



MECHANICAL ENGINEERING DEPARTMENT

SESI 1 : 2024/2025

REPORT PROJECT 2

NAME	MATRIX NO.
MOHAMMAD SYAHMIL HAKIMI BIN MOHD SUFIAN SYAH	24DTP22F1054
MOHAMED FAIZAL BIN RAJA HUSIN	24DTP22F1001
MUHAMMAD AMMAR BIN EIROHMAN	24DTP22F1039
MUHAMMAD SYABIL FITRI BIN MOHD NABIL	24DTP22F1045

SUPERVISOR NAME : ENCIK MOHD ALY RAJAIE BIN HALIM

REPORT ENDORSMENT

The report entitled “ Brightboard Autowipe ” is being submitted, reviewed and endorsed to fulfil the conditions and requirements of report writing as specified.

Checked by :

Supervisor’ s signature :

Supervisor’ s stamp :

Date :

Endorsed by :

Project coordinate’ s signature :

Project coordinate’ s stamp :

Date :

CERTIFICATION OF PROJECT ORIGINALLY AND OWNERSHIP

BRIGHTBOARD AUTOWIPE

NAME	MATRIX NO.	CHAPTER
MOHAMMAD SYAHMIL HAKIMI BIN MOHD SUFIAN SYAH	24DTP22F1054	1.0, 1.1, 1.2, 3.3, 3.4, 3.10, 4.1, 5.1, 5.5
MOHAMED FAIZAL BIN RAJA HUSIN	24DTP22F1001	1.3, 1.4, 1.5, 3.5, 3.6, 4.4, 5.2
MUHAMMAD AMMAR BIN EIROHMAN	24DTP22F1039	1.7, 2.1, 2.2, 3.7, 3.8, 3.9, 4.3, 5.3, 5.7
MUHAMMAD SYABIL FITRI BIN MOHD NABIL	24DTP22F1045	2.3, 3.1, 3.2, 4.2, 5.4

We hereby declare that this report is the result of our work, except that we have outlined its sources and this project will be the owner of the polytechnic.

ENDORSED BY :

(MOHAMMAD SYAHMIL HAKIMI BIN
MOHD SUFIAN SYAH)

(MOHAMED FAIZAL BIN RAJA HUSIN)

(SUPERVISOR: EN. MOHD
ALY RAJAIE BIN HALIM)

(MUHAMMAD AMMAR BIN EIROHMAN)

(SUPERVISOR STAMP)

(MUHAMMAD SYABIL FITRI BIN
MOHD NABIL)

DATE :

DATE :

ACKNOWLEDGEMENT

Thank the Almighty for His grace. We successfully completed our Final Year Project and this report to meet the requirements of each polytechnic student pursuing a diploma. We faced many challenges in completing the project and paperwork, but with patience, effort, and teamwork, we successfully completed it. We would like to thank everyone who helped us complete this report. Our appreciation is given to our great supervisor, Encik Mohd Aly Rajaie Bin Halim , whose contribution in giving suggestions and encouragement to help us coordinate our project especially in writing this report and also during our final project. Last but not least, may thanks you to our family for lots of support, friends and who has been involved directly or indirectly on the guiding the team during this project. We wish congratulate to continue our diploma. Finally, we sincerely apologize for wrong and mistaken during the progress on this project. Hopefully this opportunity will always be our common benefits to future. Thank you.

ABSTRACT

Whiteboards are commonly used in classrooms, offices and meetings for brainstorming and presentation. Regular cleaning is essential to maintain clarity and prevent ghosting, but manual cleaning can be time-consuming. An automatic whiteboard cleaner system using Arduino called “Brightboard Autowipe” offers a convenient solution.

LIST OF CONTENTS

CONTENT	PAGE
CHAPTER 1 : INTRODUCTION	
1.1 Introduction	6 -7
1.2 Project Background	8
1.3 Problem Statement	9
1.4 Project Objectives	10
1.5 Project Scope	10
1.6 Expected Project Result	10
1.7 Summary	11
CHAPTER 2 : LITERATURE REVIEW	
2.1 Introduction	12
2.2 Previous studies / journal / investigation	13 – 17
2.3 Summary	17
CHAPTER 3 : METHODOLOGY	
3.1 Introduction	18
3.2 Gantt Chart	19
3.3 Block Diagram	20 - 21
3.4 Materials and Equipment & Costing	21 – 26
3.5 Data Analysis Method	27
3.6 Flow Chart	27
3.7 Drawing Project	28 – 30
3.8 Fabrication / Arrangement	31
3.9 Measurement and Marking Process	31 - 35
3.10 Summary	35
CHAPTER 4 : DATA AND DISCUSSION	
4.1 Introduction	36
4.2 Survey Questions	37 - 38
4.3 Project costing	39
4.4 Result Of The Project	40 - 42
CHAPTER 5 : RECOMMENDATION AND CONCLUSION	
5.1 Problem Faced During Innovation	43
5.2 Problem Faced When Designing The Project	44
5.3 Problem Faced In The Use Of Material	44
5.4 Overall Discussion	45
5.5 Recommendation	45
5.6 Conclusion	46
5.7 References	46
APPENDIX	47 - 48

CHAPTER 1

1.1 INTRODUCTION

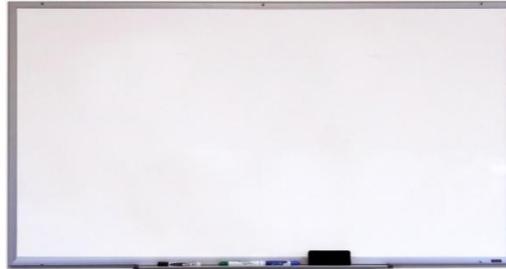


Figure 1.1 shows a whiteboard

Whiteboards are now an essential component of conference rooms, businesses, and schools in the digital age for concept visualization, teaching, and brainstorming. However, smudges, markings, and eraser residue frequently cause whiteboards to become dirty and challenging to read. Using Arduino technology, the issue can be resolved by implementing Brightboard Autowipe, an automatic whiteboard cleaning. With the help of this automated solution, human cleaning is no longer necessary, and the whiteboard is always kept tidy and presentable.



Figure 1.2 shows a Arduino Uno

This project involves using an Arduino Uno to control a cleaning mechanism that moves horizontal the surface of the whiteboard and removes any unwanted marks or residue. This automated cleaner will save time and effort, allowing users to focus on the content of the whiteboard rather than its cleanliness. The Arduino board will be programmed to move the cleaning mechanism in a systematic pattern, covering the surface of the whiteboard.

Additionally, the Arduino board can be programmed to adjust its cleaning path accordingly. This innovative solution not only improves the efficiency and effectiveness of cleaning whiteboards but also enhances the overall user experience. The cleaning action can be observed in both forward and return strokes of the cleaner, and the time consumed for cleaning the whiteboard is less compared to manual cleaning methods.

Some of the components for this Brightboard Autowipe project are rack and pinion, Stainless steel shaft, Arduino Uno, motor driver, and others. The rack is an essential component of the Brightboard Autowipe as it provides the mechanism for the linear movement of the cleaning tool. As the gear rotates, it moves the cleaner horizontally across the whiteboard's surface, ensuring comprehensive coverage during the cleaning process. The Pinion works in conjunction with the rack gear to facilitate the movement of the cleaning mechanism. It helps to transfer the rotational motion to the linear motion required for efficient cleaning. The combination of rack and pinion ensures smooth and precise movement across the whiteboard. The Arduino Uno serves as another potential option for the microcontroller, offering similar programming capabilities and control features. Its compatibility with various motor drivers and sensors makes it a versatile choice for the Brightboard Autowipe project. The motor driver translates the signals from the Arduino board into the necessary power and voltage levels required by the motor. It ensures smooth acceleration, deceleration, and directional control of the cleaning mechanism, enhancing the overall efficiency and performance of the automatic whiteboard cleaner. By incorporating these components into the design and programming of the Brightboard Autowipe project, a reliable and efficient solution for maintaining clean and presentable whiteboard surfaces can be achieved.

1.2 BACKGROUND PROJECT

The Brightboard Autowipe project utilizing Arduino technology offers a cutting-edge solution to address the common issue of maintaining clean and readable whiteboard surfaces. By incorporating a range of components, including the rack and pinion for linear movement, the Arduino Uno for control and programming, a motor for driving the cleaning mechanism. With the ability to systematically cover the surface of a whiteboard, this Brightboard Autowipe ensures a consistently clean and presentable state, optimizing user

experience and productivity. By combining Arduino technology with innovative design, the Brightboard Autowipe sets a new standard for maintaining pristine whiteboard surfaces, freeing users from the time-consuming task of manual cleaning.

1.3 PROBLEM STATEMENT

These conventional whiteboard cleaning methods are all dependent on human effort and, as such, are susceptible to a number of problems that need to be tackled if the surfaces are to be kept efficiently and effectively. One major issue is energy inefficiency, especially in cases where whiteboards are used extensively. This calls for the design of an Brightboard Autowipe system that will be energy-efficient and at the same time be friendly to the environment. Apart from the fact that the traditional cleaning processes, which involve chemicals or tools, are also an issue with regard to the safety factor, there exists a need for an automatic cleaner system devoid of danger or hazard to its users. This is further compounded by time pressures in a busy classroom or conference room where sessions are pulled over quickly. Thus, effective space management using an Brightboard Autowipe system will be necessary for rapid and efficient cleaning within the shortest period possible. There will be a need to mount an Brightboard Autowipe system that keeps a whiteboard clean at all times in order to enrich the image of classrooms and meeting areas. Any whiteboard solution development related to maintenance considerations must necessarily address these complex challenges on many fronts.

