UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Optimizing Waste Sorting Practices: Development of a 3D Display

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SEEDS Project Report

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Background

In 2014, a group of CHBE 573 students embarked on a SEEDS project to improve the waste sorting practices of UBC students living in on-campus residences. The target residence was Marine Drive, which had shown high rates of misplaced waste. The group proposed a recycling pathway that led users through a coordinated system of visual prompts that assisted them in proper waste-sorting practice. In addition to floor graphics, coloured routes and audible stimuli, the group proposed 3D display posters which show correctly sorted waste (Barreira et al., 2014).

Studies have been conducted at other universities to observe the impact of 3D displays on waste sorting practices. A study from the University of Washington (Johnson, 2013) on the effect of different types of waste sorting signs found that 3D displays were the most effective. A study from Carnegie Mellon University (Chung et al., 2011) found that 2D displays did not catch students' attention, and they would look into the bins for guidance. Misplaced items in the bins generally perpetuated more misplacement.

Figure 1: University of Washington 3D display

Figure 2: Carnegie Mellon University 3D Prototype

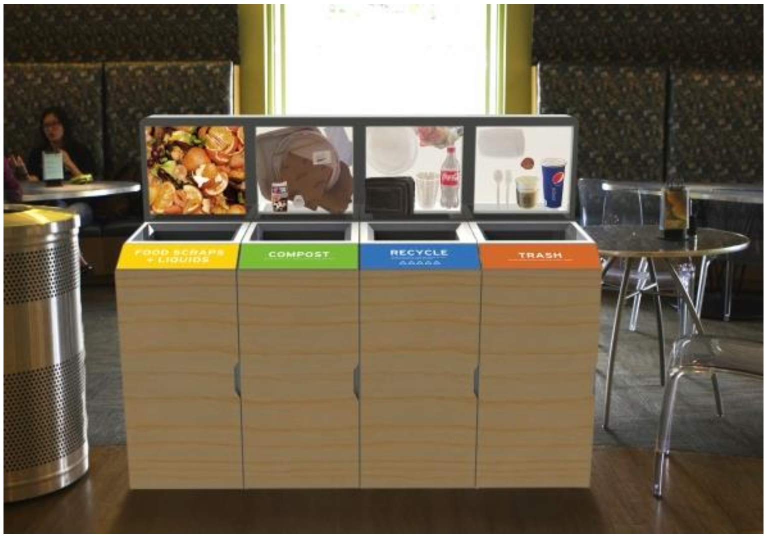

Figure 3: Carnegie Mellon 3D Final Design

Project Objective

The purpose of this project was to develop a prototype 3D display that could be used to demonstrate appropriate waste sorting by showing frequently misplaced items above the correct receptacles.

Design Considerations

<u>Integration into Standard Waste Stations</u>

The 3D display is designed to be integrated into the standard waste sorting stations that currently exist around UBC campus. These waste sorting stations are placed in different environments on campus: some are against walls, some are against glass, some are in the middle of rooms. Therefore, the design is meant to be integrated onto the sorting station without being dependent on the surrounding support structures.

Figure 4: Standard Waste Sorting Station at UBC (Source: www.sustain.ubc.ca)

Visibility

To maximize visibility, the display is positioned as close to eye-level as possible. This eliminated the option of mounting the 3D display to the front panels of the sorting stations. To accomplish an eye-level position, the back panel has been elected as the sole supporting component of the structure. The back panel has a depth of only 2.3 cm, which constrains the methods by which the display could be attached to the waste sorting station. This led to the selection of overhanging hooks as a means of securing the display container to the back panel.

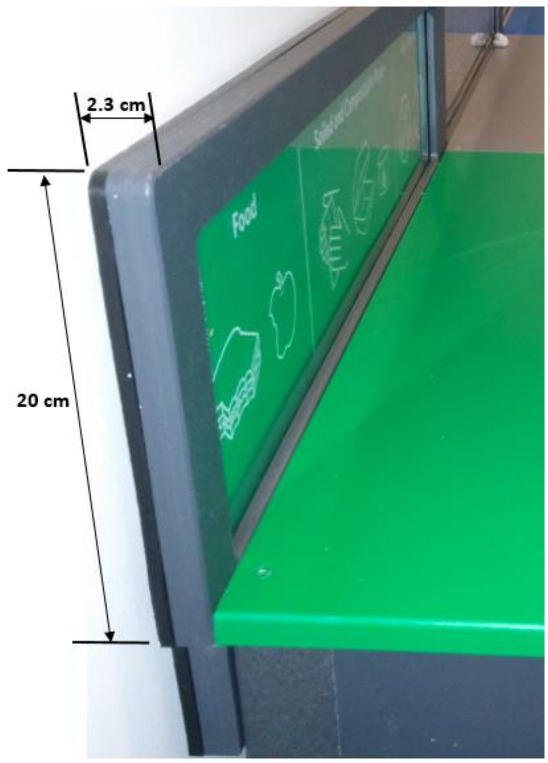

Figure 5: Dimensions of Back Panel

Another aspect of visibility is the display size and material. The display container must be of sufficient size to contain the essential, frequently misplaced waste items, and also made from transparent material in order to be an effective waste sorting tool.

