Hwa Chong Institution
Project Work
Category 3 Inventions Log Book

Title of Project: The Stove Accessory
Group Name: The Stove Accessory
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1. Problem Finding

(The beginning…)

Identify a problem you would like to solve. You may want brainstorm for problems using different approaches eg 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.

Problems in the kitchen:

1. Fume hood not 100% effective, place gets oily when frying

2. Fire hazards

3. Many ways to get burnt

4. Water is wasted when washing dishes

5. Forget to turn off the stove which could result in a fire or gas poisoning

Possible solutions:

1.1 - Fan to direct all the fumes upwards

1.2 - Pan or cooking liquid that reduces splatter

2.1 - A mechanism to turn off the gas when fire is detected

2.2 - A fireproof coating on surfaces near fire

3.1 - Lightweight gloves that conduct heat away fast to increase burn threshold

4.1 - A solution of liquid in which dishes can be left in overnight to remove all the dirt

4.2 - A new water efficient dishwasher

4.3 - A new kind of soap that emulsifies yet washes off quickly

5.1 - Timer that turns off the stove

5.2 - Appliance that detects anomalies and shuts off the gas

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

The current solutions are very expensive, and are difficult to install for the common person. Hence, the problem of "can forget to turn off the stove" was selected (Problem 5). It was easier to imagine a feasible solution to this problem as compared to the other problems.

A survey and interview was conducted, showing that this was a real problem, and a quick online search for data revealed that there are a lot of stove related fires in Singapore (second largest cause of residential fires in 2018).

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

*add more columns and rows where necessary

Considerations for Selection	Problems			
	Fume Hood not 100% effective	Kitchen has many fire hazards	Water is wasted when washing dishes	Possibility of forgetting to turn off the stove
How common is it?	5	2	4	2
How impactful is it?	2	4	3	5
Is a solution feasible?	2	2	3	4
Total Score	9	8	10	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)

There is a possibility of forgetting to turn off the stove when cooking. Fires in the kitchen are a serious and common problem. There are at least 166,100 cooking equipment fires in U.S homes every year. Hence it is important to make sure people do not leave stoves on and unattended.

Several methods to solve this problem have been proposed. The most efficient thus far can turn off a gas stove after a set time, but can only be attached to the gas pipe. Others can turn off but only after the stove is left unattended for a fixed time.

Kitchen fires are a serious problem with huge impacts. Action is needed to minimise the number of home accidents and let home cooks use the stove without worries.

2 B   Compare and contrast the existing or similar solutions.

1. iGuardStove https://iguardfire.com/
    a. Benefits
        i. Automatically shuts off the stove after 5 minutes of no one being in the kitchen
        ii. User can remotely monitor or disable the stove using smart devices
    b. Disadvantages
        i. It has a slightly complicated installing process as the device has to be installed on the gas valve
        ii. Expensive price tag (USD 595)
        iii. Needs to be installed by a certified gas plumber
2. Standard Kitchen Timer
    a. Benefits
        i. Mechanical or electric
        ii. Timer goes up to 100 minutes
        iii. Expensive varieties have additional features such as multiple timers or longer maximum duration
    b. Disadvantages
        i. Disconnected from the stove
        ii. User must be close by when the time is up
        iii. Users who are distracted may not remember to turn off the stove
3. Cookstop https://www.cookstop.com/
    a. Benefits
        i. Switches off the stove after up to 30 minutes of no one being in the kitchen
    b. Disadvantages
        i. Expensive (USD 399)
        ii. Only works on electric stoves

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.

A device that can be easily installed on any stove, and has a timer that turns off the stove after a set time. The device is installed on the stove knob instead of on the gas pipe, so professional assistance is not required.

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

It will enable the user to have the peace of mind to rest while cooking dishes that require large amounts of time on the stove, as the invention will turn the stove off by itself.

The user can leave the house while cooking, increasing productivity and helping the user get more things done.

The invention also helps by reducing the likelihood of a stove fire.

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

It is hundreds of times cheaper, and it is easy to install for anyone. The integration of the mechanism to switch off the stove makes the invention more useful than a standard kitchen timer.

