

Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

Title of Project: Motorised Whiteboard Duster
Group Name: 3-06
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1. Problem Finding

(The beginning...)

Identify a problem you would like to solve. You may want to brainstorm for problems using different approaches e.g. thematic, survey or general brainstorming etc.

1 A Document a list of problems you have identified. Your documentation should show clearly how your group came up with the problems.

We have tried to identify problems encountered by persons who we can easily identify with, such as students and teachers, as well as more vulnerable groups such as elderly persons and those with special needs. The list of problems identified are listed below:

Problem	Considerations
a) Visually impaired persons may not have a chance or experience difficulties using electronic devices such as computers.	We often see visually impaired persons having difficulties using computers. Special hardware and software catered specially for them may also be expensive and inaccessible to them.
b) It is tedious and time consuming for teachers and students to clean the whiteboard manually daily	Every day, we see our teachers and fellow classmates spending time cleaning the whiteboard. The process is tedious and disruptive and often results in us losing concentration.
c) Some elderly persons are less tech-savvy and need help using gadgets such as mobile phones and tablets	We often encounter our grandparents asking for help on using gadgets to surf the internet or mobile phones to send messages etc.

1 B You should have selected a problem based on some considerations. Identify and justify these considerations.

The selection of the problem to solve for our project was based on the following considerations:

Consideration	Justifications
a) People who are affected by the problem/Impact of the problem	<ul style="list-style-type: none">✓ It is easier to work on a problem which we ourselves have personally encountered or can identify with so that we can better understand the issue and propose relevant and useful solutions.✓ It is also more beneficial to select a problem which affects a larger group of people so that the solutions will be more impactful.✓ It is more meaningful to select a problem which affects the vulnerable group as they need help most.
b) Occurrence of problem	<ul style="list-style-type: none">✓ It is more efficient to select a problem which we encounter very often in our daily lives.

c) Availability of solutions in the market	✓ It is more meaningful and impactful to select a problem where solutions are not currently widely available or if available, are not very accessible in the market.
d) Capability required	✓ As students, there may be a limit to what we can do. Hence, the solutions to the problem selected must be something that is within our ability.

1 C List some problems your group would like to solve. List also the considerations for selection of problem in the evaluation grid below. Score the considerations, against the problems, with points 1 (least significant) to 4 (most significant). Sum up the total points for each problem. Identify that problem you would like to solve.

Problem Evaluation Grid

Considerations for Selection	Problems		
	Visually impaired persons may not have a chance or experience difficulties using electronic devices such as computers	It is tedious and time consuming for teachers and students to clean the whiteboard manually daily	Some elderly persons are less tech-savvy and need help using gadgets such as mobile phones and tablets
Impact of problem <i>1 (low); 4 (high)</i>	2	4	3
How far we can identify with the problem <i>1 (small extent) ; 4 (large extent)</i>	1	4	3
Occurrence of problem <i>1 (infrequent); 4 (very frequent)</i>	3	4	3
Availability of solutions in the market <i>1 (many); 4 (little or none)</i>	3	3	1
Capability required <i>1 (high); 4 (low)</i>	1	2	4
Total Score	10	17	14

2. Define the Problem

(This is one...)

Now that the problem has been identified. It is important to gather information on the extent of the problem and/or evaluate the usefulness of existing solutions based on *some criteria*. You may need to conduct surveys and research on existing solutions.

2 A Extent of problem (Research and discuss the problem and write down the problem statement)

Cleaning the whiteboards manually with a hand duster is time consuming and creates inconvenience for both teachers and students on a daily basis. Specifically,

- a) The cleaning process is very time consuming and tedious. Precious learning hours are being lost each day as this process takes place during/after EACH lesson.
- b) It breaks the concentration of the students when the teacher requests a student who is in the midst of taking notes to clean the whiteboard or when the teacher stops the class to clean the board.
- c) It leads to fatigue in the teacher or student cleaning the entire board, especially when trying to reach for the higher parts of the board.
- d) Precious time is also being wasted when trying to locate missing whiteboard dusters.

2 B Compare and contrast the existing or similar solutions.

The existing solutions/inventions listed below do not require the users to clean the board manually. The entire whiteboard is cleaned automatically with a press of a button.