1.4 PROJECT OBJECTIVES

1. To design a automated system capable of cleaning whiteboards without requiring too much manual intervention.
2. To develop automatic whiteboard cleaner using Arduino technology.
3. To create a easy maintenance, user-friendly and cost-effective automatic whiteboard cleaner.

1.5 PROJECT SCOPE

The project scope involves creating an automatic whiteboard cleaner that can effectively clean whiteboards in classrooms or any other places. This project will involve the combination of mechanical, electrical, and programming parts that will implement a forward and reverse movement of the cleaning mechanism for effective cleaning of the wiping surface. The aim of this project is to develop a cleaner that is fairly affordable, energy efficient, and easy to service and maintain so that the amount of time and energy spent by users to get rid of the whiteboards can be reduced and allow them to dedicate more time to such activities as teaching, brainstorming, etc. Also, our project can be used in a classroom or almost everywhere there is a whiteboard.

1.6 EXPECTED PROJECT RESULT

The Brightboard Autowipe that will be constructed for this project is expected to fully function with the capability of effortlessly wiping the whiteboard surfaces on its own. The Brightboard Autowipe machine will be able to traverse the surfaces with the utmost efficiency and precision while moving in a linear fashion in order to erase every inch completely.

1.7 SUMMARY

The Brightboard Autowipe project aims to develop an automated system for cleaning whiteboards after use, targeting classrooms and meeting rooms to enhance efficiency by eliminating manual cleaning efforts. This project involves creating hardware and software to detect whiteboard usage and initiate the cleaning process automatically, addressing issues of time wastage and cleanliness. This project seeks to streamline the user experience and improve workspace efficiency, ultimately providing a solution that improves the overall workflow in educational and professional settings.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Brightboard Autowipe is an innovative solution aimed at simplifying the maintenance of whiteboards. Beginning with a comprehensive analysis of existing cleaning methods, the project identifies opportunities to enhance efficiency through automation. The main objective of the project is to create a system that can automatically clean whiteboards without human intervention. The methodology of the project involves using an Arduino Uno microcontroller as a data processor. Rigorous testing demonstrates consistent and reliable cleaning results across various whiteboard sizes and surface conditions. Specifically, the device prioritizes user-friendliness, cost effectiveness, and sustainability in its design, making it practical for everyday use. By achieving its objectives of automatic whiteboard cleaning while minimizing manual effort and time, the project provides a valuable solution for individuals and organizations seeking to maintain pristine whiteboard surfaces effortlessly. This innovative approach not only enhances productivity by reducing maintenance tasks but also contributes to environmental sustainability through efficient resource utilization. Overall, the Brightboard Autowipe presents a promising advancement in the field of automated cleaning technology, offering a practical solution to a common workplace charter.

2.2 PREVIOUS STUDIES/JOURNAL/INVESTIGATION

Based on this "IR Controlled Automatic Whiteboard Cleaner Using Arduino" journal, it presents a project that aims to develop an automated system for cleaning whiteboards using Arduino. The main objective of the project is to create a system that can automatically clean whiteboards without human intervention. The methodology of the project involves using an Arduino Uno microcontroller as a data processor and an infrared sensor for detecting obstacles. The IR sensor detects any obstruction in front of the whiteboard cleaner and sends a signal to the Arduino board. Based on the signal received, the Arduino board controls a motor to navigate the cleaner around the obstacles and continue cleaning the whiteboard. The result of the project is a successful prototype of an IR controlled automatic whiteboard cleaner. The prototype was tested and found to effectively stop when there is a barrier in front of it and then turn according to the test conducted. The paper concludes that the automatic whiteboard cleaner prototype using Arduino is a practical and efficient solution for cleaning whiteboards. The project successfully implemented an IR-controlled automatic whiteboard cleaner using Arduino. The objective of creating an automated system for cleaning whiteboards without human intervention was accomplished.

Based on this "A Design of Robotic Board Cleaner by Using Arduino Microcontroller" journal, this research journal presents the design and development of a robotic board cleaner using an Arduino microcontroller. The objective of this project is to create an affordable and effective solution for floor cleaning, specifically targeted towards Indian users and factories. The methodology of the project involves designing a suitable chassis for the robot to carry its weight and assembling various electronic components such as motors, sensors, microcontrollers, motor drivers, and wheels. The robot is equipped with an ultrasonic sensor to detect obstacles and navigate around them. The system utilizes an Arduino Uno microcontroller to process data from the ultrasonic sensor and drive a DC motor for movement. The results of the project show that the prototype of the floor cleaning robot is able to automatically stop when it encounters a barrier and turn in a different direction to continue cleaning. The research paper highlights the potential benefits of an automated floor cleaning machine, including cost-effectiveness, time efficiency, and the reduction of physical strain associated with manual cleaning. Moreover, the paper emphasizes the importance of maintaining clean and hygienic floor surfaces for a healthy

and safe environment in both residential and commercial settings. Overall, the research project successfully achieves its objective of designing and implementing an automatic floor cleaning robot prototype using the Arduino microcontroller.

Based on this "Automatic whiteboard cleaner" journal. The journal presents an innovative solution to simplify the maintenance of whiteboards. Beginning with a thorough analysis of existing cleaning methods, the project identified opportunities to streamline the process through automation. Through extensive research and iterative design, the team developed a prototype featuring motorized brushes, suction mechanisms, and specialized cleaning solutions to efficiently remove dry erase marker residue and stains. Rigorous testing demonstrated consistent and reliable cleaning results across various whiteboard sizes and surface conditions. Importantly, the device prioritized user-friendliness, cost-effectiveness, and sustainability in its design, enhancing its practicality for everyday use. By achieving its objectives of automating whiteboard cleaning while minimizing manual effort and time, the project provides a valuable solution for individuals and organizations seeking to maintain pristine whiteboard surfaces effortlessly. This innovative approach not only enhances productivity by reducing maintenance tasks but also contributes to environmental sustainability through efficient resource utilization. Overall, the "Design and Construction of a Whiteboard Automatic Cleaner" presents a promising advancement in the field of automated cleaning technology, offering a practical solution to a common workplace challenge.

Based on "Design and Construction of a Whiteboard Automatic Cleaner" journal. The journal presents an innovative solution to simplify the maintenance of whiteboards. Beginning with a thorough analysis of existing cleaning methods, the project identified opportunities to streamline the process through automation. Through extensive research and iterative design, the team developed a prototype featuring motorized brushes, suction mechanisms, and specialized cleaning solutions to efficiently remove dry erase marker residue and stains. Rigorous testing demonstrated consistent and reliable cleaning results across various whiteboard sizes and surface conditions. Importantly, the device prioritized user-friendliness, cost-effectiveness, and sustainability in its design, enhancing its practicality for everyday use. By achieving its objectives of automating whiteboard cleaning

while minimizing manual effort and time, the project provides a valuable solution for individuals and organizations seeking to maintain pristine whiteboard surfaces effortlessly. This innovative approach not only enhances productivity by reducing maintenance tasks but also contributes to environmental sustainability through efficient resource utilization. Overall, the "Design and Construction of a Whiteboard Automatic Cleaner" presents a promising advancement in the field of automated cleaning technology, offering a practical solution to a common workplace challenge.

Based on the journal titled "Design & Fabrication of Smart Board Cleaner," the paper introduces a novel solution aimed at simplifying the upkeep of smart boards. The project commences with a comprehensive examination of existing cleaning methodologies, identifying opportunities for streamlining the process through automation. Leveraging extensive research and iterative design techniques, the team engineers a prototype equipped with motorized brushes, suction mechanisms, and specialized cleaning solutions to effectively eliminate dirt, stains, and debris from smart board surfaces. Through rigorous testing, the device demonstrates consistent and reliable performance across various smart board dimensions and conditions. Notably, the design prioritizes user-friendliness, affordability, and eco-friendliness, enhancing its practicality for everyday use. By achieving its objectives of automating smart board maintenance while minimizing manual intervention, the project delivers a valuable solution for individuals and organizations seeking efficient smart board upkeep. This innovative approach not only boosts productivity by reducing maintenance tasks but also promotes environmental sustainability through resource-efficient practices. Overall, the "Design & Fabrication of Smart Board Cleaner" signifies a significant advancement in automated cleaning technology, offering a practical remedy to a prevalent challenge in modern educational and professional settings.

Based on the journal titled "Automatic Whiteboard Eraser" by David Danelia, the paper introduces an innovative solution aimed at simplifying the maintenance of whiteboards. Beginning with a comprehensive analysis of existing cleaning methods, the project identifies opportunities to enhance efficiency through automation. Through extensive research and iterative design, the team develops a prototype Automatic Whiteboard Eraser featuring motorized brushes, suction mechanisms, and specialized cleaning solutions to effectively eliminate dry erase marker residue and stains. Rigorous testing demonstrates

consistent and reliable cleaning results across various whiteboard sizes and surface conditions. Crucially, the device prioritizes user-friendliness, cost-effectiveness, and sustainability in its design, making it practical for everyday use. By achieving its objectives of automating whiteboard cleaning while minimizing manual effort and time, the project provides a valuable solution for individuals and organizations seeking to maintain pristine whiteboard surfaces effortlessly. This innovative approach not only enhances productivity by reducing maintenance tasks but also contributes to environmental sustainability through efficient resource utilization. Overall, the "Automatic Whiteboard Eraser" presents a promising advancement in the field of automated cleaning technology, offering a practical solution to a common workplace challenge.