Functionality

If chosen to be a permanent component of the waste sorting stations, the display must be functional. Over time the contents of the display may need to be changed as food service outlets update their disposable containers and cutlery, and as waste-sorting practices change, in order to target the items most frequently misplaced. To allow for this, the design incorporates a removable lid.

Another component of the display is that it is a completely standalone piece that is supported by the hooks, requiring no drilling into the waste sorting stations. This allows for mobility so the effectiveness of the 3D display can be tested on waste stations in various locations

Prototype Design

Based on the design considerations, a prototype was developed. Off-the-shelf items were purchased to meet design requirements. A large transparent container with lid, secured by a hooked system allows for visibility, functionality and mobility during testing.

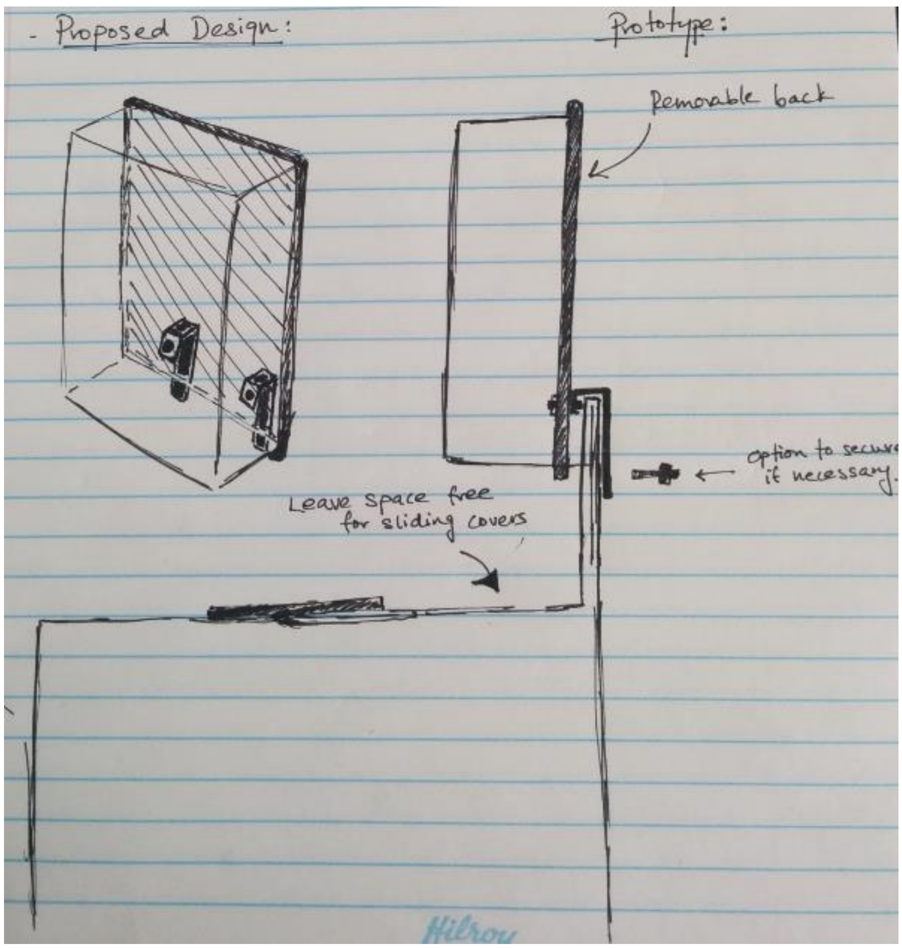

Figure 6: An Early Prototype Sketch

Materials

- KIS 15 L Stackable Omni Box (http://www.canadiantire.ca/en/pdp/kis-omni-box-15-l-0424277p.html) was selected for the display container.

Figure 7: Display Container

- MAURICE Over The Door Hooks

Figure 8: Label for Hooks

Holes were drilled through the hooks and the lid of the display container and bolts were used to secure the hooks in place.