However, while Solution 1, 3 and 4 require the installation of a motor on the normal whiteboard, Solution 2 is an interactive smart electronic board. In terms of cost, Solution 2 is very expensive, with each board selling at more than US\$1,000. Solutions 1 – 3 also clean the entire whiteboard at one go, i.e. they cannot be customised to clean only the desired parts of the whiteboard. However, our duster is inexpensive and is able to clean desired parts of the whiteboard in a short period of time.

Solution	Function	Gaps
<u>Solution 1</u> Automated Motorised Whiteboard	<ul style="list-style-type: none">● Based on rotation of flexible whiteboard surface material around the rollers and cleaning the surface by the dusters fixed at the back of the board.● When the switch is on, current is passed to the motors and they start rotating. The rollers connected to it also rotates which in turn rotates the sheet around it. The sheet moves from the front to the back side of the board and gets rubbed due to the friction between sheet and dusters. The sheet which is initially at the back side of the board comes in front for use.	<ul style="list-style-type: none">● Unable to only clean the desired parts of the whiteboard● Not portable as the cleaner is fixed to the whiteboard

Solution	Function	Gaps
<u>Solution 2</u> Chalk Free Writing Screen Projection Smart Whiteboard	<ul style="list-style-type: none"> ● 5 in 1 interactive electronic board ● Clean the entire board with only a press of a button 	<ul style="list-style-type: none"> ● Expensive (US\$1,240) ● Unable to only clean the desired parts of the whiteboard
<u>Solution 3</u> Automatic Whiteboard Cleaner System	<ul style="list-style-type: none"> ● Dusters mounted on shafts which are in turn connected on a supporting frame. ● The first motor drives the shafts in the required direction. A second motor then drives the entire duster frame in a horizontal motion so that the board is cleaned as the frame reaches the other end of the board. 	<ul style="list-style-type: none"> ● Bulky (Takes up space on the whiteboard) ● Not portable and can only be used for one whiteboard ● Unable to only clean the desired parts of the whiteboard
<u>Solution 4</u> IR Controlled Automatic Whiteboard Cleaner Using Arduino	<ul style="list-style-type: none"> ● Cleans the whiteboard using IR control ● Customised cleaning, i.e. allows cleaning of desired part of the whiteboard using the IR remote 	<ul style="list-style-type: none"> ● Slow. Takes 1 min 55 secs to clean the entire board. ● Requires complex programming ● Requires many hardware components such as Arduino uno microcontroller, Stepper motor, Servo motor, CNC shield etc.

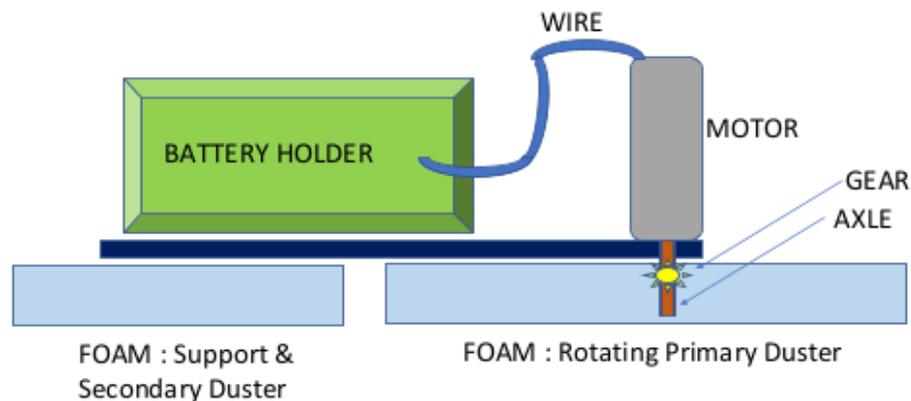
3. Your BIG IDEA# (Developing the idea....)

Write down your proposed invention and why you want to do it. State also how you think your proposed invention is better.

3 A Describe your proposed invention.

Our proposed invention is a motorised whiteboard duster that is spun by a motor, with the battery holder attached on top of it, resulting in a part of the duster to spin, enabling the user to clean the whiteboard more effectively and efficiently.

PROTOTYPE 3 SKETCH



3 B Explain the purpose of your proposed invention and the potential benefits to users.

The objective of our invention is to reduce the time spent on cleaning white boards to facilitate efficient teaching using whiteboards.

Other than saving precious time and energy, our invention is affordable and can be produced at a relatively low cost. Hence, it will be accessible to most people. It is also safe and easy to use and can be easily operated easily by the likes of students.

All in all, our proposed invention increases the efficiency of cleaning the whiteboard, thus reducing precious time and energy wasted on such a low value-added task for teachers and students.

