Ecotopia

Team

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Problem and Solution Overview

According to the US Environmental Protection Agency (EPA), Americans generated an average of 4.38 lbs. of trash per person *every day* in 2012. [1] While some trash can be combusted for energy, the EPA estimates that about 2.9 lbs. of trash are discarded in landfills per person per day, which are highly toxic to the environment because it will take hundreds of years to degrade. Although some corporations such as Google have already provided biodegradable plastics instead of plastic utensils, they actually do not biodegrade any quicker than traditional plastics. Our goals are to increase personal awareness and help users form habits to reduce their waste footprint over time. We decided to implement Augmented Reality technology into user's in-store shopping in order to achieve our goals. Specifically, we focused on helping shoppers make eco-friendly purchases in the grocery stores by identifying the trash component of the items they want to buy and creating incentives with the help of social aspects.

Contextual Inquiry Target, Stakeholders, Participants

We conducted four contextual inquiries with participants who have different backgrounds in order to gather a diverse set of data. Initially, our goal was to explore how people sort trash in order to see if there were ways we could increase their awareness. For one of our inquiries, an apprentice-based approach was used to ask if we could shadow a shopper and ask questions about the items they bought. For the other inquiries, we conducted interviews combined with a journaling task where we asked the participant to track everything that they threw away over the course of a day on a scrap of paper.

Contextual Inquiry Participants[2]
Adam is a second-year master student at the University of Washington (UW). He has a good understanding of trash sorting, so he disposes trash properly both at home and in public. Adam considers the availability of goods in the grocery store, the goods he needs, and the price of them when buying something. He generally doesn't care how much trash he will create while he is purchasing. Instead, he tends to think something eco-friendly during shopping, such as avoiding buying goods with plastic bags and buying eco-friendly goods. The contextual inquiry was conducted in the parking lot near Safeway in the U District.

Betty is currently a developer at Microsoft and a graduate of the UW. While at UW, she was very involved in organizations like UW Students Expressing Environmental Dedication (SEED), and

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[1] http://www3.epa.gov/epawaste/nonhaz/municipal/
[2] All names have been changed to protect the privacy of participants

continues to volunteer for projects related to fair-trade practices in her spare time. Betty finds much personal meaning in making environmentally conscious decisions, though she is more passionate about making sure her purchases promote fair-trade practices. As someone who is already very conscious about reducing trash, she did not feel our app would benefit her, but she stressed the importance of such an app as a teaching tool. The contextual inquiry was conducted in a cafe near her workplace.

Katherine is currently a college student at the UW. She moved from places where eco-friendliness was not a high priority for the government or the society so she has less education on methods to sort trash and reduce waste. A lot of her actions were driven from a cost-effective standpoint. She would like to learn more on how to sort trash. She is more interested in trash output for larger institutions and how she is matching up with these groups. The contextual inquiry was conducted in the HUB on campus.

Sue is an international student from China at the UW. She doesn't tend to sort trash properly because she had no experience with needing to do so in the past. Although she is trying to understand the trash sorting guidelines, she has a hard time differentiating her trash and it takes her a long time to sort trash correctly. The contextual inquiry was conducted in her dorm room on campus.

Contextual Inquiry Results and Themes

One main theme we found was the importance of an individual's personal values. Our participants demonstrated a wide range of commitments to an eco-friendly lifestyle; however, everybody wanted to know that they were effectively making a difference. Part of this involved learning more about the impact of one's personal actions. For example, Adam was more interested in knowing the trend of the trash he produced over time, to potentially reduce waste in the future. Betty also talked about finding personal meaning in her efforts to be more environmentally aware and conscious of fair-trade practices. She talked about her efforts as being part of a larger goal to make the world better and leave a legacy through other people, through infrastructural changes, or through a ripple effect.

Our inquiries revealed two problems associated with reducing a participant's personal impact on the environment. The first was the cost trade-offs often involved in purchasing "eco-friendly" alternatives in stores. For example, Betty noted that she was much less willing to pay for organic foods or buy eco-friendly alternatives because of the higher cost.

The second problem was the lack of education on sorting trash properly. Sue, as an international student from China, was not familiar with trash sorting in the US. She had a hard time differentiating her trash at home and would spend a while standing in front of the trash cans in public in order to understand the trash guidelines. Katherine had a similar experience since she was from a city where trash sorting wasn't as institutionalized as it is in Seattle.