Based on this “ Automatic Whiteboard Eraser” journal, this journal aimed to revolutionize the erasing process in educational and professional settings by developing an innovative robotic system (Wienecke et al., 2005). This system involved the meticulous design and implementation of a robotic arm that was equipped with advanced computer vision and motion control technologies. Through the use of computer vision algorithms, the robotic arm was able to precisely and selectively erase text and drawings on a whiteboard without causing damage to surrounding content. The incorporation of sensors enabled the robot to navigate dynamic environments and avoid obstacles seamlessly. The primary objective of this project was to design, manufacture, and implement a highly accurate and adaptable robotic arm, capable of efficiently erasing whiteboard content while maintaining the integrity of the remaining content. The paper puts forward a kind of mechanism design scheme that can automatically detect blackboard chalk stains and erase fonts to keep the blackboard clean. In addition to the mechanism design, the paper also discusses the hardware and software systems used in the project and provides installation instructions. The gesture recognition module used a local spatio-temporal approach to accurately recognize and interpret activities. The tracking module was designed to handle cluttered backgrounds and variable lighting conditions, ensuring accurate tracking of the whiteboard content. The whiteboard scanner eliminated global luminosity differences through adaptive thresholding, allowing for the digitization of whiteboard content. The overall cleaning process of the Automatic Whiteboard Eraser project involved mobile base motion, door-handle detection, and control of the robotic arm for completing the process.

Based on this “ Design and Fabrication of Smart Board Cleaner “ journal, this journal aims to enhance maintenance in educational and professional settings by providing an autonomous cleaning system. This system utilizes sensors and computer vision technologies to identify and target areas for cleaning on smart board surfaces with precision, while avoiding damage. The outcome of this project is expected to provide a cost-effective and time-efficient solution for maintaining clean and hygienic smart board surfaces. Moreover, the smart board cleaner's motion control algorithms enable systematic coverage, contributing to overall cleaning efficiency. The integration of magnets, powerful motors, and intelligent systems allows the smart board cleaner to climb whiteboards and perform cleaning tasks effectively. The use of Raspberry Pi 3 Model B+ and sensors in the design ensures efficient implementation of various cleaning functions. An automated floor cleaning machine can eliminate these challenges and improve the overall cleaning process by providing a more efficient and effective cleaning solution. This improves safety and reduces the risk of accidents. Additionally, the smart board cleaner offers customizable cleaning patterns to meet specific requirements for different environments. The proposed smart board cleaner is expected to provide a valuable solution for maintaining clean and hygienic surfaces in educational and professional settings. In conclusion, the design and fabrication of a smart board cleaner offers an innovative solution to enhance maintenance in educational and professional settings.

2.3 SUMMARY

An automated system is created to clean whiteboards after use; it's called the "Brightboard Autowipe." This project aims to be able to be installed in schools and meeting spaces and allow whiteboards to be used without any need for manual cleaning. This project will enhance the design of a mechanism and software programming to initiate the cleaning process automatically to move all the way to the end and go back to its original place. hence, addressing the issue of time wastage, cleanliness, and the whiteboard condition. The present-day technology advances in the areas of sensors and automation will lead the project toward improving the inefficiency that can ultimately provide an ample solution to have the overall workflow get improved while performing a session through using the whiteboard. In conclusion, the Brightboard Autowipe seems to be a very promising development in the automated cleaning field, a practical solution for a universal problem at the workplace.

CHAPTER 3

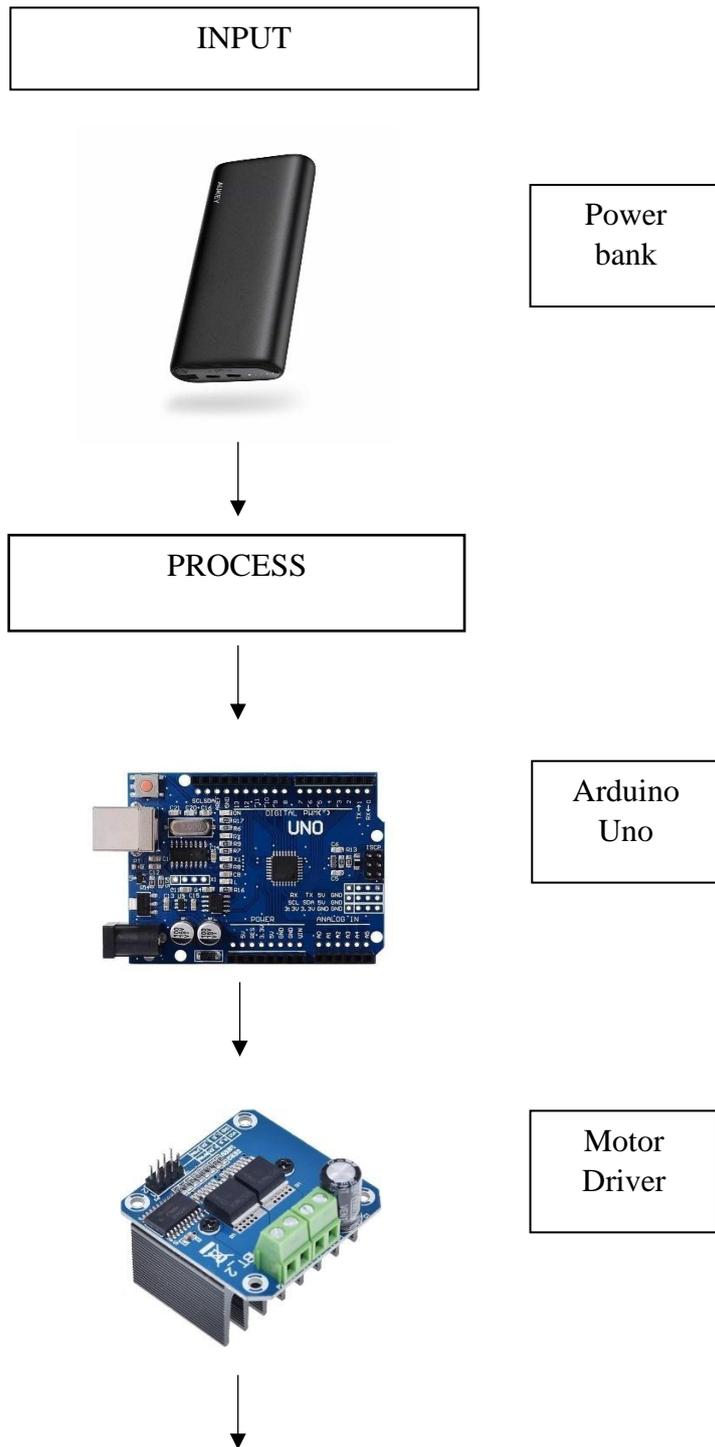
METHODOLOGY

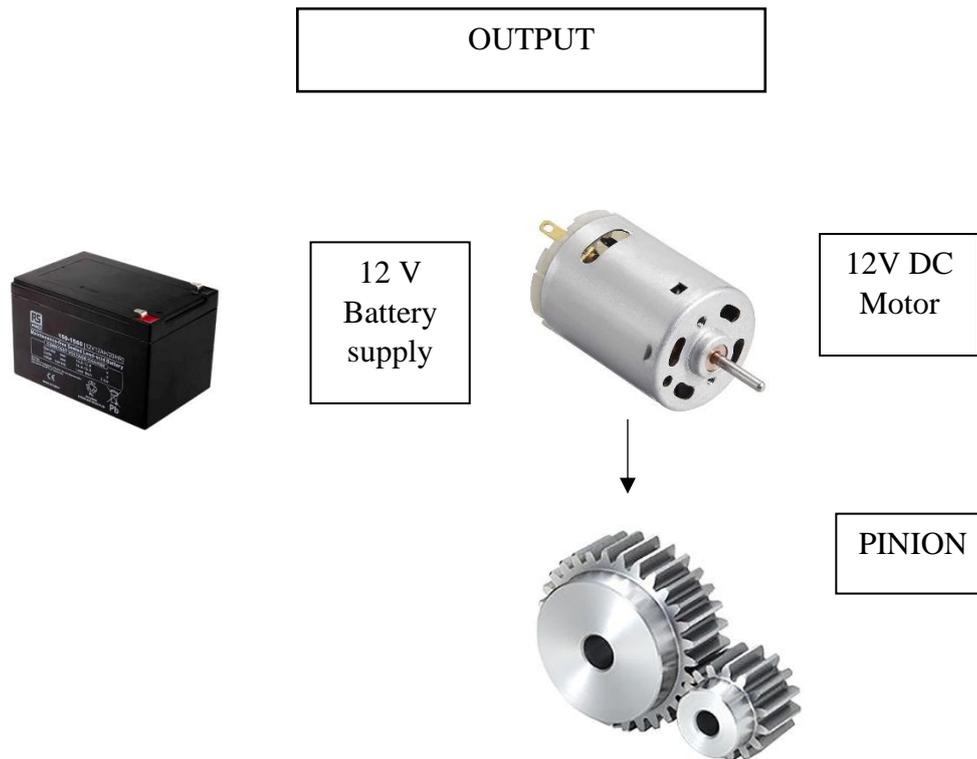
3.1 INTRODUCTION

Methodology is a set of tools and guidelines that help you organize the project by optimizing the efficiency and enhancing the performance. More specifically, a given project management method helps us to easily manage the project by providing easy-to-understand, repeatable steps and principles. The goal of any framework is to promote collaboration, increase operational efficiency, keep the project on budget, and enhance the quality of the final deliverable. A methodology does not set out to provide solutions—it is therefore not the same as a method. Instead, a methodology offers the theoretical underpinning for understanding which method, set of methods, or best practices can be applied to a specific case, for example, to calculate a specific result.

