

Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

Title of Project: Portable Cleaner
Group Name: Make Singapore Clean Again!
Group Members: <ol style="list-style-type: none">1) Tan Zhi Yong2) Ryan Ng Yiheng3) Eion Chan4) Fu Jing Hang

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.

- Forgetfulness in Elderly
- Littering in Singapore (E.g. people leaving rubbish after meals/barbecuing)
- Stress in youth
- Inability to focus in classes

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

- Forgetfulness in elderly has been a problem for a very long time and may pose danger to them. This problem is all around Singapore and we often see elderly forgetting to take their items or forgetting to take medicine.
- In Singapore, it is a common sight to see litter strewn all over grass patches, especially tissue paper, cigarette buds and food wrappings. Inside food centres, there is always food left on the tables which in turn attracts pests to come and mess it up.
- The education system in Singapore focuses a lot on grades and examinations, and students who are weaker academically tend to develop anxiety problems and be very stressed out, as they feel like they are unable to meet with their family's/societal expectations. To worsen the situation, most students are somewhat competitive, and some may be stressed because they are afraid they cannot keep up with their classmates.
- In every school, there are bound to be students who often disrupt the class. It could be because of disobedience, or possibly a hyperactive child who is just unable to sit down and focus. Although this may seem like a small problem, it can disrupt other students from learning, and the teacher will also waste precious lesson time to reprimand the individual.

1 C List some problems your group would like to solve. List also the considerations for selection of problems 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

After a second round of consideration, we have decided to compare the problem of Forgetfulness in elderly, and public cleanliness, as they are the most realistic and practical issues for us to solve.

Considerations for Selection	Problems	
	#1: Forgetfulness in elderly	#2: Cleanliness
Feasibility of possible	3	3

solutions		
Applicability	2	4
Impact	3	4
Total Score	8	11

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)

Litter is seen all around Singapore. This could be because most people believe that the government should be responsible for the cleanliness of public areas, and they should leave all of the work to them and the cleaners to clear up after their mess.

Every day, we see all sorts of litter strewn around. Tissue paper, cigarette buds, food left on BBQ pits, and even rubbish in toilets.

Another article states that a significant amount of litter is brought in daily from offshore to our beaches.¹

Also, an article from the Public Hygiene Council shows that a significant proportion of Singapore residents still admit to "situational littering", which means they sometimes intentionally litter when it is inconvenient to bin their trash.² Also, there are 58,000 cleaners who help pick up after us every day. The after-effects of littering everywhere - in parks and beaches over weekends and holidays, in heartland central car parks and around businesses and food establishments in housing estates, and even around smoking bins and bus stops in the city centre. This shows that the people are being very irresponsible, and they should have a better attitude towards keeping our country clean and green. If we do not step in to solve this problem, this issue will worsen and soon, our streets will be littered with rubbish. If this happens, our living conditions would be terrible and no tourists would be attracted to

¹ Adapted from:

Choong T.J.(January 18, 2019).*Fight against litter needs support of public*. The Straits Times.
<https://www.straitstimes.com/forum/letters-in-print/fight-against-litter-needs-support-of-public>

² Adapted from:

D'Silva E.(November 20, 2019).*First World Country? Let's clean up our act first!* Public Hygiene Council.
<https://www.publichygienecouncil.sg/news/2019/11/20/lets-clean-up-our-act-first#:~:text=Littering%20remains%20a%20problem%20in.been%20thrown%20into%20rubbish%20bins.>

our country, thus worsening our economy as well. Hence, this is a significant problem

2 B Compare and contrast the existing or similar solutions.

1. Anti Litter Campaigns

Allows many people to help to clean the environment at once. However, it usually results in a temporary improvement. If the campaign is done over a large period of time, most people would eventually lose interest and it wouldn't be effective anymore.

2. Education

This raises awareness about keeping Singapore clean to young children and hopefully they would not litter in the future. Education to older teenagers or adults would not be as effective, as they would just ignore the lesson or forget about what they have learnt as they may not find this important.

3. Posters

These are small and easy to deploy around several places and also cheap to produce. However, posters are typically ignored by the public as they do not find them interesting at all.