As for current practices, one common trend was the use of reusable bags for shopping. Reasons for using reusable bags differed slightly in that some participants, like Betty and Adam preferred reusables for environmental reasons, while others like Katherine saw reusables as a more cost-effective option. Participants also talked about how bringing reusable bags to the store took a bit of pre-planning. This pre-planning also involved creating grocery lists, but these lists were influenced more by cost and what was needed than environmental concerns.

These themes led us to some tasks to design for. One idea the participants mentioned was a histogram to track how much of each type of trash was thrown out over time. This would bring awareness to the users and help them reduce their trash production. It would be ineffective, however, to manually input every piece of trash thrown away or research what cost-effective and eco-friendly substitutes existed. Two of our participants forgot or did not realize we were asking them to journal their trash output for a day, revealing that tracking trash is potentially burdensome. Thus, we decided it would be good to automate tracking as much as possible. Another issue is the legitimacy of eco-friendly alternatives, as some corporations use "eco-friendly" labeling for PR purposes. There would need to be resources, citations, or validation from trusted non-profit or third-party organizations, to increase the user's confidence in our suggestions.

Lastly, a reward system would be necessary to motivate users to continue tracking. All of our participants mentioned a social aspect of some sort, whether to compete with friends or join a group to track trash output as a larger institution. We need our reward system to be very positive and motivating, rather than guilt-tripping users. This could potentially take the form of unlocking more features from the app or providing coupons as a reward.

Answers to Task Analysis Questions

Who is going to use the design?

Our targeted users are shoppers wanting to reduce trash output. This includes both shoppers who are new to living an eco-friendly lifestyle, and those who are experienced at reducing their trash output.

What tasks do they now perform?

Currently, users purchase what they need from the store with little thought on how much trash is produced from their shopping. Most discard of their trash without thinking about their total output.

What tasks are desired?

The six tasks that we extracted from our contextual inquiry are as follows:

> **Task 1:** Providing suggestions for eco-friendly alternatives
> **Task 2:** Reminders to bring and use reusable goods when shopping
> **Task 3:** A way to gauge at purchase-time what kind of trash would come from an item
> **Task 4:** A way to see how one's the personal trash footprint from purchased products, or the collective footprint of a group/organization compares to other people in the same neighborhood, etc.
> **Task 5:** A way to help motivate people to make eco-friendly purchases
> **Task 6:** A way to measure the impact of one's personal trash footprint on the environment

How are the tasks learned?

The app is meant to be used on a regular basis as users go about their normal shopping routines. By telling the user what kind of waste should go where, what trash components make up their purchases, and how to find more eco-friendly alternatives, they will automatically learn how to live a more eco-friendly lifestyle over time.

Where are the tasks performed?

The tasks are performed as they are shopping for goods such as at a store or office snack bar.

What is the relationship between the person and data?

The data improves a person's awareness of their place within the larger ecosystem -- in other words, their personal footprint and how it impacts the world. The data also helps people to see how they compare to others, by providing a benchmark against regional average trash production levels, for example.

What other tools does the person have?

In Seattle there are a lot of government-provided resources to help people learn about how to properly dispose of trash. The city provides separate sorting bins for recycling and yardwaste/compost, and informational pamphlets about what goes where. Throughout the city, there are lots of visual resources and reminders both for home-use and in public.

There are also many educational websites and blogs geared towards people who strive to live eco-friendly lives. This can include mobile apps that show users where the nearest bulk-food store is (since buying goods in bulk can reduce trash that results from packaging).

How do people communicate with each other?

Non-profit websites, organizations, and "green" communities are often standard portals of information and places to share tips for people who seek to live eco-friendly life-styles, volunteer work with orgs. Our app would include a social feature of some sort that allows people to see how their friends or neighbors are making progress to live more eco-friendly life-styles, and connect with other people interested in this space.

How often are the tasks performed?

Most people throw away trash at least once a day so tasks are daily. Reflections on trash output usually occur weekly for more meaningful trends -- municipal trash collection and grocery shopping happen weekly so it is easier to gauge trash output and see the distribution across recycling, compost, etc. Shopping for groceries happens around once a week.

What are the time constraints on the tasks?

Most participants, even those who live eco-friendly lifestyles, do not spend much time thinking about how to sort their trash at immediate disposal time.