The Brightboard Autowipe is a project designed to simplify whiteboard maintenance in cleaning. The project aims at analyzing the recent cleaning techniques with a view to improving the efficiency of cleaning the whiteboard through automation. The project aims to design a system capable of cleaning whiteboards without human intervention. The method will be implemented into the project with an Arduino Uno microcontroller for the programming system. Usability, cost-effectiveness, and environmental sustainability of the approach were addressed with much emphasis, making it tenable for use on a day-to-day basis without much hassle. The project immensely benefits even as it provides a product that can automatically clean a whiteboard, presenting a significant breakthrough from the myriad of individuals and organizations looking for a whiteboard that without too much of a hassle will maintain its cleanliness and reduce manual labor-time towards cleaning. Further, this will provide additional avenues in terms of productivity improvement while providing environmental sustainability by helping in resource management. The Brightboard Autowipe is a great leap in the automated cleaning system in finding a solution for handling a commonplace issue in workplaces.

3.3 BLOCK DIAGRAM

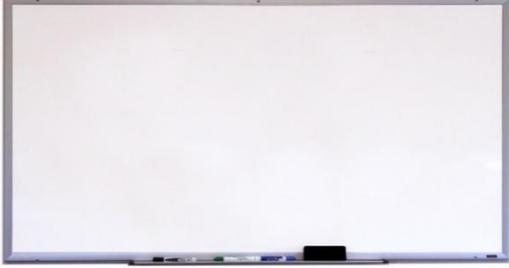


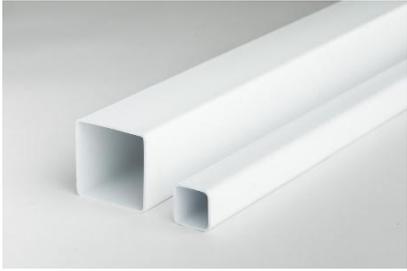


3.4 MATERIALS AND EQUIPMENT

Materials	Function
 1. Stainless Steel Shaft	Used as part of the mechanical structure supporting the movement of the cleaner.
 2. Arduino Uno	Serves as the brain of the project, controlling the motor based on the programmed instructions.

 <p>3. BTS 7960 Motor driver</p>	<p>Used to control the direction and speed of DC motors.</p>
 <p>4. 12V DC Motor</p>	<p>This motor control module regulates the direction and speed of the motor used to drive the cleaner across the whiteboard.</p>
 <p>5. Rack and Pinion</p>	<p>Used as the driving mechanism to convert the rotational motion of the motor into linear motion for the cleaner.</p>
 <p>6. Sponge</p>	<p>The cleaning surface that directly contacts the whiteboard.</p>
 <p>7. 12V Battery supply</p>	<p>Serves as the main power source for motor driver.</p>

 <p>8. Whiteboard</p>	<p>The whiteboard is the surface to be cleaned by the cleaner.</p>
 <p>9. Power bank</p>	<p>A power bank serves as the portable power source for the Arduino Uno, providing the necessary 5V supply through its USB output.</p>
 <p>10. Jumper Wire</p>	<p>For establishing reliable electrical connections between the Arduino and motor driver.</p>
 <p>11. Bolt & Nut Screw</p>	<p>For securely fastening various mechanical components such as the brackets, motor bracket, and other parts.</p>

 <p>12. PVC Square Pipe</p>	<p>Function as a body of the whiteboard cleaner.</p>
 <p>13. Sliding Door Roller Guide</p>	<p>Guide facilitates the smooth, linear movement of the eraser mechanism across the whiteboard.</p>
 <p>14. Sliding Door Roller</p>	<p>A key component for supporting and guiding the movement of the eraser assembly along the whiteboard.</p>
 <p>15. Ball Bearing Pillow Block Mounted</p>	<p>The ball bearing pillow block mounted unit supports and stabilizes the rotating shaft connected to the motor.</p>

 <p>16. 10 Meter Black And Red Wire</p>	<p>The red wire is used to carry the positive voltage from the power source, such as the 12V battery.</p> <p>The black wire is used to connect to the ground or the negative terminal of the power source.</p>
 <p>17. Stainless Steel L Bracket</p>	<p>Used to secure, mount and stabilize mechanical components.</p>
 <p>18. Spray Black</p>	<p>Black spray paint is used to coat the cover of the whiteboard eraser.</p>

COSTING

MATERIAL	QUANTITY	PRICE
STAINLESS STEEL SHAFT	1	RM 16.40
10 METER BLACK AND RED WIRE	1	RM 6.50
BTS7960 MOTOR DRIVER MODULE 43A	1	RM 30.00
RACK AND PINION	2	RM 160.20
12V BATTERY SUPPLY	1	RM 54.08
ARDUINO UNO	1	RM 28.00
WHITEBOARD	1	RM 260.00
PVC SQUARE CASING	1	RM 16.70
BOLT AND NUT	2	RM 10.40
JUMPER WIRE	3	RM13.98
SPONGE 1 METER	1	RM9.90
BALL BEARING PILLOW BLOCK MOUNTED	1	RM 10.90
STAINLESS STEEL L BRACKET	8	RM 9.20
SLIDING DOOR ROLLER GUIDE	2	RM 9.00
SLIDING DOOR ROLLER	2	RM 3.50
SCREW	2	RM 6.00
SPRAY BLACK	1	RM 6.00
POWER BANK	1	RM 25.00

TOTAL COST = RM 697.00

3.5 DATA ANALYSIS METHOD

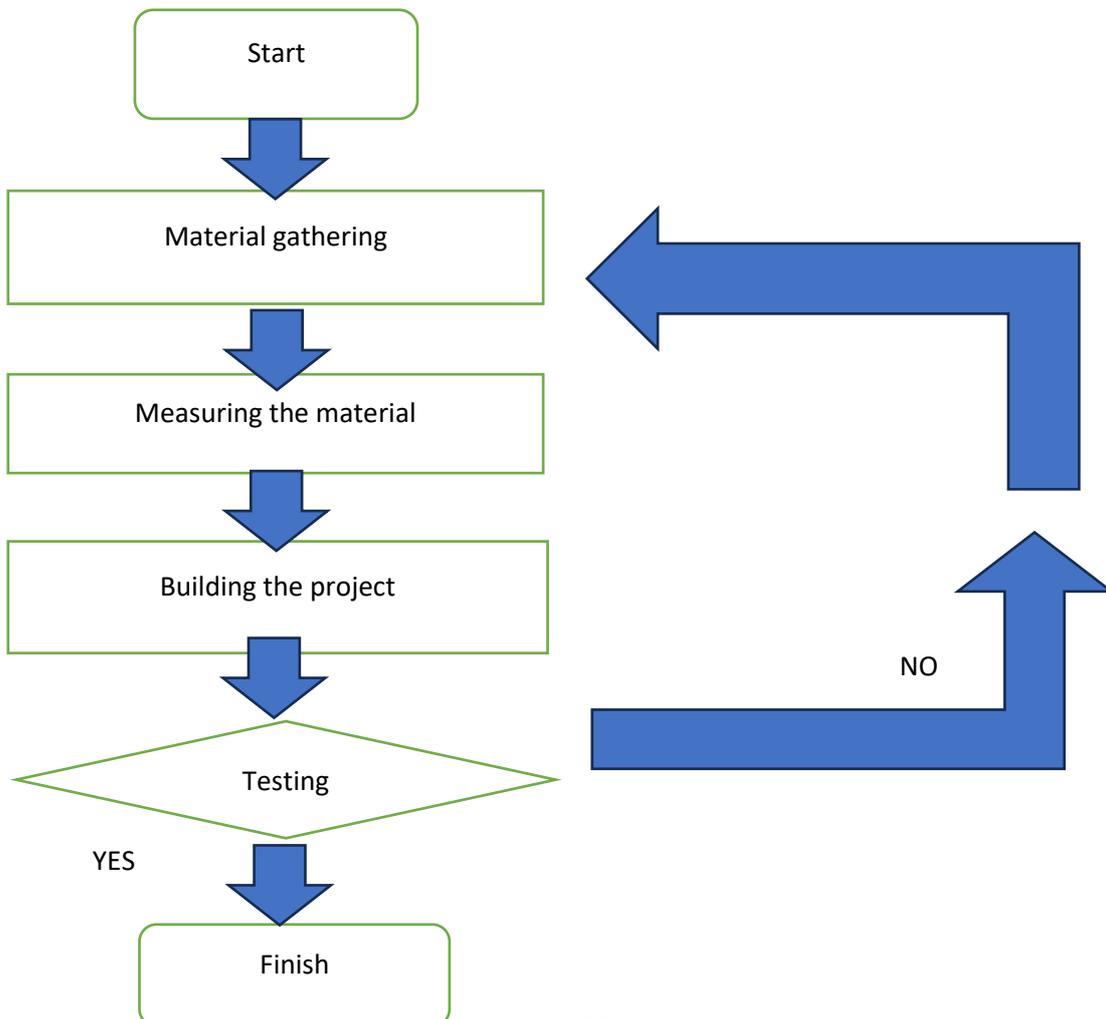
This has incorporated both observational studies and controlled experiments as part of the data collection process. The observational studies were carried out under naturalistic conditions, in actual classrooms, while in the controlled experiments, some variables were manipulated in order to assess their effect on cleaning performance.

The performance of the acquired data was then assessed using both statistical and non-statistical techniques. For instance, statistical analyses look at cleaning time and area coverage while non-statistical entails user opinion and personal assessment of cleanliness.

Relationships and trends in quantitative analysis of the data were done using statistical mean comparison methods and regression analysis techniques. Qualitative analysis involved user feedback on the cleaner and the use of thematic coding to provide insights on its usefulness and effectiveness.

This combination of performance and usability data collection and analysis of the automatic whiteboard cleaner will allow iterative improvements and further refinement in the eventual product design.