Figure 9: Display Container with Attached Hooks

Display

Research by UBC Sustainability's Zero Waste group determined that IKE's café in Irving K. Barber Library was one of the worst locations on campus for misplaced waste. Therefore, display items were selected using disposable containers from this food service outlet to determine the appropriateness of the display container size. These items included, hot and cold drink cups, lids and sleeves, compostable takeaway containers, napkins, paper bags, and cutlery. To supplement the items from IKE's café, the Zero Waste Coordinator was contacted to determine the most commonly misplaced items. The most prominent misplacements were plastic contamination of food waste, and misplacement of paper cups and napkins in the paper receptacle, when in fact they should be in the containers and food waste receptacles, respectively.

Figure 10: Food Waste Display

The challenge with the food waste display is that it cannot contain real food waste. However, plastic food can be purchased online for display purposes. Links have been provided in the Appendix.

Figure 11: Recyclable Container Display

Figure 12: Paper Display

Figure 13: Garbage Display

Design Improvements

Preliminary prototype testing showed that the hooks provide a secure hold of the back panel without requiring additional support. The size of the container (44.8 cm by 29 cm by 17.2 cm) allowed for effective display of the waste items, but appear larger than necessary for the display. The main disadvantage of the prototype display is that it partially blocks the signage on the back panel of the waste sorting station. This is primarily the outcome of using off-the-shelf items and the limited available space on the back panel.

We are proposing a more suitable design as a best fit to optimize space and containment, as well as improve visibility of the 3D display items. The figures below gives dimensional details to our recommended design:

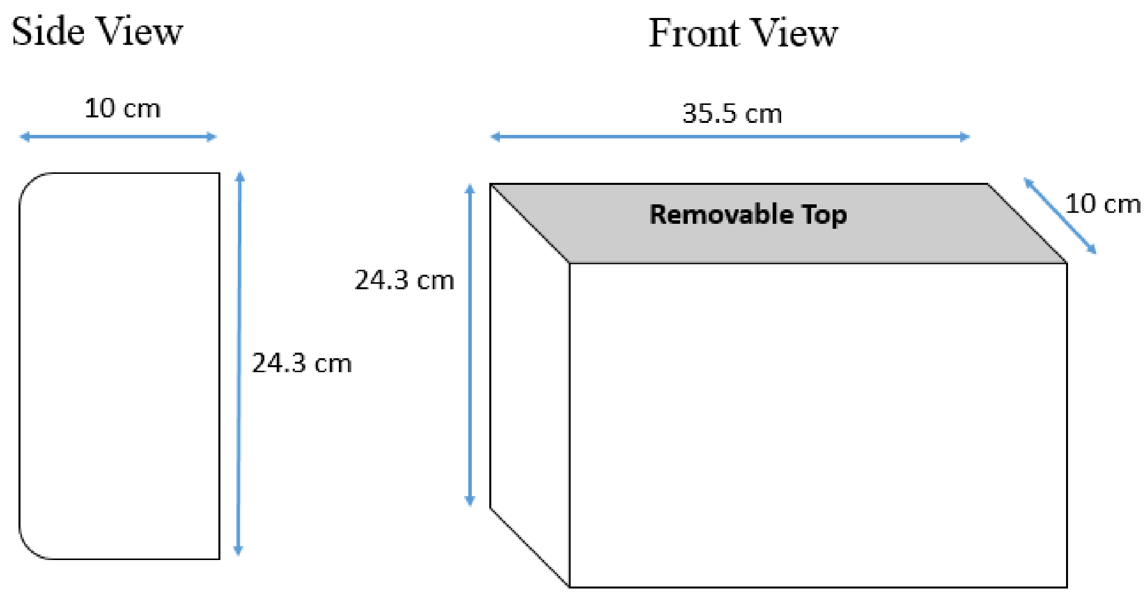

Figure 14: Display Container Dimensions

The proposed dimensions of 24.3 cm × 35.5 cm × 10 cm were determined by measuring the space occupied by the display waste materials. The proposed size reduces the amount of unused space and the size of the transparent plastic display container. This modification is a result of the need to keep existing signage visible without any form of blockage or visual interference.