With an app that tracks personal trash production, users wouldn't be able to extract very meaningful data at the beginning but the data gets more valuable over time as trends start appearing.

What happens when things go wrong?

In some cities, producing an excess of trash over a specified limit incurs additional costs (often per bag etc.) for individuals. Forgetting to properly sort trash can also lead to fines. The continuous production of trash and the increase in this production over time also contributes to a wide array of environmental problems.

On a social level, people in the eco-friendly community are sometimes negatively labeled or stigmatized for being "overly enthusiastic" about living in an eco-friendly way, which can lead to discouragement for some.

Proposed Design Sketches -- "3x4"

Design 1

Our first design focuses on using virtual reality technology during the shopping experience. With a pair of glasses, users can enjoy their shopping experience without being disturbed by notification messages or inconvenienced by having to manually search for eco-friendly information via a mobile app. The data will be automatically recorded, which creates an invisible and empirical tracking experience.

The glasses that users wear have the ability to analyze the potential trash produced for the items that users tend to buy. Users can be provided with a diagram representing an analysis of the trash components of a product, as well as alternatives if the items they want to buy produce a great amount of trash (**task 1**). Users are also able to see a list of suggestions for eco-friendly items that their friends bought when they are looking for alternatives (**task 4**). At the end, users can submit their own suggestions into the list to help others, and contribute to a crowd-sourced database of tips.
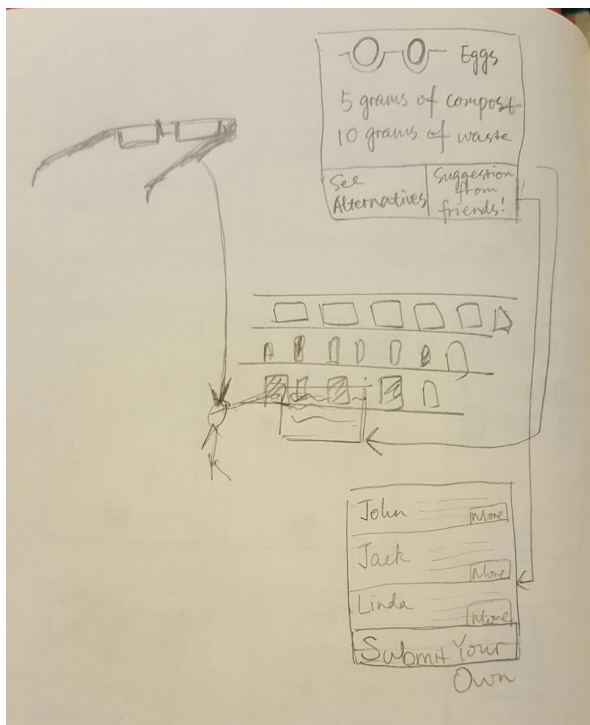
The glasses can create a virtual reality experience when users put the items that can potentially produce great amount of trash in their shopping carts (**task 3**). Through the glasses, the users can choose to view a simulation of how an item might add to environmental pollution.
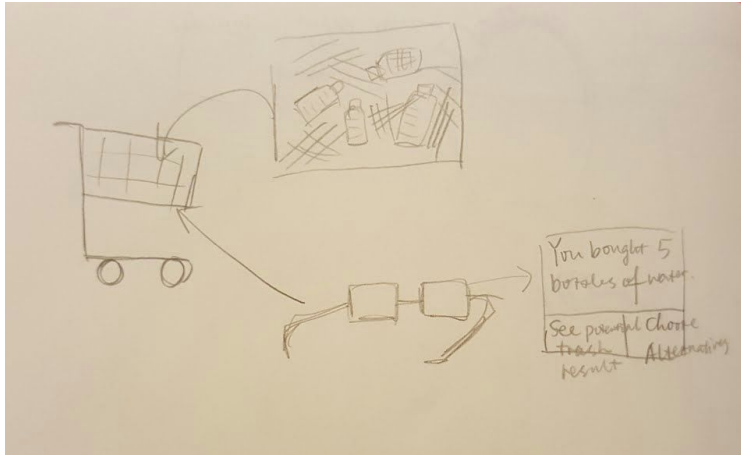
When users put an eco-friendly item into the cart, they can see the instant effect of improving the current environmental pollution through their glasses. They can also see a congratulatory image, such as gaining badges or applause from an audience (**task 5**).