3.6 FLOW CHART



3.7 DRAWING PROJECT

In the development of our Brightboard Autowipe, the combination of Autodesk Inventor, and hand sketching plays a vital role in the design process. Autodesk Inventor allows for the creation of detailed 3D models of the scrubber, incorporating specific parameters and design elements for optimal functionality. Additionally, hand sketching serves as a quick and intuitive method to explore initial concepts and refine design ideas. From using this method, allows us to seamlessly transition to detailed design, ensuring that the Brightboard Autowipe is both functionally efficient and visually comprehensible in its representation.

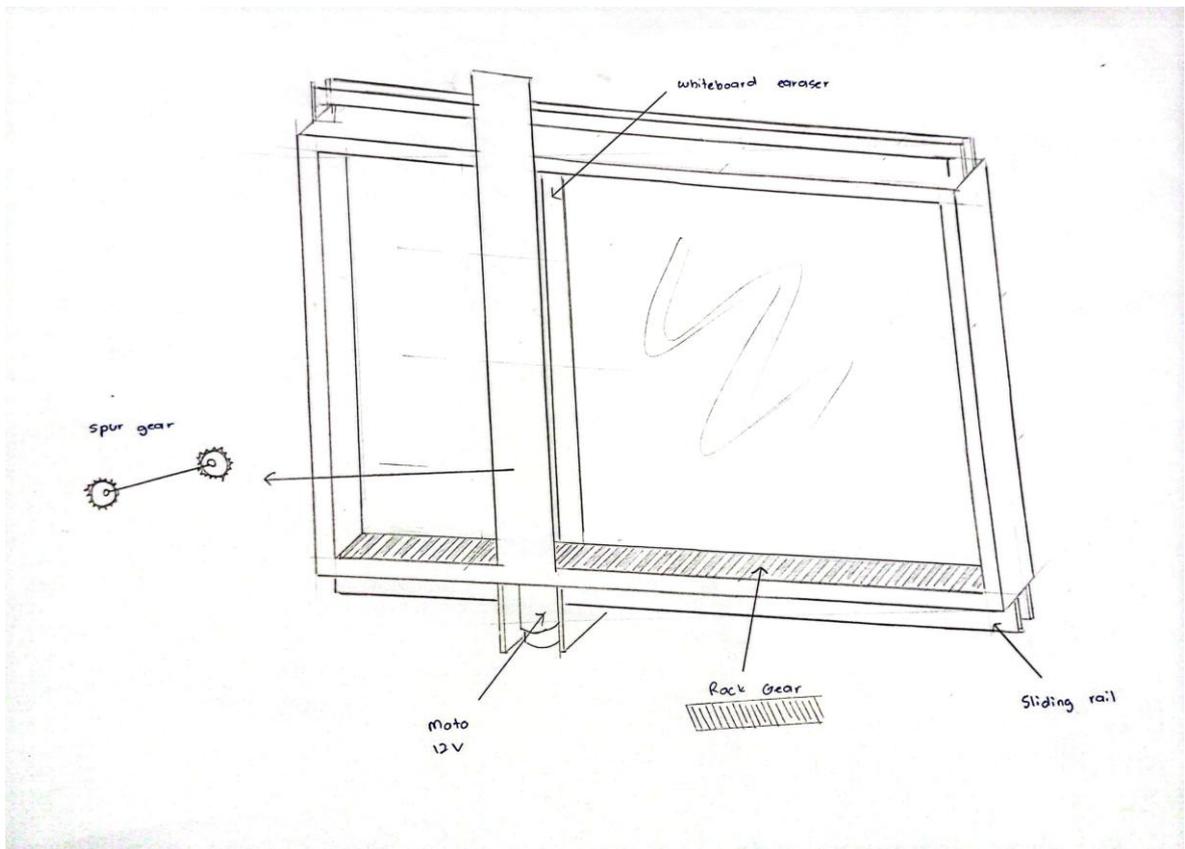


Figure 3.7.1 Project Sketch

In the Autodesk Inventor drawing of our Brighboard Autowipe, attention has been given to detail and precision. The three-dimensional model is accurately rendered, showcasing the whiteboard, Arduino Uno, motor driver, rack and pinion and other. The drawing employs parametric modelling tools to ensure dimensional accuracy and consistent proportions.

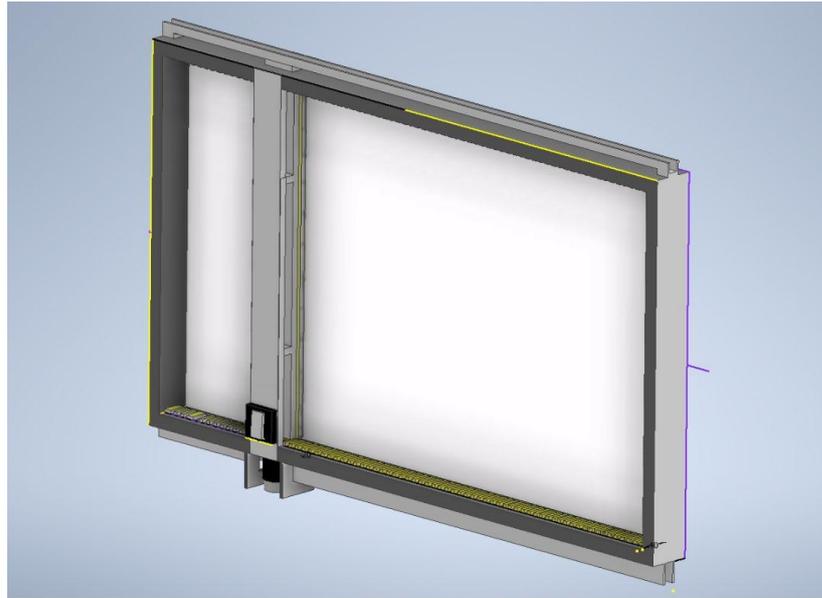


Figure 3.7.2 sketch using Inventor in front view

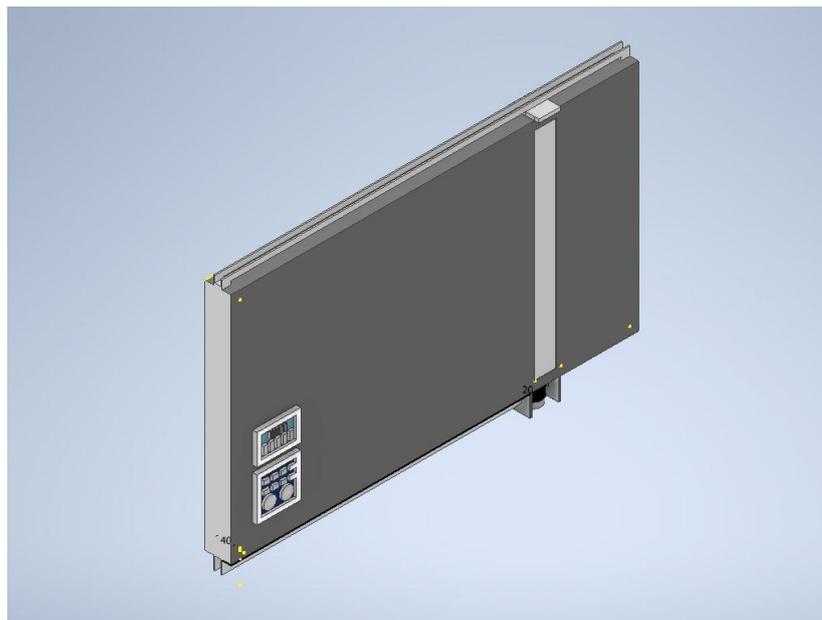


Figure 3.7.3 sketch using Inventor in back view

In the isometric drawing of the Brightboard Autowipe in Inventor, the key components include the whiteboard, serving as the writing surface, and the rack and pinion mechanism facilitating automatic cleaning. The whiteboard acts as the main interface for writing and drawing, supported by the stand for stability. Meanwhile, the rack and pinion system enables the automatic cleaning process by converting linear motion to rotational motion. Together, these components form the essential elements of the Brightboard Autowipe system depicted in the drawing.

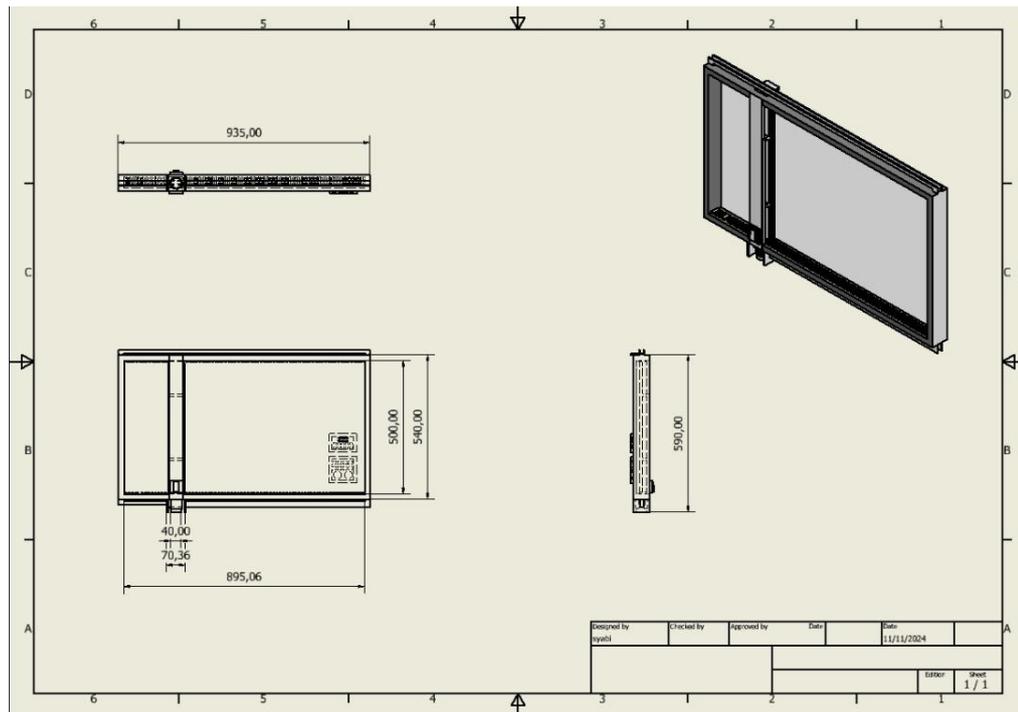


Figure 3.7.4 shown the isometric drawing of the project

The fabrication and arrangement for the Brightboard Autowipe involves the manufacturing and arrangement of the main components of the system. The fabrication process entails creating the whiteboard, rack and spur gear, as well as motion sensors and other electronic components using cutting and assembly machines. Following this, the components are assembled in such a way as to form a functioning system, including mounting the whiteboard onto the stand, arranging the automatic cleaning mechanism, and connecting electronics to ensure that the system can operate effectively and reliably.