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

The design of the parts of the device would be difficult to put together, as the device would be small. It would also be difficult to use the DAISO timer's ending response as a trigger for our device.

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

1. Proposal evaluation
2. Apr – May: Research and Analysis
3. Jun: Design planning and first prototype
4. Jun: Finalising model and theory of invention

5. Mid-term evaluation
6. Jul – Aug: Modification and completion of prototype
7. Final evaluation

#*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

A micro:bit was used because it would be easier for the user to set times, and also much more practical to trigger the turning mechanism after the time ends, as compared to using a mechanical timer.

A motor is used in conjunction with a string to turn the knob so friction is not required, so the motor can have a higher turning power in exchange for it turning more rounds. It was decided that being sure the stove would be turned off is more important than turning it off fast. As such, the invention does not need to instantly turn the knob to the off position fully.

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

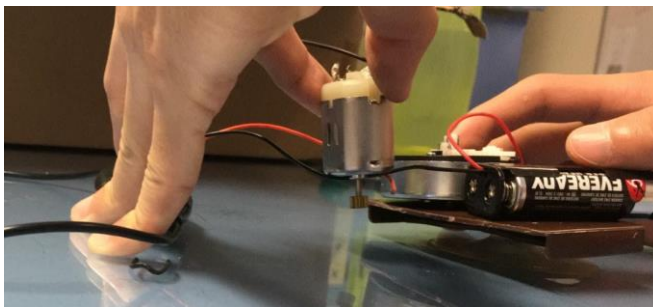The overall cost of the product will increase due to the use of computers.

The use of electronics means that the user may have to replace batteries that power the computer periodically, increasing the cost and set-up required.

4 C   Document the prototype/ product development stages. You may use drawings, photographs or videos.
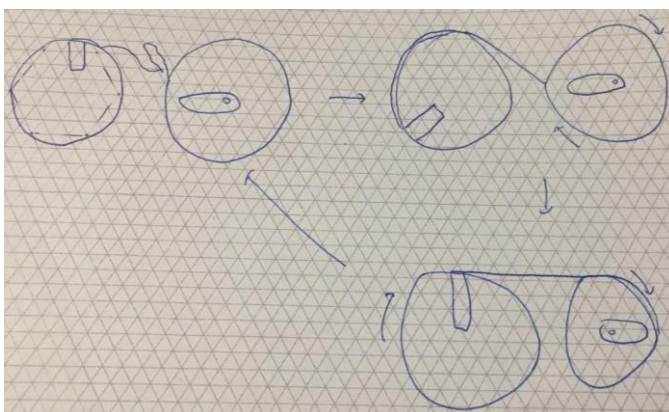
Initially, the invention was designed to not be battery operated. However, this proved impractical as the mechanical energy provided by the ending of the DAISO timer was insufficient to move the knob of the stove.

A motor was used, to be placed directly on top of the knob to turn it. However, the motor could not turn the knob 180 degrees together with itself, and the 1.5V motor could not produce such torque. There were difficulties in ensuring the timer worked 100% of the time.
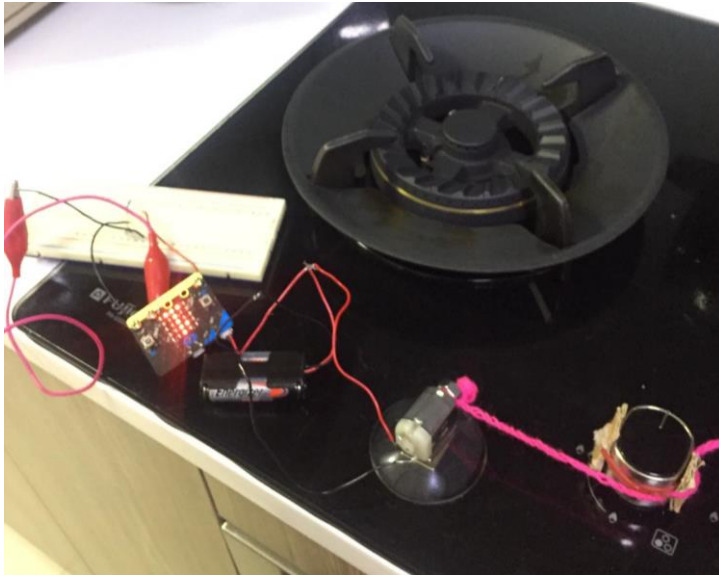

