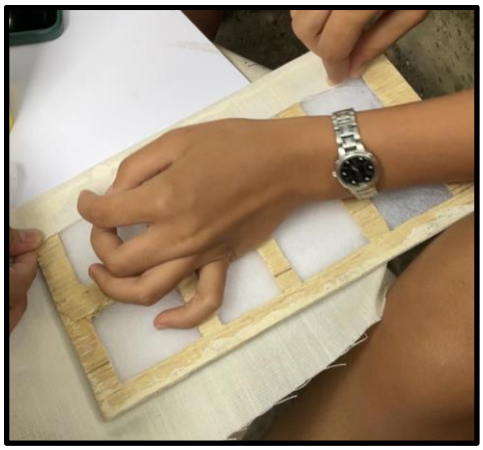



6. The 3D printed screen was affixed to the back of the eraser slot.

7. 

to drill holes on the side of the base for

8. For the filter, a square hole was created and the Katcha fabric was attached and glued on it.

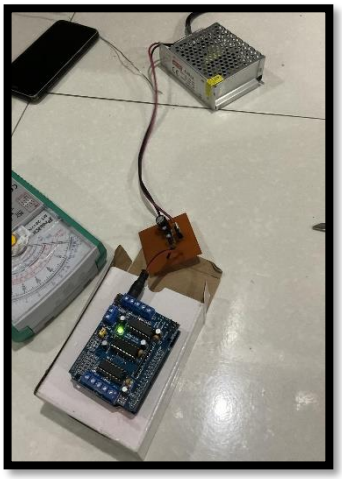


9. A paint was used to provide color and texture of the base.

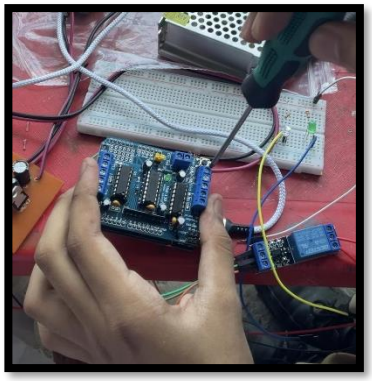
Main Function

1. The power supply's positive and negative lines were connected to the motor shield driver. Jumper wires were utilized to make the connection, which was then soldered in place. The buck converter was

inserted and helped reduce the voltage (while increasing current) from its input (supply) to its output (load).

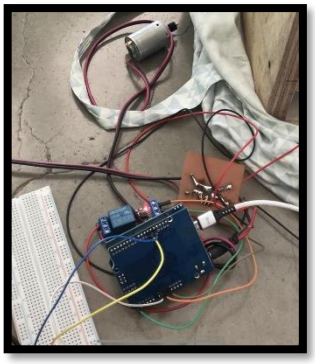


2. The wire ends for the components were stripped.
3. The motor shield driver was connected and mounted on the top Arduino Uno.

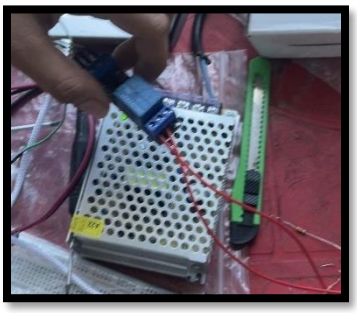


4. On the motor shield driver, the DC motor was connected to the M2 label, and the channel relay was connected to the power supply and to

the arduino analog pin A0. The positive and negative leads from the motor were soldered to these terminals.



5. The IR sensor was connected to the arduino analog pin A3
6. The 2 LEDs red and green were connected to a resistor using connecting wires and soldered it to the Arduino in analog 1 and 2.
7. The channel relay's output terminals were connected to the vacuum or air pump.



8. The components were double-checked once all the components were connected and it ensured that they were secure and functioning.

Experimental Design

This study is quantitative in nature since the question posed will be experimented with by using the materials and tools. Specifically, this investigation utilized an experimental design.

Before achieving the wanted results of the study, recommended procedures are needed to be done. These include creating the product, and the usage of materials that the researcher will be using. The researchers tested the efficacy of the Automated Chalkboard Eraser Cleaner. The following experimental design guided the researchers to test the hypothesis of the study.

1. For the first test, the researcher will put the chalkboard eraser into the cleaner.
2. After putting the eraser into the cleaner, the researcher will observe the machine's efficacy.
3. After observing the machine’s efficacy, the researcher will gather all the information being observed.

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CHAPTER 2

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

DEFINITION OF TERMS

The terms will help the readers in comprehending them, expand their vocabulary and be more aware of them. For citing purposes it is essential to understand the following terms:

Arduino - It is a technology that controls the whole program of a component.

Chalkboard Eraser- It is a school necessity that is being used to erase the writings on the board.

Chalk Dust- It is a residue that is released by the chalk.

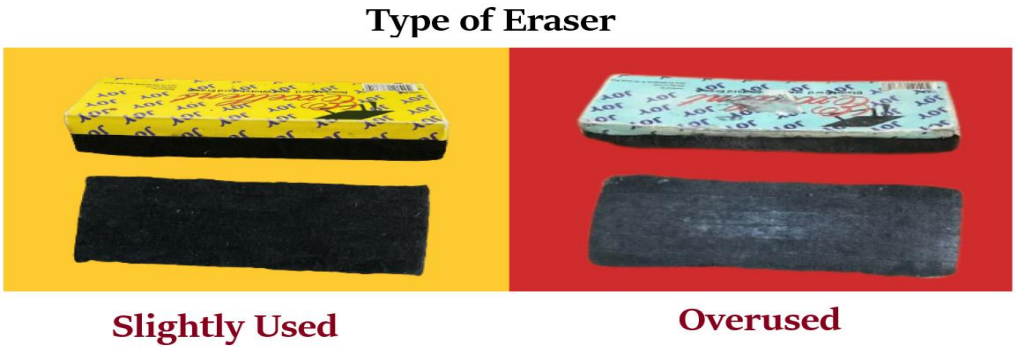
DC Motor- It is responsible for the shaking motion that is connected to the 3D printed screen.