3.8 FABRICATION / ARRANGEMENT

The Brighboard Autowipe project was conducted within the Mechanical Engineering Department at Polytechnic Banting Selangor, where the fabrication process was carried out in the project workshop to ensure a smooth workflow. To effectively manage the various tasks involved, each team member has been given their assigned task.

Each task was outlined in detail, covering everything from initial material preparation to the final assembly of the whiteboard's wiping mechanism. The fabrication steps included material cutting, structural assembly, installation of the wiping system with motor and Arduino integration and testing each component to ensure proper functionality.

3.9 MEASUREMENT AND MARKING PROCESS

Figure 3.9.1 shows the measurement process and material marking. In the process of creating the auto-wipe whiteboard, the first step is to measure and mark the dimensions. Start by determining the size of the whiteboard. After that, identify the location for the automatic wiping mechanism, considering its position so that it does not obstruct writing on the whiteboard. For marking, use a marker and ruler to draw straight lines indicating the cutting areas. Also, label each section of the board if there are multiple components to facilitate assembly. Finally, review all measurements and markings to ensure accuracy before starting the cutting process. Keeping a record of the measurements and markings is also important for reference during the manufacturing process.



Figure 3.9.1 shows the measurement process and material marking

CUTTING PROCESS

Figure 3.9.2 and 3.9.3 shows cutting process. In the cutting process, the first step is to cut the PVC square tubing that will be used for the wiping mechanism. To do this, use a grinder with a sharp and suitable cutting blade to ensure clean and precise cuts. Before starting the cutting, carefully measure the required length using a ruler and clearly mark it on the PVC tubing. After that, proceed with the cutting carefully, ensuring that the tubing does not wobble during the process to avoid mistakes. Once the PVC tubing is cut, the next step is to cut the stainless-steel shaft that will be placed in the centre of the PVC tubing. This shaft needs to be cut to the correct size because it will function to connect to the spur gear. Use an appropriate metal cutter to ensure that the cut is smooth. After all the cutting is completed, check each piece to ensure its quality and accuracy.



Figure 3.9.2 shows the stainless-steel shaft cutting process



Figure 3.9.3 shows the PVC square tubing cutting process

DRILLING PROCESS

Figure 3.9.4 shows drilling process. In the drilling process, the first step is to mark the locations of the holes to be made on the whiteboard. Make sure to measure accurately to determine the proper position for the holes that will connect to the rack gear. Once the locations are marked, use a gauge or ruler to ensure all markings are at equal distances and aligned. After marking, choose a drill bit with a diameter of 5 mm and attach it to the drill. Ensure that the drill is stable and properly aligned before starting the drilling process. Drill slowly and consistently to avoid damaging the whiteboard.

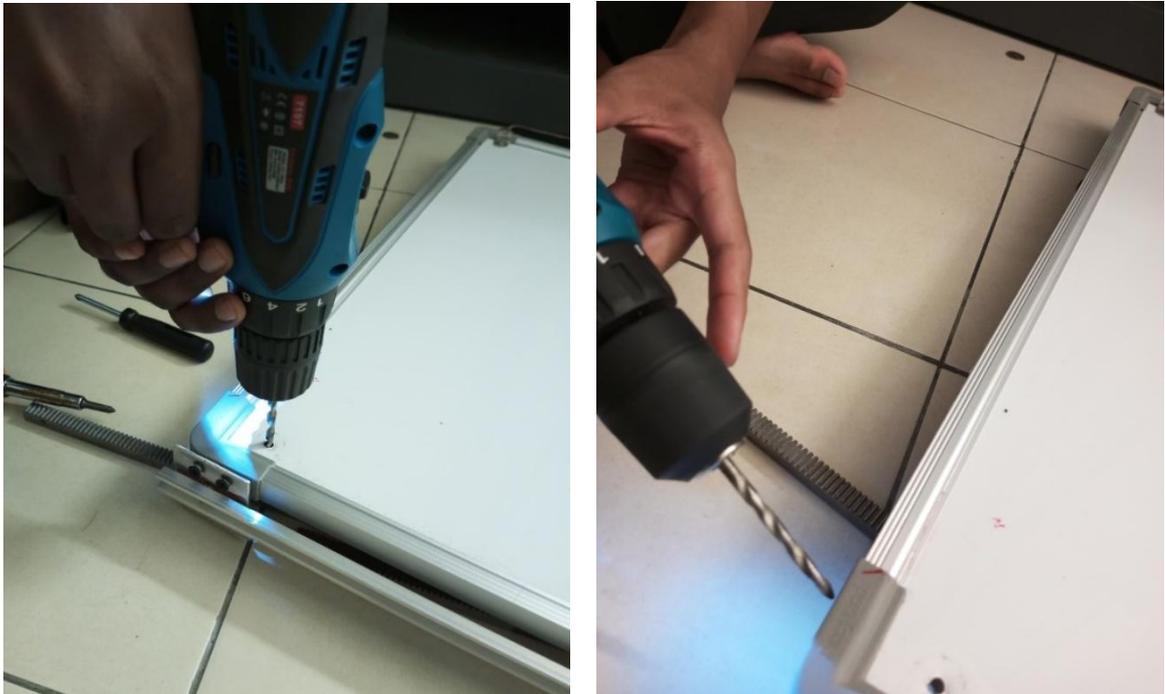


Figure 3.9.4 shows drilling process at whiteboard

ASSEMBLY PROCESS

Figure 3.9.5 shows the assembly process. In the assembly process, the first step is to attach the rack gear to the whiteboard using screws and nuts. Ensure that the holes previously drilled in the whiteboard align with the position of the rack gear. Place the rack gear in the marked position and use screws to secure it tightly. After that, attach the nuts to the back of the screws and tighten them using a screwdriver to ensure the rack gear is firmly installed. The next step is to attach the DC motor to the PVC square tubing. Make sure the DC motor is positioned correctly for it to function properly. Use screws and nuts to secure the motor to the PVC tubing, ensuring all connections are tight and stable. Also, ensure that the electrical connections to the motor are safe and not exposed.



Figure 3.9.5 shows assembly process screw and nut

WIRING PROCESS

In the wiring process for creating an automatic whiteboard cleaner using Arduino and a 12V DC motor, the first step is to design an appropriate circuit. Connect the DC motor to the Arduino circuit using a motor driver to control the motor's direction and speed. Ensure that one terminal of the motor is connected to an output pin on the Arduino and the other terminal is connected to a suitable power source, making sure all connections are secure and tight. Once all components are assembled, write the code using the Arduino IDE. Be sure to test and verify each connection and the code to ensure everything functions correctly. Accurate wiring and correct coding are essential for ensuring the automatic whiteboard cleaner operates smoothly and efficiently.

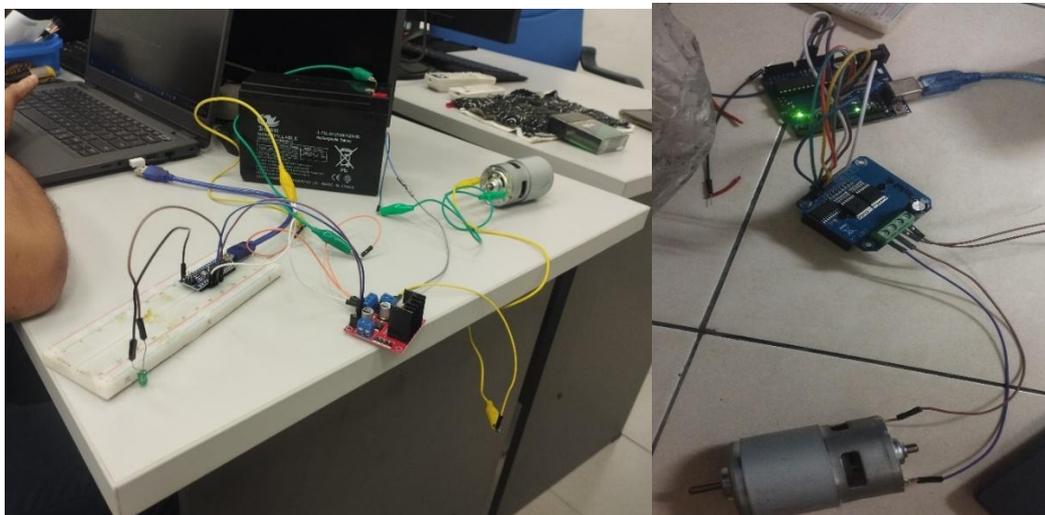


Figure 3.9.6 shows wiring process on Arduino Uno, motor driver and DC motor

3.10 SUMMARY

The Brightboard Autowipe project aims to simplify whiteboard maintenance by automating the cleaning process. The methodology involves using an Arduino Uno to control the system. The system is designed to be user-friendly, cost-effective, and sustainable, making it suitable for daily use. The project involves gathering materials, measuring and cutting them, building the prototype, and testing the final product. The final design includes components like a whiteboard, stand, Arduino Uno, motor driver, rack and pinion, all working together to automate the cleaning process.