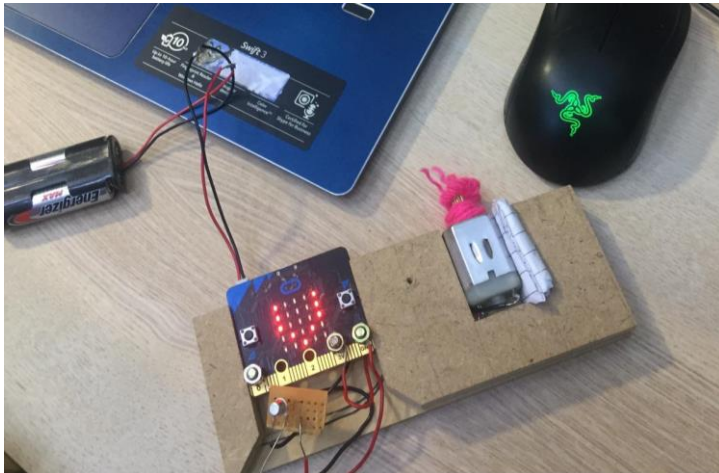The next design used the micro:bit, as it was a reliable way to control events.

String and a servo were used to turn the knob, but the servo was not powerful enough to turn the knob.

A motor was used instead, and with the string around a smaller radius, by the principle of moments, there would be more torque as the normal force resisting the movement of the motor would have a smaller perpendicular distance to its centre.

The components were secured to a board to improve the aesthetic design of the product.

This would be the final prototype.

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: 1		Tick		Remarks
Test Date: 1/3/2019	Pass	Fail	Potential Failure	The timer's ringing mechanism was directly linked to the stove knob.
Switches stove off after set time		1		Spring does not have enough energy to turn the stove knob.
Easy to install		1		It is difficult to connect the spring in the timer to the stove knob.
Affordable	1			The cost price is about $2.
Test Iteration: 2		Tick		Remarks
Test Date: 17/6/2019	Pass	Fail	Potential Failure	Batteries were used instead, and a capacitor and a 3 way switch to power a motor.
Switches stove off after set time			1	No complete prototype was constructed as the mechanism was impractical.
Easy to install		1		It was still complex to connect the device to the stove knob.
Affordable		1		The user would have to keep buying batteries which deplete very quickly because the capacitor was constantly discharging.

Test Iteration: 3		Tick		Remarks
Test Date: 19/6/2019	Pass	Fail	Potential Failure	Metal casing of the timer was used to complete a circuit when it rings, powering a motor to turn the stove knob
Switches stove off after set time		1		Cause of failure is unknown.
Easy to install		1		It was complex to connect the device to the stove knob.
Affordable	1			The cost price is about $3.
Test Iteration: 4		Tick		Remarks

Test Date: 27/6/2019	Pass	Fail	Potential Failure	Micro:bit and servo were used.
Switches stove off after set time		1		The servo was not powerful enough to turn the knob the whole way.
Easy to install	1			Using a servo instead of a motor simplified the design.
Affordable	1			Although the price has increased, it is still hundreds of times cheaper than solutions on the market.
Test Iteration: 5		Tick		Remarks
Test Date: 29/7/2019	Pass	Fail	Potential Failure	Micro:bit and motor were used.
Switches stove off after set time	1			The motor had a small radius, increasing the torque until it was sufficient to turn the knob
Easy to install	1			There is only a 3-step process to install the accessory and takes no more than a minute.
Affordable	1			The total cost of materials is under 100 SGD.

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 (eg books, magazine, websites, journal articles, interview, photographs, product brochure, reviews etc.)

iGuardStove | The Automatic Stove Shut Off Device - Rated #1. (2014, June 25). Retrieved March 4, 2019, from https://iguardfire.com/

NFPA - Reports and statistics about cooking fires and safety (n.d.) Retrieved March 4, 2019, from https://www.nfpa.org/Public-Education/By-topic/Top-causes-of-fire/Cooking/Reports-and-statistics-about-cooking-fires-and-safety

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