Design 2

Our second design focuses on incorporating a social aspect to help motivate users to reduce their trash output. Inspired by the UbiGreen paper[3], this design features a mobile app game that provides each user with a plot of land for them to take care of.

As a user buys items, they can tag them as plastic, compost, etc. This tagging and sorting process teaches the user about the trash components of their purchases as well as how to properly sort their trash for disposal later (**task 3**). Items that are improperly tagged or consist of long-lasting trash

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[3] http://repository.cmu.edu/cgi/viewcontent.cgi?article=1118&context=hcii

components (i.e. plastic) end up in the user's plot, eventually turning their plot of land into a landfill. This gives the user a visual sign of how their personal trash footprint impacts the environment (**task 6**).
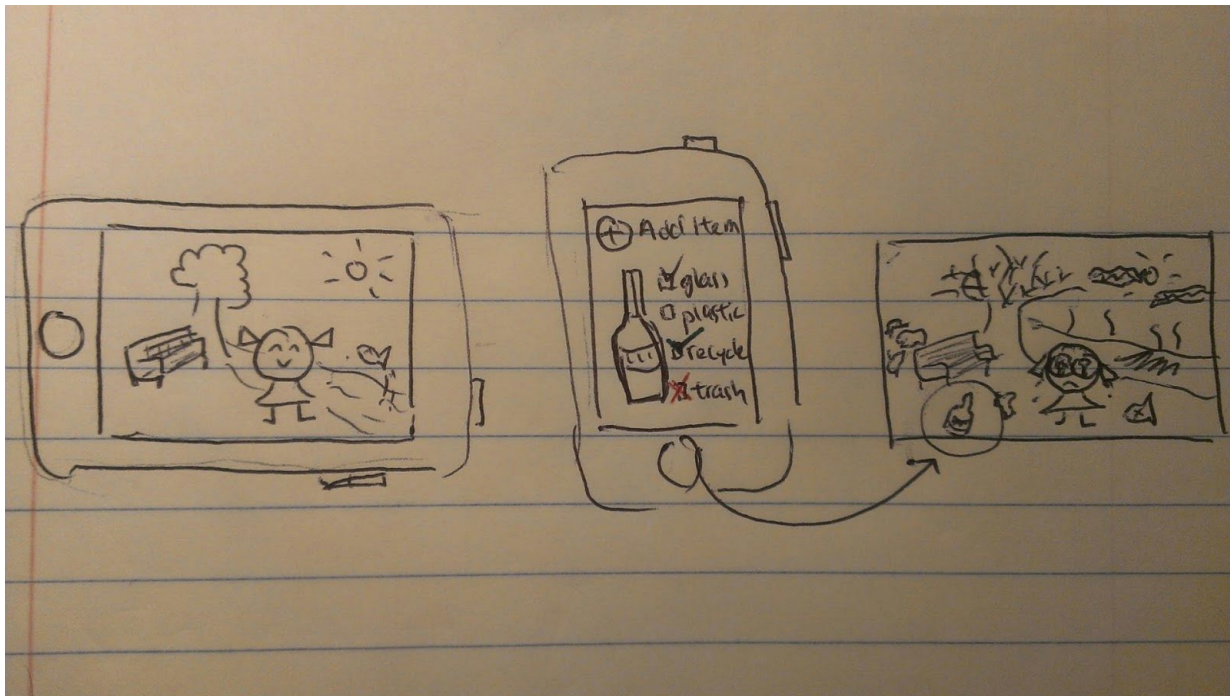
Users can visit the landfills/land plots of their neighbors, view their neighbor's progress, and share tips to encourage each other to reduce their trash output (Fig. 2.1). Users can also join a "community plot" to compete in challenges with other communities to see who can reduce their trash output the most (**task 4**). Badges and coupons for eco-friendly stores in one's neighborhood can be awarded to groups or individuals that reduce their trash the most (**task 5**).