CHAPTER 4

DATA AND DISCUSSION

4.1 INTRODUCTION

The Brightboard Autowipe project combines Arduino technology, mechanical design, and efficient programming to create an automatic whiteboard cleaner that is both user-friendly and energy-efficient. The data collected during the testing phase of the project provided insights into the performance, reliability, and efficiency of the system. Various aspects, such as cleaning speed, energy consumption, and the durability of mechanical components, were analyzed to ensure optimal functionality. The discussion focuses on evaluating these results against our initial design goals, addressing any discrepancies, and highlighting areas for potential improvement. This comprehensive analysis validates the effectiveness of the Brightboard Autowipe in real-world applications, particularly in educational or professional environments that frequently use whiteboards.

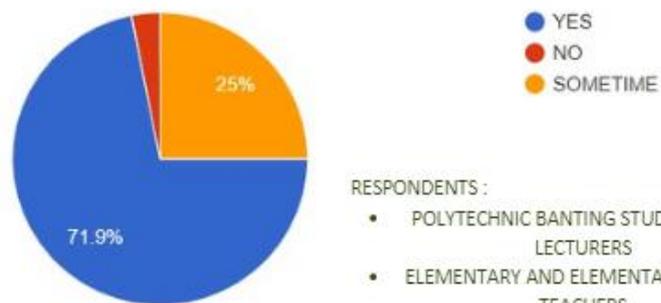
4.2 SURVEY QUESTION

The Brightboard Autowipe survey aims to gather valuable insights and opinions from key users such as polytechnic students, lecturers, and elementary and secondary school teachers. This feedback is important for understanding user needs and preferences, as well as assessing the effectiveness and practicality of the automatic whiteboard cleaner in a variety of educational settings. By seeking feedback from those who frequently use whiteboards, the project desires to enhance its features and ensure that the Brightboard Autowipe is both user-friendly and beneficial in improving classroom experiences.

Here are the questions asked during the survey :

Do you often using whiteboard in your classrooms such as teaching, brainstorming or visualing ideas?

32 responses

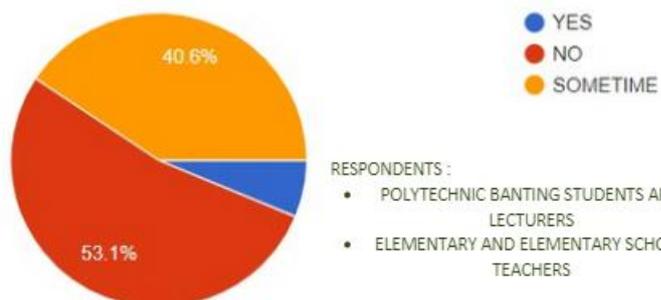


RESPONDENTS :

- POLYTECHNIC BANTING STUDENTS AND LECTURERS
- ELEMENTARY AND ELEMENTARY SCHOOL TEACHERS

Are you satisfied with the cleanliness and maintenance of whiteboards in your classroom?

32 responses

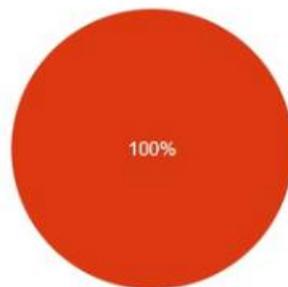


RESPONDENTS :

- POLYTECHNIC BANTING STUDENTS AND LECTURERS
- ELEMENTARY AND ELEMENTARY SCHOOL TEACHERS

Have you ever used an automatic whiteboard cleaner?

33 responses



- YES
- NO

RESPONDENTS :

- POLYTECHNIC BANTING STUDENTS AND LECTURERS
- ELEMENTARY AND ELEMENTARY SCHOOL TEACHERS

Would you be interested in using an automatic whiteboard cleaner to save time and effort?

34 responses



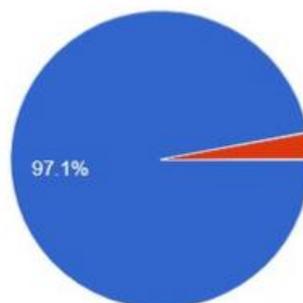
- YES
- NO

RESPONDENTS :

- POLYTECHNIC BANTING STUDENTS AND LECTURERS
- ELEMENTARY AND ELEMENTARY SCHOOL TEACHERS

Would you recommend an automatic whiteboard cleaner to others?

34 responses



- YES
- NO

RESPONDENTS :

- POLYTECHNIC BANTING STUDENTS AND LECTURERS
- ELEMENTARY AND ELEMENTARY SCHOOL TEACHERS

4.3 PROJECT COSTING

MATERIAL	QUANTITY	PRICE
STAINLESS STEEL SHAFT	1	RM 16.40
10 METER BLACK AND RED WIRE	1	RM 6.50
BTS7960 MOTOR DRIVER MODULE 43A	1	RM 30.00
RACK AND PINION	2	RM 160.20
12V BATTERY SUPPLY	1	RM 54.08
ARDUINO UNO	1	RM 28.00
WHITEBOARD	1	RM 260.00
PVC SQUARE CASING	1	RM 16.70
BOLT AND NUT	2	RM 10.40
JUMPER WIRE	3	RM13.98
SPONGE 1 METER	1	RM9.90
BALL BEARING PILLOW BLOCK MOUNTED	1	RM 10.90
STAINLESS STEEL L BRACKET	8	RM 9.20
SLIDING DOOR ROLLER GUIDE	2	RM 9.00
SLIDING DOOR ROLLER	2	RM 3.50
SCREW	2	RM 6.00
SPRAY BLACK	1	RM 6.00
POWER BANK	1	RM 25.00

TOTAL COST : RM 697.00

4.4 RESULT OF THE PROJECT

This project aimed to create an automatic whiteboard cleaner. This project was successfully implemented. The device moved along the whiteboard surface powered by the DC motor driven by an Arduino Uno. This could detect the edges of the board, which was good, then overshoot and would go all over the exact surface to clean. The cleaning mechanism, based on a duster in the cleaner, removed whiteboard markings and wiped clean with each pass.

However, there were minor problems encountered during testing, such as speed irregularities on the motor and difficulty in cleaning off dried-up or stubborn marker residue. These are issues that became apparent after tests of motor calibration and cleaning material replacement. Although these challenges could have indicated that the project was a failure, a proof-of-concept cleaning solution was created through this process, and it was determined that there is value in the further development of these systems.



Figure 4.4.1 shows the result of the project.

PROJECT ANALYSIS

Time taken for the whiteboard eraser to move forward and backward:

Date 26/10/2024 :

FORWARD	BACKWARD
5s	7s

Total time = 12s

CALCULATION

For both forward and backward movement

i. Force

$$F = m \times a$$

$$\text{mass, } m = 2.5 \text{ kg}$$

$$\text{acceleration, } a = 2 \text{ m/s}^2$$

$$F = 2.5 \times 2 \\ = 5 \text{ N}$$

ii. Torque

$$\tau = F \times r$$

$$\text{Force, } F = 5 \text{ N}$$

$$\text{Distance from the rotation axis}$$

to the force point,

r

$$\tau = 5 \times 0.9$$

$$= 4.5 \text{ Nm}$$

iii. Motor rotation (Circumference)

$$C = \pi \times D$$

$$\text{Pinion Diameter, } D = 10 \text{ mm}$$

$$= 0.01 \text{ m}$$

$$C = \pi \times 0.01$$

$$= 0.0314 \text{ m}$$

iv. Number Of Rotations

$$\text{Number Of Rotations} = \frac{\text{Linear distance}}{\text{Circumference}}$$

$$\text{Linear distance} = 90 \text{ cm}$$

$$= 0.9 \text{ m}$$

$$\text{Circumference} = 0.0314 \text{ m}$$

$$\begin{aligned}\text{Number Of Rotations} &= \frac{0.9}{0.0314} \\ &= 27 \text{ rotations}\end{aligned}$$

v. Time taken for complete cycle (Rotation)

$$\text{Time taken (in minutes)} = \frac{\text{Number of rotations}}{\text{Motor speed}}$$

For forward movement,

$$\text{Motor speed} = 255 \text{ rpm}$$

$$\begin{aligned}\text{Time taken (in minutes)} &= \frac{27}{255} \\ &= 0.106 \text{ min}\end{aligned}$$

$$\begin{aligned}\text{Time taken (in seconds)} &= 0.106 \times 60 \\ &= 6.35 \text{ s}\end{aligned}$$

For backward movement,

$$\text{Motor speed} = 155 \text{ rpm}$$

$$\begin{aligned}\text{Time taken (in minutes)} &= \frac{27}{155} \\ &= 0.174 \text{ min}\end{aligned}$$

$$\begin{aligned}\text{Time taken (in seconds)} &= 0.174 \times 60 \\ &= 10.45 \text{ s}\end{aligned}$$

Total time taken for complete movements = 16.8 s

CHAPTER 5

RECOMMENDATION AND CONCLUSION

5.1 PROBLEM FACED DURING INNOVATION

The development of the Brightboard Autowipe project encountered several challenges, including difficulties in achieving a compact and efficient mechanical design that could move the eraser smoothly across the whiteboard. The whiteboard cleaner became less stable, an error in programming occurred during simulation in Arduino software, and the motor driver became hot and burned. During the wiring process, our motor driver and Arduino Nano burned due to incorrect wiring on the positive and negative terminals on the battery supply. The same thing happens when we wire the DC motor. The whiteboard eraser moves for a few seconds before the wires and motor driver burn, and the Arduino Nano is not responding.

