Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

Title of Project: The New Paper Bag
Group Name: 3-33
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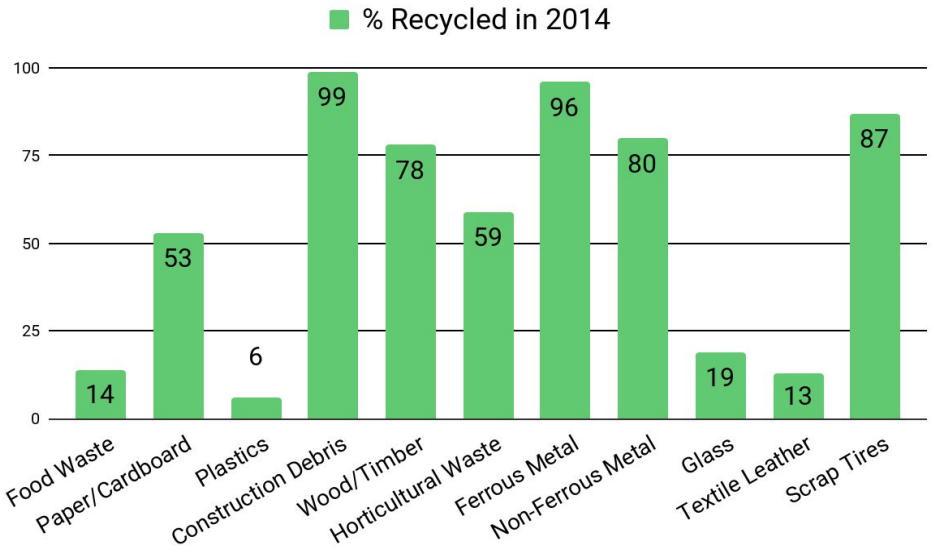
1. Problem Finding

We decided to look into reducing wastage of water, plastic or paper. After researching the extent of the issue, unavailability of existing solutions and the likely feasibility of prototype construction, we put our findings in a decision making matrix.

We decided to focus on plastic wastage, and paper wastage as a secondary issue based on their scoring from the matrix below. We discarded water wastage as a focus because there are already many solutions available, as well as foreseeable difficulty in prototype construction.

Considerations for Selection	Problems		
	Plastic Wastage	Water Wastage	Paper Wastage
Extent of Issue	4	3	3
Unavailability of existing solutions	3	1	4
Feasibility of prototype construction	3	2	3
Total Score	10	6	10

2. Define the Problem



(Bar graph representing information from *Singapore Waste Statistics*, (2015, March 20). retrieved from: http://www.zerowastesg.com/tag/recycling-rate/)

According to zerowaste.sg, 763 thousand tonnes of plastic and 576 thousand tonnes of paper are disposed each year, with plastic having the lowest recycling rate of all materials listed at only 6%. 11% of total waste disposed in 2017 was plastic, 20% of this being plastic bags. Paper makes up 16% of 2017's total waste disposed 6th lowest recycling rate of all types of waste at 50%, which means 576 thousand tonnes of paper is disposed each year. It is also difficult to recycle in recycling plants: cleaning off ink produces many toxic chemicals that can cause water and land pollution.

Survey:

We conducted a survey to collect data on respondents' awareness of the issue and willingness to change. 78 responses have been collected thus far. Almost all understand that plastic bag wastage is a serious issue that needs to be addressed, but only a quarter of respondents actually bother to use reusable bags. However, respondents in this group do not regularly do so, about 55% of the respondents use reusable bags infrequently. Meanwhile the 78% of respondents that use plastic bags more often; do so very frequently.

Existing Solutions:

Reusable bags are environmentally friendly as they are reusable. However, they can be inconvenient because of their size or lack of availability. They are much more expensive than plastic bags, at $3 each, and require washing in-between uses.

Shopping trolley bags are another alternative, people use these in place of plastic bags as they have a large storage space, and are reusable too. However, they can be difficult to maneuver in crowded areas or when using the stairs. In addition, it is also unnecessarily large, as it will always be the same size no matter how little or how much it is carrying. Like reusable bags, it also needs to be washed once in a while. Unlike previous existing inventions, however, the trolley bag is very expensive, costing an average of around $25-$30.

DIY paper bags do not need washing, and are highly environment- and cost-friendly. However, due to their DIY nature, these are often very tedious to make, and can be very fragile, meaning they might only be used a few times before they break and are discarded.

3. Our Big Idea

The invention is to be a frame with handles. Newspaper will be attached to the frame, such that it makes up the structure of the bag. We started off considering using magnets, pins, or clips to attach the newspaper to the frame.