Power Supply- It supplies electric power to the connected components in order to function.

LED- It serves as an indicator if the process is done.

3D Printed Screen- It holds the eraser and at the same time removes the dust by shaking motion.

Removable Filter- It is where the chalk dust particles are being collected.



This chapter analyzes and interprets the data collected from the Automated Chalkboard Eraser Cleaner experiment. For clarity and consistency in the discussion, the data are presented by table analysis.

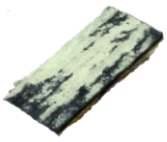
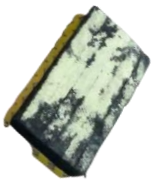
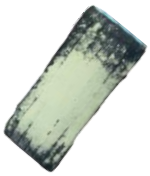
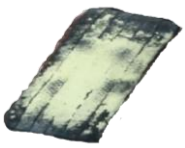
Amount of Chalk Dust	**Type of Eraser**	**Time Consumed in Cleaning**	**Intensity of Dc Motor**	**Result**
	Slightly Used	5 secs	Low	
	Overused	5 secs	Low	

Table 1.1 Effectiveness of the Product

Table 1.1 and table 1.2 shows the effectiveness of the product.

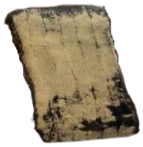
Amount of Chalk Dust	**Type of Eraser**	**Time Consumed in Cleaning**	**Intensity of Dc Motor**	**Result**
	Slightly Used	20 secs	High	
	Overused	20 secs	High	

Table 1.2 Effectiveness of the Product

CHAPTER 3

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter covers the summary, findings, conclusion, and recommendation on the use of Automated Chalkboard Eraser Cleaner

Summary

This study aimed to determine the effectiveness of the Automated Chalkboard Eraser Cleaner S.Y 2022-2023.

1. To visually evaluate the product's effectiveness in removing chalk dust particles from the following types of erasers:
    a. Slightly-used Eraser
    b. Overused Eraser
2. To determine the exact time duration in removing the chalk dust in the eraser.
3. To identify the exact intensity of the DC motor in order to effectively clean the eraser. Based on the findings and testing methods observed. There are topics and areas that can help you develop your skills regarding it.

Findings

1. The partial result of the product was not able to fully clean the eraser due to insufficient time and intensity of vibration.
2. The researchers conducted several testing to come up with the exact time (20 seconds) and intensity of vibration needed to visually see the result.
3. The data gathered from the experiment clearly shows that the chalkboard eraser cleaner effectively removed the dust from the eraser regardless of its type.

Conclusion

The partial efficacy of the eraser cleaner product was attributed to the limited time and inadequate vibration intensity employed during the cleaning process. Subsequently, a series of tests were conducted by the researchers to determine the optimal parameters required to attain the desired outcome. Following the experiments, it was established that a vibration time of 20 seconds, coupled with an appropriate intensity level, produced significant improvements in cleaning efficacy. The findings of the study demonstrate the

high effectiveness of the chalkboard eraser cleaner in removing dust particles from erasers regardless of its type.

RECOMMENDATIONS

Based on the findings and testing methods observed. There are topics and areas that can help you develop your skills regarding it.

1.1 Following information for future researchers' basis in conducting similar studies are highly suggested this following topics:

1.2 Robotics- Functionality of LED lights

1.3 Robotics- Arduino information, Uses and functions on how it works.

1.4 Robotics- The use of IR sensors in its technical fields.

1.5 Robotics- Making code and using C+ programming language.

The researcher recommends this study among the following individuals:

Students. Students may be able to come up with new ideas with the help of this research as the basis for their proposed product.

Future Researchers. It would be advisable to encourage future researchers to conduct studies that are related to this research project for it

might be able to help the industry with their creative thinking and methods to further enhance the concept of the study.

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APPENDICES

APPENDIX A – Product Making Documentation







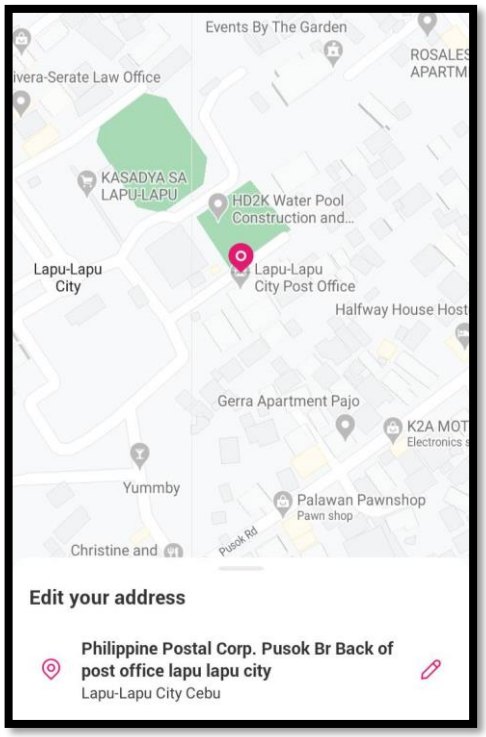



APPENDIX B – Product Testing






APPENDIX C – Location Map



APPENDIX D – Product Testing Results

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