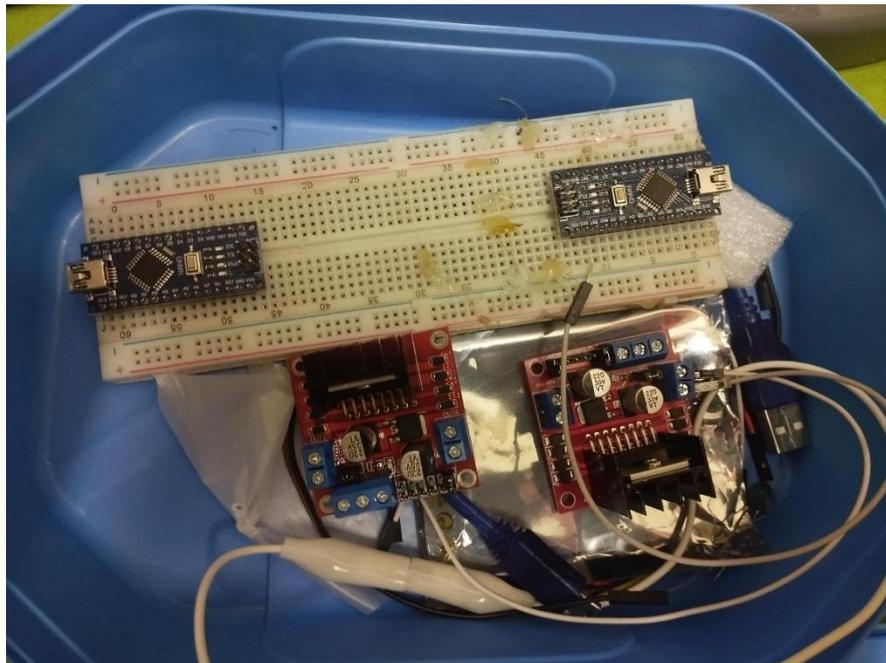


Figure 5.1.1 shows the burned motor driver and Arduino Nano.

5.2 PROBLEM FACED WHEN DESIGNING THE PROJECT

In designing the automatic whiteboard cleaner, there were a few key challenges that had to be faced. First, there was the big issue of how to move the cleaner very precisely over the area of the whiteboard. Tuning the motor control and gear system for great smoothness and consistency without slipping or stalling took quite some adjustment and testing.

The other challenge was designing a user-friendly system with mechanical reliability was challenging; building something that would not show major wear after continuous use. Last but not least, efficiently and responsively coding the motors with Arduino Uno was challenging because this involved fine-tuning of the system to users' input. These problems required iterative testing, refinement, and creative problem-solving in order to provide a stable and functional design.

5.3 PROBLEM FACED IN THE USE OF MATERIAL

In the process of creating the Brightboard Autowipe project, several issues that we face including purchasing screws and nuts with the wrong diameter, leading to incompatibility in assembly. Additionally, there was a mistake in buying a bracket for the DC motor that was not suitable for the model used, resulting in difficulties in securely mounting the motor. Furthermore, cutting the shaft too short, caused challenges in connecting it with other components, such as the pinion, and could lead to mechanical failure. These issues highlight the importance of careful planning and precise measurements before purchasing materials.

5.4 OVERALL DISCUSSION

As the result of the research, our group have identified the suitable solution for the problem such as buying the right bracket for the motor and the right size of the screw and also buy it more than needed to make sure we have a spare screw in case some of them is missing. Additionally, we have carefully plan the process again to ensure the success of our project. However, during the presentation day, we were unable to demonstrate the functionality of our project to our panel. It's because the night before the presentation day, when we wanted to do the final testing of our project, the DC motor didn't work. We found that the port from the motor driver to the DC motor has no electric current flow using a multi meter. Maybe this is due to overload or our whiteboard eraser is too heavy. However, we managed to record a video of how our project worked two days before the incident and showed it to the panel.

5.5 RECOMMENDATION

- Add sensor to detect markings on the board, allowing the eraser to automatically activate only where needed, reducing wear and conserving power.
- Implement Bluetooth or Wi-Fi connectivity to enable remote control and scheduling, allowing users to activate or schedule board cleaning from a smartphone app.
- Add a small, controlled spray mechanism to the board before the eraser begins its wiping motion, which would help to remove more stubborn marks and maintain a cleaner board surface.

5.6 CONCLUSION

The Brightboard Autowipe project has synergized Arduino technology with mechanical design and ergonomic aspects to develop an efficient automatic whiteboard cleaning system. Designed with energy efficiency, cost-effectiveness, and ease of maintenance in mind, this innovation addresses the needs of various educational environments, such as classrooms and lecture halls. Looking at the other side of the innovation, the Brightboard Autowipe solution helps improve efficiency and convenience as well, particularly to teachers, lecturers, and students who are usually the victims of a whiteboard's tedious cleaning process.

5.7 REFERENCES

GOOGLE SCHOLAR

1. *Southeast Asian Journal of Technology and Science Design and development of smart whiteboard cleaner in classroom application.* (n.d.). ResearchGate. https://www.researchgate.net/publication/343218988_Southeast_Asian_Journal_of_Technology_and_Science_Design_and_development_of_smart_whiteboard_cleaner_in_classroom_application
2. Sannamat, R., Ashiqur, R. R. M., Tanmony, R. A., Ahammed, R., & Ahammed, R. (2023, May 6). *Design and Fabrication of an Automatic Whiteboard Cleaner.* <http://suspace.su.edu.bd/handle/123456789/760>
3. Felix, L. a. . E. O. U. I. D. J. H. E. M. (2023). Development and fabrication of an upgraded automatic whiteboard cleaning machine. *Zenodo (CERN European Organization for Nuclear Research).* <https://doi.org/10.5281/zenodo.8029287>
4. https://d1wqtxts1xzle7.cloudfront.net/59813912/IRJET-V6I435020190620-12287-zmr79c-libre.pdf?1561096304=&response-content-disposition=inline%3B+filename%3DIRJET_Design_and_Fabrication_of_Smart_Bo.pdf&Expires=1713790950&Signature=fRPiP4y-46mrgb97VO-bII-IPjXqSnbrsxI0o4vYoZXPfi4NvV11yHFX2u~WSrUBY-3MsyQKEVykLg1mK5FyDyZrK-dESY27hJ0vaKLHFHQ5Qo-pumy7hLD1SBh2QLC1~RIyljARhdLIRMr6Dr1kQs0C1mZ4dHY6DIS0byQ8o2zfw4f02nc78ZNR2UTE6saYwjoEqS5EMnRJK9drFL0ivUCFl~5On73iiq2cws9Lqq43iwtDWz5RpEbY3-7VL-2lrl-



JABATAN KEJURUTERAAN MEKANIKAL

JADUAL AGIHAN TUGASAN INDIVIDU KUMPULAN PROJEK

TAJUK PROJEK : BRIGHTBOARD AUTOWIPE

SUB-CHAPTERS	DESCRIPTION
NAME OF STUDENT : MOHAMMAD SYAHMIL HAKIMI BIN MOHD SUFIAN SYAH (24DTP22F1054)	
CHAPTER 1	1.0 INTRODUCTION 1.1 PROJECT BACKGROUND 1.2 PROJECT SCOPE
CHAPTER 2	2.2 PREVIOUS STUDIES/ JOURNAL/ INVESTIGATION
CHAPTER 3	3.3 BLOCK DIAGRAM 3.4 MATERIAL AND EQUIPMENT 3.10 SUMMARY
CHAPTER 4	4.1 INTRODUCTION
CHAPTER 5	5.1 PROBLEM FACED DURING INNOVATION 5.5 RECOMMENDATION
NAME OF STUDENT : MOHAMMED FAIZAL BIN RAJA HUSIN (24DTP22F1001)	
CHAPTER 1	1.3 PROBLEM STATEMENT 1.4 PROJECT OBJECTIVE 1.5 EXPECTED PROJECT RESULT
CHAPTER 2	2.2 PREVIOUS STUDIES/ JOURNAL/ INVESTIGATION
CHAPTER 3	3.5 DATA ANALYSIS METHOD 3.6 FLOW CHART
CHAPTER 4	4.4 RESULT OF THE PROJECT
CHAPTER 5	5.2 PROBLEM FACED WHEN DESIGNING THE PROJECT

NAME OF STUDENT : MUHAMMAD AMMAR BIN EIROHMAN (24DTP22F1039)	
CHAPTER 1	1.7 SUMMARY
CHAPTER 2	2.1 INTRODUCTION 2.2 PREVIOUS STUDIES/ JOURNAL/ INVESTIGATION
CHAPTER 3	3.7 DRAWING PROJECT 3.8 FABRICATION/ ARRANGEMENT 3.9 MEASUREMENT AND MARKING PROCESS
CHAPTER 4	4.3 PROJECT COSTING
CHAPTER 5	5.3 PROBLEM FACED IN THE USED OF MATERIAL 5.7 REFERENCE
NAME OF STUDENT : MUHAMMAD SYABIL FITRI BIN MOHD NABIL (24DTP22F1045)	
CHAPTER 1	1.3 PROBLEM STATEMENT
CHAPTER 2	2.2 PREVIOUS STUDIES/ JOURNAL/ INVESTIGATION 2.3 SUMMARY
CHAPTER 3	3.1 INTRODUCTION 3.2 GANTT CHART
CHAPTER 4	4.2 SURVEY QUESTION
CHAPTER 5	5.4 OVERALL DISCUSSION

Pengesahan Penyelia Projek :

.....
Nama :