4. Carrying a litter bag

This is very useful as people can pick up trash they have disposed of and will not litter on the floor. However, the general public find this too cumbersome and they will not bother to bring one out as they do not find it important to keep the place clean and littering is ok.

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 product is a portable cleaner. This portable cleaner's shell is fully made by 3d printing. There is a motor that is attached to a fan blade behind, which creates a vacuum when the fan blade spins, hence sucking in the trash. Once the capacity is full, the user can dismantle it and dispose of the trash. The cleaner is small but powerful, and it can easily suck up rubbish on the floor (tissue paper can also be sucked up). The cleaner can also be easily assembled, consisting of 2 3D-printed shells, a motor, and a button switch. The battery case also has a magnetic cap, so the user can swap out the batteries quickly.

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

The portable cleaner could be used to collect rubbish efficiently. Our portable cleaner is smaller and lighter than cleaners that are currently being sold, yet able to collect a reasonable amount of trash as

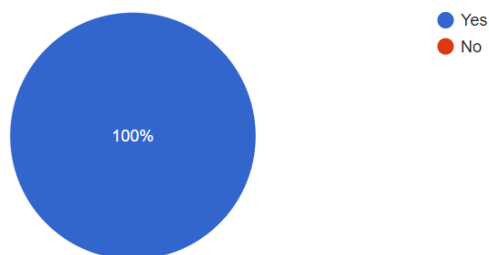
the entire cone shaped funnel - roughly 12cm - is meant to collect all of the rubbish. It will make it more convenient for users to dispose of their rubbish since it is small and easy to use. Only a press of a button, and the cleaner will start sucking stuff up. With this cleaner, we hope that it will motivate users to clean up litter as it will no longer be cumbersome to bend down and pick rubbish, and they can just suck all of the rubbish up easily.

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

Most cleaners today are quite big and cumbersome to bring along just to clean up. Our cleaner is much smaller yet powerful enough to suck up rubbish, such as tissue paper and small plastic wrapper. Since it is so lightweight and small, it can easily be stored inside a bag, or even handheld. In class, when there is a lot of rubbish on the floor, students can quickly take the cleaner and suck up all of the rubbish quickly with ease, and students would be more motivated to clean up after themselves. It has a reasonable amount of storage space for the rubbish, because of the hollow cone shaped funnel, as mentioned above. Based on our survey results, after conducting a class trial, all of our participants said that it was very convenient for them to clean up small rubbish, and 90% of the participants were willing to use the cleaner for a long term. The cleaner would be very effective in schools and especially in classrooms, when there is a lot of rubbish left after lunch and recess, hence solving the problem of littering in class, and students would have more conducive learning environment. This shows that the cleaner is effective and serves its purpose of being a small yet effective portable cleaner.

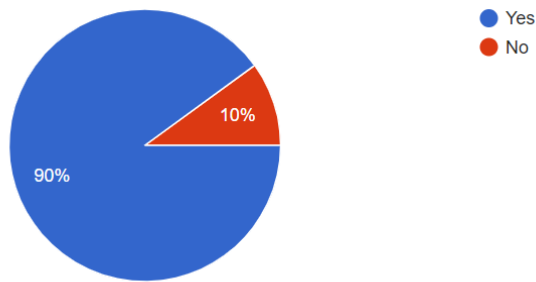
Does the portable cleaner make it more convenient for you to clean up small-sized trash?

20 responses



Are you willing to use the portable cleaner for a long term?

20 responses



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

Designing the overall shell of the cleaner

Difficulty in getting the parts for the prototype

Lack of knowledge about making a portable cleaner

A lot of time needs to be spent on producing the prototype

Repairing the cleaner when it malfunctions

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

Planning for our project (T1W5-T2W3)

Making of our prototype and preparations for testing (T2W3-T2W8)

Testing of prototype in class (T2W9-T2W10)

Improvement of prototype based on feedback from class trial (T2W10-T3W2)

Final improvement based on mid-term evaluation and testing (T3W2-T3W8)

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 used PLA plastic to create most parts of the cleaner as it is a strong material and is an affordable 3D printed filament. The technology we used was 3D printing, as we could make unique designs quickly and efficiently, and the prototyping process could be done faster.