Upon selection of this modification, two 'h-shaped' hooks (one on each end) have been proposed as shown below:

HOOK DIMENSIONS & PROTOTYPE

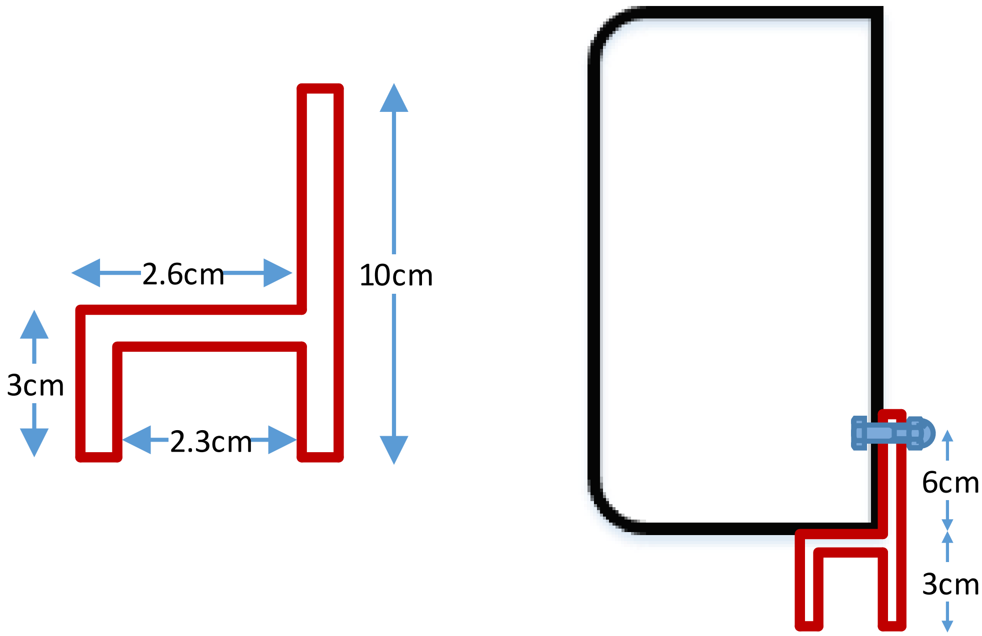

Figure 15: Custom Hook Dimensions and Display

This selection stemmed from the need to keep the display bin high enough to avoid blockage of existing information on the recycle stations. The diagram above demonstrates how the display bin sits on the hooks and is fastened with hex nuts. The basal dimension of 2.3 cm is the top surface depth of the standing ledge of the standard waste sorting stations. The purpose of this is for the hooks to be tightly fastened to limit movement and shaking of the bin boxes when they are in place. This particular shape/design was selected to leave room for the bin to be transferred to other sites where necessary.

We have also recommended the use of a special nut; Hex Nut. This is based on the need to have a rounded base attached to the nut head. From observation, some recycle stations are placed close to glass windows, painted steel beams, polished wooded walls and painted walls. The need for a rounded base is to prevent scratching of surfaces by the nuts as most nuts are either flat surfaced or pointed. This cap covers that surface and limits damage to wall surfaces should these recycle stations be moved during re-arrangements or emptying of trash bins et al. The drawing below is a sample of what the hex nut looks like:

HEX NUT (Recommended)

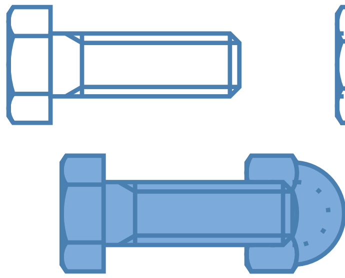

Figure 16: Proposed Hex Nut

Two (2) Hex Nuts recommended, with the following parameters:

- Thread Diameter: 0.25 in.
- Shaft Length: 0.75 in.
- Thread length: 0.625 in.

Future Recommendations

The functional 3D waste sorting display offers the opportunity for data collection. The recommendation is that the display is field tested to gauge the improvement of waste sorting practice. User-testing may also provide insights into further improvements of the display model. There is also an opportunity to incorporate eye-catching, artistic display elements to further engage users.

Acknowledgements

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References

Berriera, D., Fountain, J., Imbault, A., & Tsai, W. (2014). Alternative Systems for Zero Waste User Engagement. *UBC Social Ecological Economic Development Studies (SEEDS) Student Report*.

Chung, E. et al. - Environment, Technology & Society. (2011, April 30). Retrieved February 13, 2015, from http://hackfest.cmubi.org/past-versions-of-this-class/environment-technology-society/2011-accomplishments/wastesortingsystem

Johnson, J. (2013). Husky Den Waste Bin Signage (Final Report). UW Garbology Project.

Appendix

Plastic Food:

http://www.walmart.com/ip/Pack-of-24-Farmer-s-Market-Artificial-Red-Delicious-Decorative-Fruit-Apples-3/24558996

http://www.walmart.com/ip/Floracraft-Design-It-Simple-Decorative-Fruit/24695779

http://www.ebay.ca/sch/i.html?_from=R40&_trksid=p2050601.m570.l1313.TR0.TRC0.H0.Xplastic+fruit.TRS0&_nkw=plastic+fruit&_sacat=0

http://www.ebay.ca/sch/Decorative-Fruit-Vegetables-/36018/i.html