Secondary 1 Students

- With less time wasted on erasing the board, students can absorb and process more information from the teachers during lessons. This resulted in more effective teaching and less disruptions as it reduces the time taken to clean the whiteboard.
- With such seamless effort in erasing the whiteboard, students' focus and attention is not disrupted, saving a lot of time.

- Students will be able to spend the time resting or doing other more value-added things, instead of wasting valuable time cleaning the whiteboard

Secondary 1 Teachers

- Teachers can spend less time erasing the board and more time teaching the students, allowing students to absorb more information.
- Teachers can save energy when erasing the board because less arm movement is required when using our device to achieve the desired result, i.e. a clean whiteboard.
- A cleaner board = better working environment for the teachers = more productivity

3 C In what ways would your proposed invention be different and/or better than existing solutions, if any?

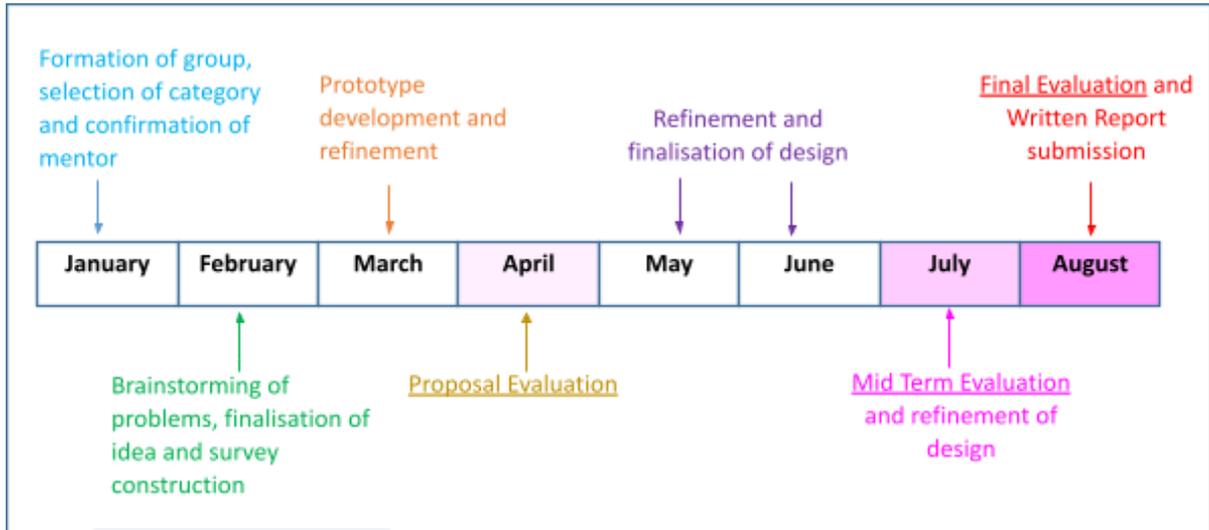
Our invention is better than existing solutions as it

- (a) Can be produced at low cost and hence, is affordable and accessible to more people.
- (b) Allows the cleaning of only the desired parts of the whiteboard instead of the entire board which is a major drawback of most current solutions. By cleaning only the desired parts, it allows students to continue taking down notes while the teacher cleans other parts of the board for their use.
- (c) Is safe and easy to use and can be operated easily by the likes of students
- (d) Is easy to maintain and does not require the installation of a motor on the whiteboard.

3 D What are some problems you expect in the course of your proposed invention?

1. Difficult for members to meet up for discussions. All of us have different commitments such as CCA and coupled with the current COVID situation, it is challenging to find a convenient time for us to discuss matters pertaining to our project, and meet up with our mentor for consultation.
2. Costs of the parts involved in the making of this duster. As we want to produce a duster with the lowest cost possible, we spent much time scouting for parts which are low cost and yet efficient and suitable for our duster .
3. After attaching the motor and components, the duster became bulky and heavy. We had to find ways to reduce the number of parts required so that it would not be too heavy and bulky for the user to operate it.

3 E What and when are the major milestones (project timeline) in your invention?



#must be able to be constructed based on current / emerging technologies, must not violate the laws of Science or go against the laws of nature.

4. Construction or Modelling Process*

(This first... then that...)

You are now onto the fabrication of your prototype/ product. You need to select material and understand how to put them together so that your prototype/ product can perform its function.