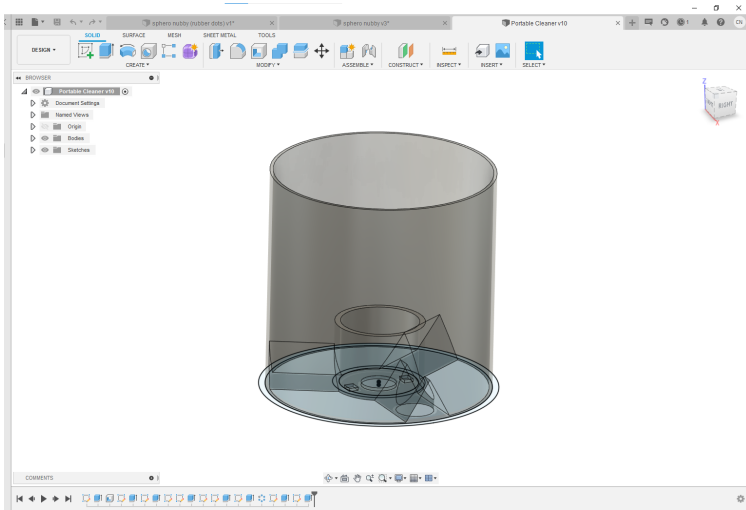
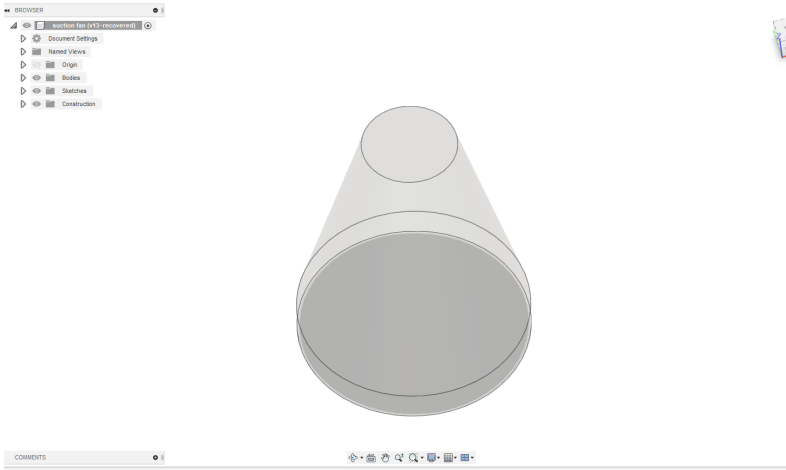
4 B Explore these considerations that may guide the construction of your prototype/ product.