The first prototype was a thin, collapsible frame that could fold around a sheet of newspaper to form a small box, secured by velcro and magnets. It was small, flimsy, and difficult to assemble, hence it was discarded in favor of another design. (see Appendix A for concept art and images of the first prototype)

The second prototype more closely resembled a conventional plastic bag. Two cloth pieces were joined by two handles on each end, with clips to secure the newspaper. It was bigger and stronger than the first prototype, being able to support more than 3kg of weight. It was

also comparatively easier to assemble. (see Appendix B for images of the second prototype) However, the clips were difficult to use as they were separate from the frame.

The third prototype swapped out the clip mechanism and used pins to secure the newspaper, which was more sturdy than the previous clip design. However, it was even harder to assemble, and was susceptible to getting stuck or tearing the newspaper. We also reinforced the base with a strip of fabric, which significantly improved the strength of the bag as the cloth helped the newspaper hold more weight. (see Appendix C for images of the third prototype)

The fourth prototype incorporated and improved on the best elements of the previous prototypes.We decided to use the clip mechanism, and the clips were permanently attached to the frame for ease of assembly. The cloth base from prototype 3 was added to reinforce the strength of the bag further. Velcro straps on the sides prevented the bag from opening too wide, preventing the newspaper from tearing. (see Appendix D for images of the fourth prototype)
To help users, we created a guide to assembling it. (see Appendix E for images of the assembly guide)

Advantages of the prototype:
Compared to reusable bags and trolley shopping bags, our invention is more portable and cheaper as it is smaller, and construction costs are estimated to be around $2. Reusable bags cost $3 or so, and trolley bags are priced at around $30. In addition, our prototype does not require cleaning, as the newspaper can be discarded and replaced with a new sheet after use. Because of this, it also upcycles newspaper, reusing it and giving it a 'second life'.

Compared to DIY bags, our invention can be assembled more quickly and with more ease. Some DIY bags take around 8 minutes, but it only takes around 1 and a half minutes to fold and attach the newspaper to our prototype. In addition, the cloth straps and base make it far more durable than DIY bags, and it is also much stronger.

However, the newspaper or the grip used to secure it may not be enough to hold extremely heavy items. Contents may also be stained by the newspaper ink, though this is a more trivial issue. Even if the bag contains food items like fruits, they would usually be washed before consumption anyway. The bag is also not waterproof, and may not be aesthetically appealing to some users, and is not that large because it uses newspaper as its body. The newspaper is at risk of being torn during folding or assembly, but this is largely due to operator error and not the prototype itself.

If we have the chance, we do wish to look into repurposing other kinds of materials to form the main structure of the bag, such as clothes. Other materials like that would mean contents will not be stained. We plan to find ways to streamline the assembly process further, perhaps by using different kinds of clips. We also understand that our prototype could use some aesthetic improvements, but this is of lesser importance as we plan to focus on refining the concept and functionality of the invention first.

4. Construction or Modelling Process

Attachment Mechanisms: Clips are strong and easy to operate, since they are attached to the frame.

Main Body: Newspaper.

Cloth strips used for frame and supporting base: Cuts on costs, gives the bag a minimalist design and helps hold the main paper body in shape.

Attachment Bars: Recycled plastics (could be cardboard in the future) further reduces construction costs and upcycles old materials.

5. Modification and Evaluation

Test Criteria

Test Iteration:	Tick			Remarks
Test Date: 12/8/18	Pass	Fail	Potential Failure	
Test Criteria 1: Weight	tick			Prototype 4 can support about the same amount of weight as a reusable bag with the cloth base as reinforcement
Test Criteria 2: Ease of assembly			tick	Clips are secured to the frame and assembly has been streamlined, but some users might find it difficult to assemble

To gather feedback on our prototype, we engaged in door-to-door visits with residents of a housing estate near to a grocery store. We explained the prototype functions to them, and then let them attempt assembly of the invention to evaluate its convenience. (see Appendix F for an image of one of the interviewees, whose parents requested his identity to remain anonymous)

We interviewed 21 households, though only 9 were willing to try out the prototype. Feedback gathered was largely positive and majority of the interviewees expressed a willingness to use the invention as an alternative to reusable bags. Some residents recommended that 2-3 sheets of newspaper should be used at a time instead of just one, for an optimal balance between ease of assembly and strength of the bag. Some interviewees did complain about the prototype's complexity as they faced difficulty assembling it the first few times. Elderly interviewees were also afraid that they were not dextrous enough to secure the device easily. Others said it did not look attractive.