4 A Explain how and why the materials were chosen for the prototype/ product of your invention

We chose the materials with care and took into consideration several important factors, such as the cost and weight of the materials. We want to ensure that the duster is as efficient, light and affordable as possible. We hope that users will find our product easy and convenient to use.

4 B Explore these considerations that may guide the construction of your prototype/ product.

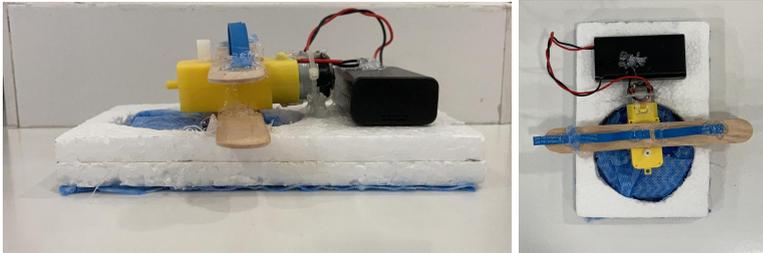
Considerations that we took into account that helped guide us during the construction of our prototype

Consideration 1	Price of materials used	We want our motorised duster to be affordable, allowing this product to be easily accessible to anyone.
Consideration 2	Weight of the motorised duster	We want our duster to be as light as possible to facilitate usage, especially by younger students. We also want it to be portable and easy to carry around.
Consideration 3	Size of the motorised duster	We want the duster to be small and compact. This will ease usage of our product, especially if they are to be used by younger students. A smaller duster will also be easier to carry around.
Consideration 4	Effectiveness of the motorised duster	We strive for the motorised duster to effectively and efficiently clean the whiteboard as compared to regular whiteboard dusters. This will then entice people to use it, rather than it being profligate.
Consideration 5	Noise emission of the motorised duster	We want the motorised duster to generate as little noise as possible during usage so as to minimise distraction and facilitate a conducive learning environment.

4 C Document the prototype/ product development stages. You may use drawings, photographs or videos.

This is our first prototype.

The materials used include Motor, Foam Duster, Hot Glue, Batteries, Battery Holder, Wires, Ice Cream Sticks, Tape



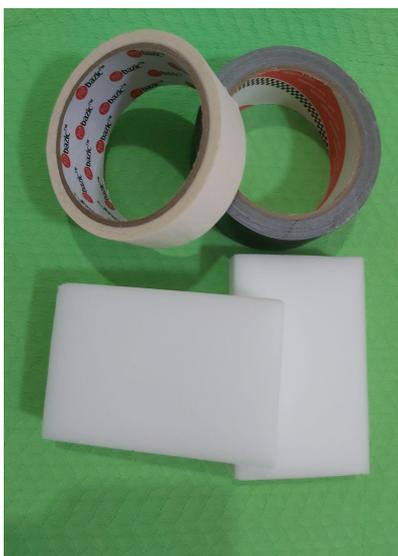
This is our second prototype.

The materials include Plastic boards, Batteries , Rubber bands, Aluminium foil, DC motor Wires



The materials for the third prototype which we used are as listed below:

Tape, Pieces Of Foam, Duster, Lego Parts (Beams, Stoppers, Axels, Gears), Motor, Battery Holder



Step 1: Firstly, we gathered all the materials together before we started. Then we connected all the parts together, connecting the beams to stoppers and axles before inserting the gears.