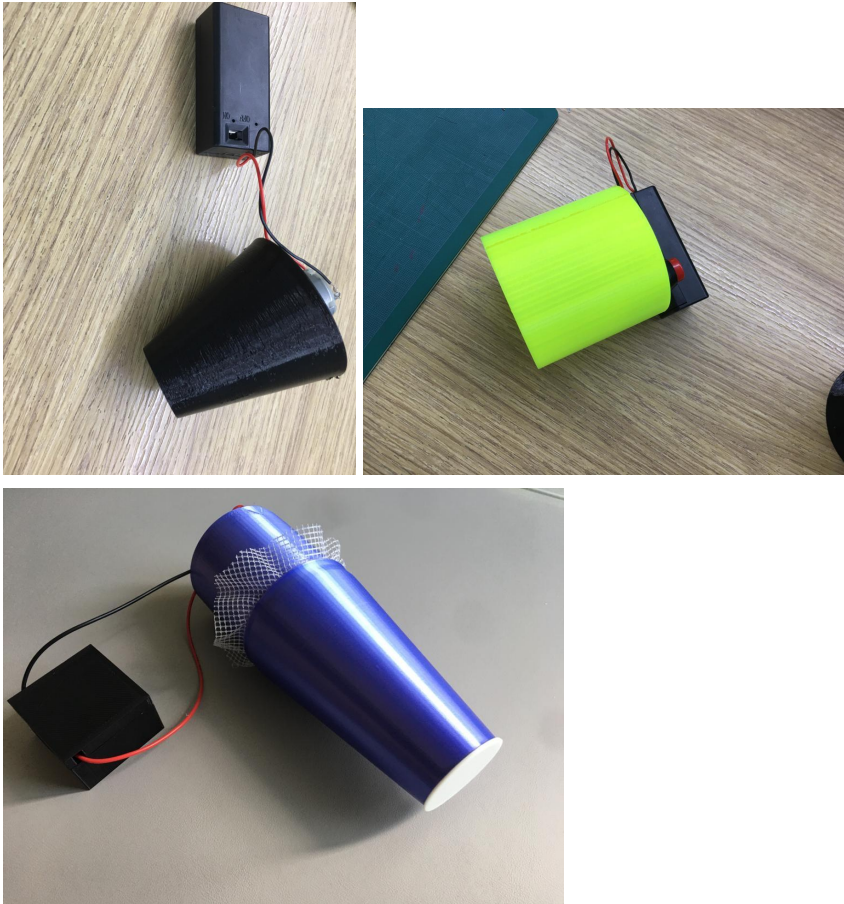
There was another filament material, PETG, and it was much stronger than PLA. However, PETG required a much higher heat to print, and also took longer to do so. Hence, we decided to use PLA as it would be much faster when we were prototyping.

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

We used the software, Fusion360, to create a 3D design of the cleaner. The design is shown down below, and it is just the rough design of the shell and the fan blade. This also includes the nozzle at the top of the cleaner. The first few designs (as shown in the pictures) were just small tests on the parts to see if they worked. After more improvements and testing, we finally combined all of them together and finished our cleaner.

One problem we originally faced was the lack of power in the motor, as the batteries that were sold could only go up to 9 volts. Hence, we decided to combine two 9 volt batteries together, connecting them in series, and our motor could spin even faster, generating more suction force. Another problem encountered was making the back of the cleaner open enough for air to pass through. Although our motor could spin with much power, there was barely enough space for wind to pass through the back of the motor, and there was little suction force. After some thinking, we came up with the idea of having the back supported by 3 sticks, connecting to the motor, and the outer shell. This not only allowed much air to pass through, but also kept the shell of the cleaner strong.





OR

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 no 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.

Test Iteration:	Tick			Remarks
	Pass	Fail	Potential Failure	
Test Date: 20/6/2021				
Strength of Shell	✓			It is able to withstand gentle knocks and the entire structure is stable. Was able to sustain the entire class trial later on without any major damages.
Electrical Connection	✓			The motor was originally spinning irregularly. After some adjustments, it works perfectly and the motor spins fast. To make the connection very secure, we soldered the wire to the motor.
Ability to Suck up Tissue	✓			The hole is big enough and the fan blade is able to create a strong enough suction force.

*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.

<https://drive.google.com/file/d/1EoZJEXkOq7tAGmoRIBhCvcc6s-bmZvip/view?usp=sharing>

This is a video showing how the cleaner works.

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, magazines, websites, journal articles, interview, photographs, product brochure, reviews etc.)

Tan, K. (2017, July). Littering in Singapore: Littering isn't as little as it seems. Retrieved from <https://blogs.ntu.edu.sg/hp3203-2017-07/causes/individual-perspective/>

Kukjira, R. (2017). Causes, Problems and Possible Solutions to Stop Littering. Retrieved from <http://www.conserve-energy-future.com/>

Getty Images (Owner). (n.d.). "Thank You" words on post-it note[digital image]. Retrieved from https://www.incimages.com/uploaded_files/image/1920x1080/getty_469566889_105923.jpg

NIH National Institute of Aging U.S. (2020, October 21). Memory, Forgetfulness, and Aging: What's Normal and What's Not? Retrieved from <https://www.nia.nih.gov/health/memory-forgetfulness-and-aging-whats-normal-and-whats-not>