In conclusion, our prototype is a completely original idea that has struck a compromise between reusable and plastic bags in the sense that, like plastic bags, it is lightweight, cheap and does not need cleaning and, like reusable bags, is eco-friendly, durable and larger than most plastic bags. It functions as a grocery bag for dry products and can potentially compete

with and replace reusable bags in the market, and can be used in place of plastic bags, reducing overall plastic usage and wastage.

Milestones:

7/4/18: Construction of paper visualisation of prototype

8/5/18: Construction of first prototype

15/6/18: Construction of second prototype

9/7/18: Construction of third prototype

11/8/18: Completed construction of the fourth prototype

6. References

Singapore Waste Statistics, (2015, March 20). retrieved from: http://www.zerowastesg.com/tag/recycling-rate/

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Bow Valley Waste Management Commission, retrieved from: http://bvwaste.ca/wp-content/uploads/2012/04/Plastic-Bag-Reasons-Feb-22-2011.pdf

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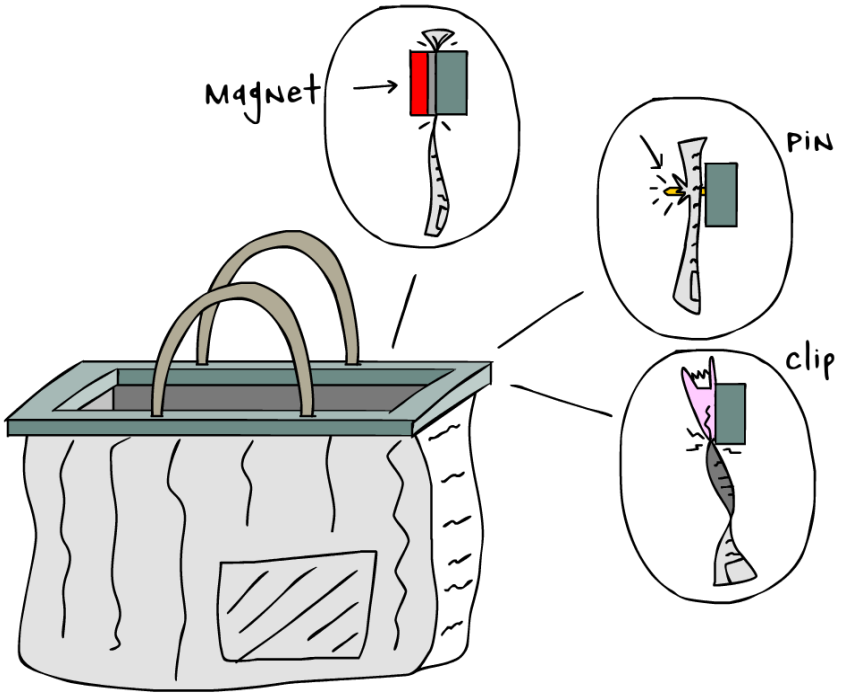
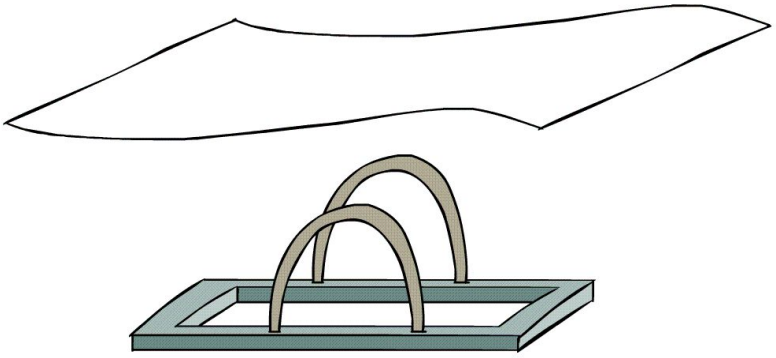
Boh, S.(2018, March 6). *Parliament: No plan to impose plastic bag levy, other types of disposable bags not much greener: Amy Khor,* retrieved from: http://www.straitstimes.com/politics/parliament-no-plan-to-impose-plastic-bag-levy-other-types-of-disposable-bags-not-much

National Environmental Agency: *Waste Statistics and Overall Recycling,* retrieved from: http://www.nea.gov.sg/energy-waste/waste-management/waste-statistics-and-overall-recycling

Appendix A:



Concept art of the prototype: A frame with handles. Cross sections of possible attachment mechanism are shown beside it.



Original concept: Newspaper would be dropped into the frame.

The first prototype, assembled and empty.


