

Hwa Chong Institution
Project Work
Category 3
Inventions Log Book
(Revised for 2020)

Title of Project:

Greenmill

Group Name:

Greenmill

Group

Members:

1) Gary Vintario

2) Song Wei Cheng

3) Declan Ng Kian Heng

4) Toh Jin Hao

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Project Brief

Our project aims to minimize the usage of electricity by using electricity generating gym equipment to power the gym so that we can reduce the need to burn fossil fuels to generate electricity. We have done some research and found some existing solutions like SPORTS-ART gym equipment which utilises a generator and microinverter. We also discovered a bicycle generator which you can place on a bicycle wheel and as you cycle, electricity is generated. We improve this product by making it more portable and gym friendly, transforming it into a treadmill generator which you can just clip onto a treadmill and you're ready to go!

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 spent about 2 weeks brainstorming and trying to think of different problems that we face in our daily life, and came up with 4 of them:

- electricity wastage (to produce electricity, fossil fuels will be burnt, which will produce greenhouse gases and harm the environment)
- ink wastage
- wastage of the kinetic energy which we produce everyday
- high amount of trash production

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

We discussed and decided on three considerations. Firstly, we chose this problem because it is a common problem which we face in our daily lives. For example, people forget to turn off the lights, and leave electronics plugged in when not needed. Secondly, we also chose it as we feel that people do not feel the need to solve this problem quickly and not enough is being done to solve this problem. Lastly, we also chose it as this is also one of the more serious problems and is causing a major impact on our lives and the environment. The severity of the problem is important because priority, time and effort should be put into more severe problems instead of minor issues, as they will affect us more.

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.

Some of the problems we want to solve are Electricity Wastage, Ink wastage and excessive trash production.

Based on the three different considerations, we made a decision matrix to evaluate the different problems and decided to solve the problem of electricity wastage.

Problem Evaluation Grid

*add more columns and rows where necessary

Considerations for Selection	Problems		
	Electricity Wastage	Ink Wastage	Excessive trash production
Severity	4	3	4
Cost	4	4	2
Feasibility	4	3	3
Total Score	12	10	9

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.

The problem we have identified is the problem of Electricity Wastage.

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

Extent of the problem based on research done over a few weeks: Producing electricity requires the burning of fossil fuels, which produces harmful excess products such as carbon dioxide. This contributes to global warming and increases the average temperature, causing heat stroke and death.

We have conducted more research and have found out that according to the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), 25 percent of all global greenhouse gas is generated from the burning of coal, oil and natural gas for electricity and heat.

source: <https://www.channelnewsasia.com/world/explainer-power-impact-climate-change-1339031>

Problem statement: To minimize the usage of electricity by using electricity-generating gym equipment to power the gym so that we can reduce the need to burn fossil fuels to generate electricity.

2 B Compare and contrast the existing or similar solutions.

Some existing solutions of electricity wastage are:

- Solar panels
- Wind turbine
- LED lighting



https://en.wikipedia.org/wiki/Solar_panel



<https://www.nationalgeographic.org/encyclopedia/wind-energy/>

Solar panel and wind turbine both produce energy. Solar panel uses light energy to produce electricity while wind turbine uses the wind to turn a generator to produce electricity.

However, LED lighting only reduces the amount of electricity that is used, reducing the usage of electricity, saving electricity, solving the problem of electricity wastage

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 to make gym equipment that produces electricity when in use by gym users through a motor generator that converts kinetic energy into electricity. We thought of putting the generator on a treadmill and as the treadmill runs, electricity is produced

Our invention is a very portable generator that you can bring with you and clip it onto treadmills. Then you can start jogging and let the electricity be generated and stored into the generator for later use.

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

It is to produce electricity while people are using treadmills, allowing people to use less electricity. The benefit to users is that the electricity produced by them when they are using the gym can be used to charge their phones or used to power other things.

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

Our solution will also be eco friendly as it uses energy generated when exercising to produce electricity, instead of burning fossil fuels to generate electricity.

Our solution is more user friendly, as it is small and easy to carry around. Users can bring it around to different gyms instead of having to go to the same one all the time.

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

1. Whether the solution can be durable in the long run
2. Finding a place to attach the motor
3. Whether people will find it useful
4. How much electricity it can save

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

Date of meeting	Progress of the project
25/02/21	We were tasked to brainstorm about some of the problems the people around us have or the problems that we ourselves face. For every problem that was raised, we looked into the existing solution and whether it was possible and feasible to come up with a solution to solve it.
11/03/21	We confirmed the problem that we were planning to solve, which was about electricity wastage as we thought that it was the one that was easier to solve amongst the 3 different problems. We looked up about some of the existing solutions that was used to reduce electricity wastage, and brainstormed from there about possible solutions
25/03/21	We came up with different solutions and decided to go with the piezoelectric chips idea as we felt that this was the most interesting and less commonly used idea. We went to do more research about the chips, knowing more about how they work and the theory behind them.
14/04/21	Having known about the details about the piezoelectric chips, we decided to think about how we could apply it to gym equipment. We thought about the treadmill as it was one of the equipment most gym users use at the gym.
28/04/21	We decided to put the piezoelectric chips at the top of the treadmill and we started to make a sketch and rough design about how it would look using some 3d model applications that were recommended. We also calculated how many piezo chips we would need and the approximate cost.
18/05/21	Mentors did not have much experience in this field, so they were not able to give much input. This is when we started considering if we should switch to another project or topic so that we could have more expert opinion on our inventions.