D'Silva, E. (2019, November 20). First World country? Let's clean up our act first! Retrieved from <https://www.publichygienecouncil.sg/news/2019/11/20/lets-clean-up-our-act-first#:~:text=Littering%20remains%20a%20problem%20in,been%20thrown%20into%20rubbish%20bins>

Tai, J. C. (2019, January 18). Fight against litter needs support of public. *The Straits Times*, Retrieved from <https://www.straitstimes.com/forum/letters-in-print/fight-against-litter-needs-support-of-public>

Trash and food remnants strewn across table[digital image]. (n.d.). Retrieved from https://static.straitstimes.com.sg/s3fs-public/styles/article_picture_780x520_/public/articles/2014/07/17/dirtysghais3e_2x.jpg?itok=xamg2CrS×tamp=1435159793

Rubbish left at pavilion[digital image]. (n.d.). Retrieved from https://static.straitstimes.com.sg/s3fs-public/styles/article_picture_780x520_/public/articles/2014/07/17/dirtysghais6e_2x.jpg?itok=Ea9OnRi9×tamp=1435159793

Bojarsinov, A. (Owner). (n.d.). Wait sign isolated on white [digital image]. Retrieved from <https://thumbs.dreamstime.com/z/wait-sign-isolated-white-38658432.jpg>

Handheld vacuum cleaner[digital image]. (n.d.). Retrieved from

https://www.google.com/imgres?imgurl=https%3A%2F%2Fimages.philips.com%2Fis%2Fimage%2FPhilipsConsumer%2FFC6130_01-IMS-en_SG%3F%24jpglarge%24%26wid%3D1250&imgrefurl=https%3A%2F%2Fwww.philips.com.sg%2Fc-p%2FFC6130_01%2Fminivac-handheld-vacuum-cleaner&tbnid=U9_PwLigez1egM&vet=12ahUKEwiP8Pz76uHvAhUZzXMBHVH8BPYQMygBegUIARDMAQ..i&docid=dLHBS0w8kxBr1M&w=1250&h=768&q=vacuum%20cleaner&hl=en&ved=2ahUKEwiP8Pz76uHvAhUZzXMBHVH8BPYQMygBegUIARDMAQ

GE Industrial Portable Vacuum Cleaner[digital image]. (n.d.). Retrieved from

https://www.google.com/imgres?imgurl=https%3A%2F%2F5.imimg.com%2Fdata5%2FCO%2FQX%2FMY-16461692%2Fge-industrial-portable-vacuum-cleaners-500x500.jpg&imgrefurl=https%3A%2F%2Fwww.indiamart.com%2Fproddetail%2Fge-industrial-portable-vacuum-cleaner-16061481791.html&tbnid=bjQICJI8kKxD7M&vet=10CHgQMyj_AWoXChMI-OSliOvh7wIVAAAAAB0AAAAAEAM..i&docid=SRF_dAMRK9ofrM&w=500&h=500&q=vacuum%20cleaner&hl=en&ved=0CHgQMyj_AWoXChMI-OSliOvh7wIVAAAAAB0AAAAAEAM

Chanturiiia, O. (Owner). (n.d.). X red mark. Cross sign graphic symbol.[digital image]. Retrieved from

https://www.google.com/imgres?imgurl=https%3A%2F%2Fthumbs.dreamstime.com%2Fb%2Ffx-red-mark-cross-sign-graphic-symbol-crossed-brush-strokes-red-mark-cross-sign-graphic-symbol-154904211.jpg&imgrefurl=https%3A%2F%2Fwww.dreamstime.com%2Ffx-red-mark-cross-sign-graphic-symbol-crossed-brush-strokes-red-mark-cross-sign-graphic-symbol-image154904211&tbnid=T_XXKRzyXw7alM&vet=12ahUKEwjo5u2c6-HvAhU553MBHae2ABAQMygAegUIARDeAQ..i&docid=KvvmXFcANlys-M&w=800&h=800&q=cross%20sign&hl=en&ved=2ahUKEwjo5u2c6-HvAhU553MBHae2ABAQMygAegUIARDeAQ