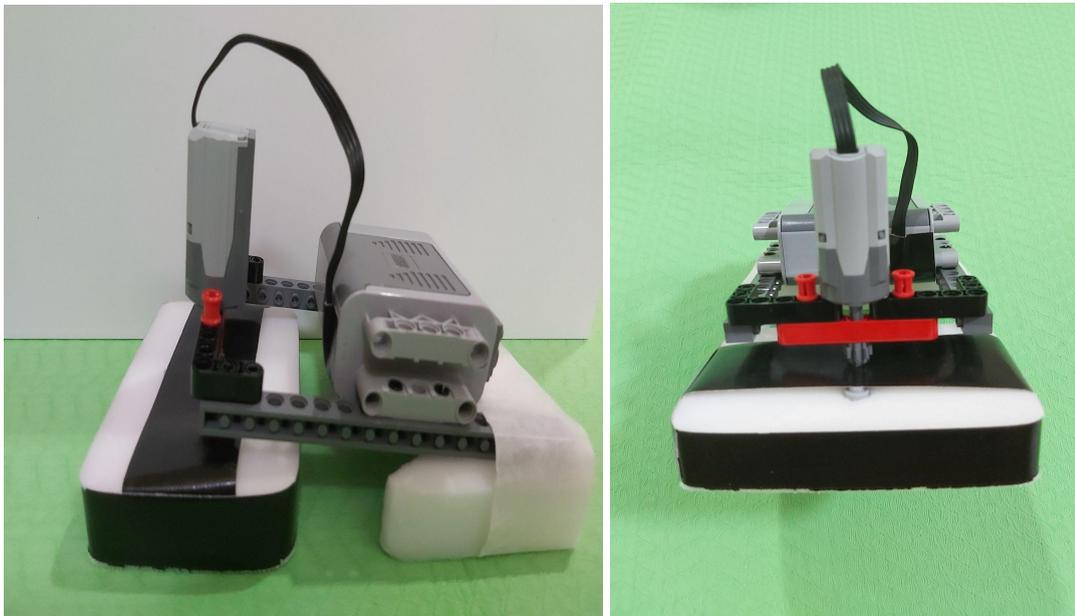
Step 2: Secondly, we took the pieces of foam and placed our lego contraption on top of it and connected them together; the foam acting as a solid platform on which the lego could be supported.

Step 3: Thirdly, we can secure the battery holder to the beams and proceed to connect the wire from the battery holder to the motor.

Step 4: Fourthly, we used tape to bind the whole structure together so as to connect the respective parts and form our motorised duster.

Step 5: Lastly, we used some wires to connect the battery holder to the motor to motorise our duster.

Here is our finished product!



OR

If construction of the prototype is not possible, then you have to create an animation / as a proof of concept that it can be applied on a bigger scale.

4A Explain why construction of a prototype is not possible and the proof of concept is needed in your case.

4B Briefly explain how the video / animation can effectively show how your invention will work and the different considerations.

Warning:

- Video / animated simulation only if prototyping is absolutely not possible.
- Video / animated simulation must be logical and convincing that the invention works.
- Constraints must be clearly included in the logbook or the project will be heavily penalized.

5. Modification and Evaluation

Upon the completion of your prototype/ product, you would need to see if it is working the way you want it to work. Check if your product has met the identified purpose and the user's need; and implement necessary modifications and improvements. This process may take several rounds.

5 A Write down your prototype/ product test criteria and check against it if it works. Identify areas of weakness for modification. Indicate the test iteration and date of test.

Prototype 1

Test Iteration:	Tick			Remarks
Test Date:	Pass	Fail	Potential Failure	
Efficiency of the motorised duster		✓	-	Usage of our first prototype was not efficient. It took a long time and strength to clean the entire whiteboard.
Weight of the motorised duster	✓		-	The duster was extremely light and thus did not require much strength or energy to lift and use it.
Effectiveness of the motorised duster		✓	-	The motorised duster was unable to clean the whiteboard effectively, smudging the ink marks rather than cleaning them.

Prototype 2

Test Iteration:	Tick			Remarks
Test Date:	Pass	Fail	Potential Failure	
Efficiency of the motorised duster		✓	-	Like the first prototype, our second prototype took a long time to clean the whiteboard. It also required some external impetus to carry out the cleaning.
Weight Mass of the motorised duster	✓		-	The duster was relatively light and easy to use.
Effectiveness of the motorised duster		✓	-	The duster was unable to clean the whiteboard effectively, leaving many traces of ink marks. It also short-circuited upon usage.

Prototype 3

Test Iteration:	Tick			Remarks
	Pass	Fail	Potential Failure	
Test Date:				
Efficiency of the motorised duster	✓		-	Our third prototype was able to almost instantaneously clean the whiteboard without the need of any external force.
Weight of the motorised duster	✓		-	The duster was relatively light, and quite compact.
Effectiveness of the motorised duster	✓		-	The duster did not leave any marker ink on the whiteboard and, as stated above, cleaned the whiteboard quickly and effectively.

*Add more rows for more criteria

** Repeat table for next test iteration

OR if you are creating an animation / video to show how your invention will work, write down the different possibilities / outcomes [success or failure] if a full-scale prototype is to be constructed.

6. References

Read <http://www.bibme.org/citation-guide/apa/> on how to cite references.

6 A Cite the references you have used for your project work. Your source of reference should come from different types (e.g., books, magazine, websites, journal articles, interview, photographs, product brochure, reviews etc.)

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