The prototype compressed, as to make it portable (left)
The assembled prototype holding newspaper (right)

Appendix B:

The second prototype. It has a thin lightweight frame with detachable clips, which help to secure the newspaper to the frame. The straps were made using recycled cloth.

Appendix C:

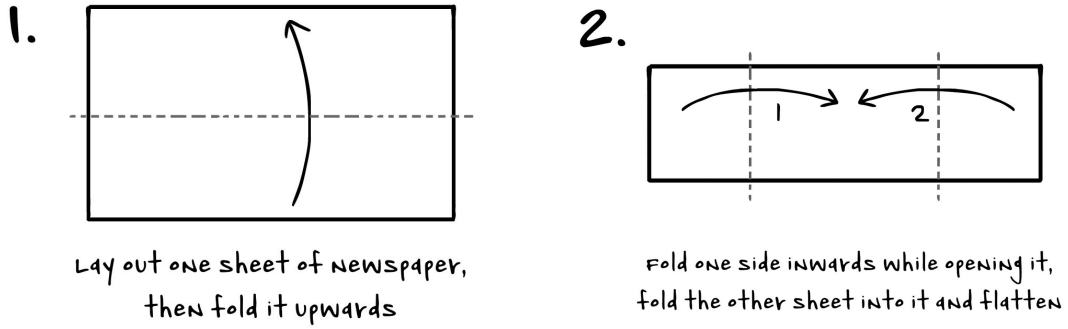
Images of the third prototype.
The black cloth base can be seen connecting the two straps in the photo on the left.

Appendix D:

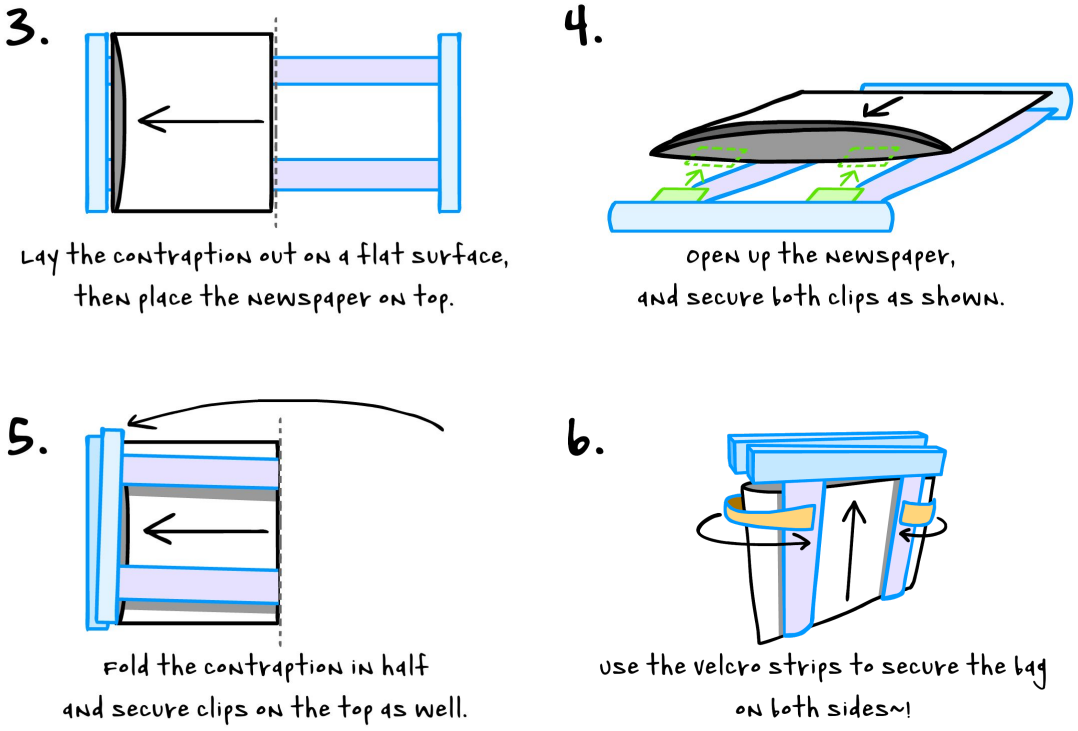
The fourth prototype, unfolded (above)

The fourth prototype assembled, without newspaper (left) and with newspaper (right)

Appendix E:



(If step 2 is not displayed correctly, view it via this link: https://i.imgur.com/UTtVco2.gif)



A 6-step instruction manual on how to assemble the prototype.

Appendix F:

The child of a neighbour who was willing to let his picture be taken after he successfully assembled the prototype with minimal guidance. His parents requested his identity to remain anonymous.