June holidays	We researched some more on piezoelectricity and tried to find piezo strips and chips to purchase to test out. However, we realised that our calculations were incorrect and we would need a lot more piezo strips and chips than expected, and this was too expensive. Moreover, we found out that the efficiency rate is too low and not much electricity is produced. Therefore, we started thinking about what other ideas we could work on.
12/07/21	We brainstormed further and decided to change our idea to a motor generator. We will place the motor on the treadmill. When the treadmill runs, the motor generator will turn and produce electricity. We will test it out further on bicycles and gym equipment. Main objective: find out how to hold the generator in place while still keeping it portable (able to click it in and remove it easily). Wei Cheng tested the generator out and found out that it works on a bicycle, but his phone was unable to charge. Now we will test if it works on a treadmill.
02/08/21	We went to the school gym to take measurements of the treadmill and tested out whether the motor could work. Afterwards, we thought of the possible ways that we could secure the motor to the treadmill. We decided to attach it using a clip that is placed under the sides of the treadmill and on top. We then prepared some wood to cut out the shape based on our measurements of the clip. We also decided to make a 3D model to showcase our idea. Now the challenge is how to make the motor stable and secure, but also portable.

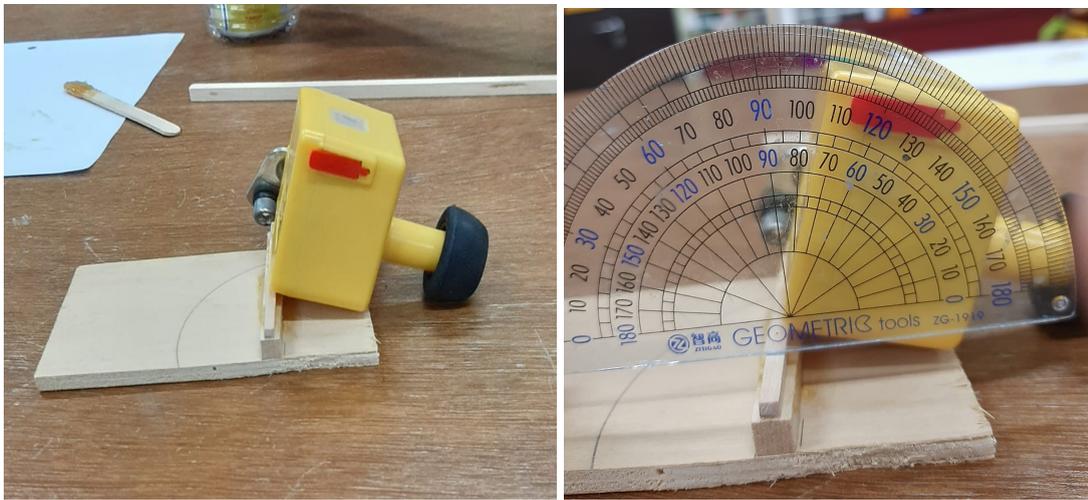
#must be able to be constructed based on current / emerging technologies, must not violate the laws of Science or go against the laws of nature.

4. Proposed 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.

Some details and measurements taken



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

We chose to use a piece of wood and trim it thinner to fit into the gap of the treadmill. We then attached the generator to the wood at an angle to allow for the rubber spinner to be in contact with the surface of the treadmill. We chose to use wood as it is strong enough and is light at the same time. It is also more eco friendly.

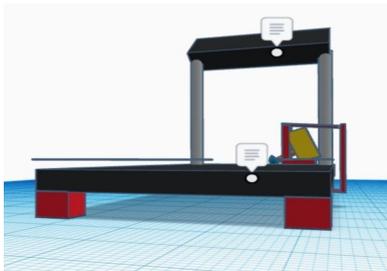
4 B Explore these considerations that may guide the construction of your prototype/ product.

We needed to mark out dimensions on the wood to trim it to the correct size that fits into the treadmill. To do this, we made a trip to the school's gym and took the measurements from a treadmill.

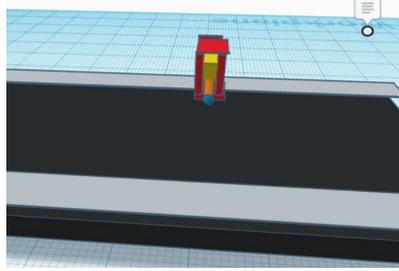
4 C Propose how the prototype/ product will be constructed or developed. You may use drawings and photographs.

We have constructed a plate to fit into the gap in the treadmill. On the plate would be a slope that would elevate the generator by 16° for the rubber spinner to touch the surface of the treadmill. (photo of the plate and slope above).

To ensure that the plate stays in place and doesn't move backwards with the treadmill, we have planned to design a clip that would hold the plate in place, which would be attached to both ends of the treadmill (from the surface to the bottom) at the side. The C-shaped clip with springs on both ends would span a length of 14cm and 1cm thick. The springs would make sure that the generator and the plate would clip on tightly to the treadmill.



Side view



Front View

Dimensions:

Material used: Metal

Length of board: 7cm

Height of board: 0.5cm

Length of clip: 3.5cm

Height of clip: 6cm

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 in 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 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. References

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

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

Piezoelectricity - How Does It Work?: What Is It Used For?

Chris Woodford - <https://www.explainthatstuff.com/piezoelectricity.html>

Eco-powr™ Technology

<https://www.gosportsart.com/eco-powr-technology/>

Explainer: The Impact Of Power on Our Environment

Melissa Low- Bookmark Bookmark Share WhatsApp Telegram Facebook Twitter Email LinkedIn - <https://www.channelnewsasia.com/world/explainer-power-impact-climate-change-1339031>