During these social competitions, summary reports can be generated after time intervals of a pre-specified length (i.e. a week, 30 days, etc.) showing the most common sources of trash, and users can compete individually or as a group to come up with the most creative alternatives or the greatest number of alternatives that could be used instead of the products that were purchased (**task 1**).
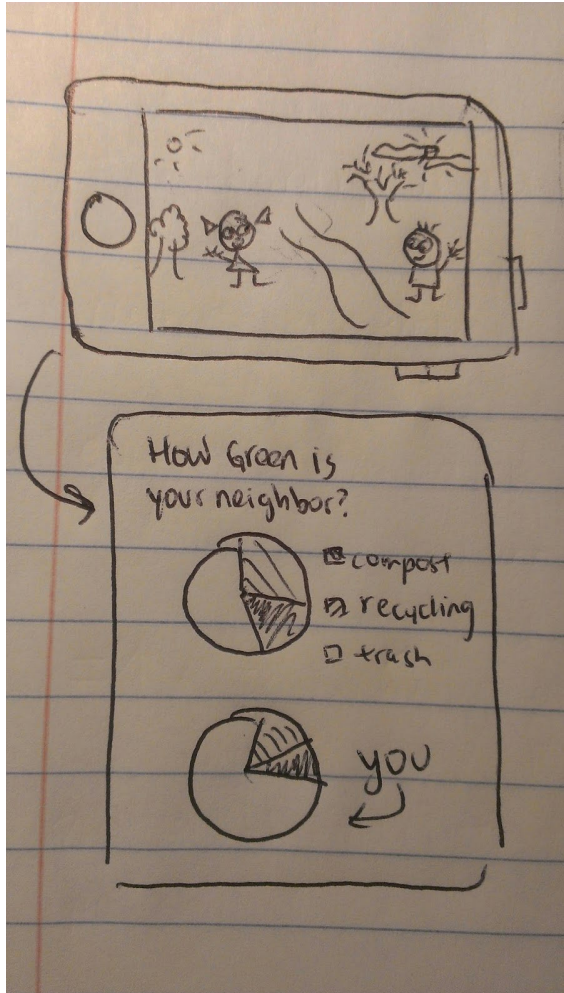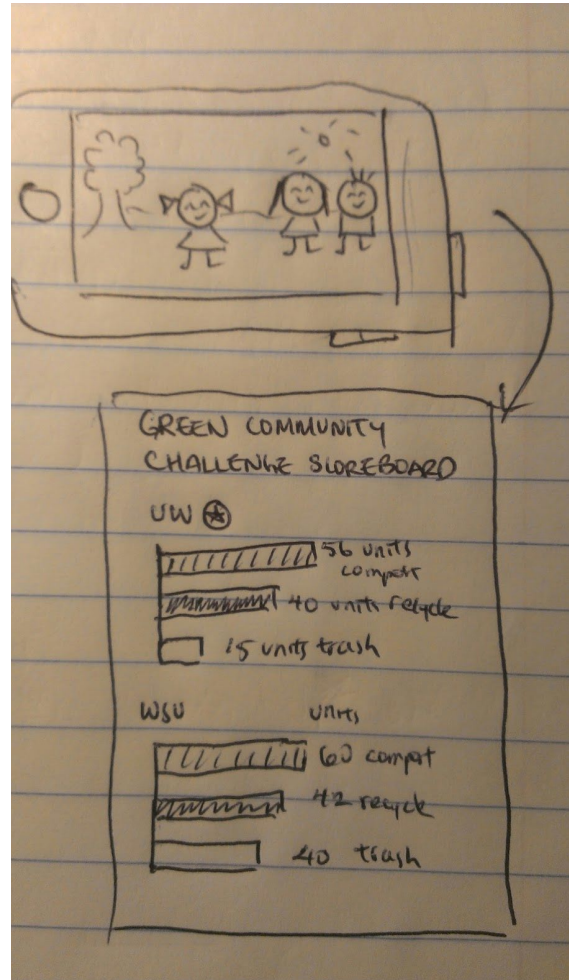
Fig 2.1

Fig 2.2

Design 3

Our third design focuses on helping users to make eco-friendly decisions in-advance by helping them to plan out their grocery list before purchasing, and get suggestions for alternatives.

Each item that has an eco-friendly alternative and will have some way to allow the user to see more information (**task 1**; [Top left fig; mid-right fig]) Users can view information about an item, presented as a simple graph of what type (compost, recycling, trash) of waste will come of it (**task 3**; [Top left fig.]).

Users can see their trash trends over time via a histogram to show a user's trash output as compared to that of other people or groups that they know (**task 4**; [bottom left fig.]). Buying alternatives will give the user points to purchase coupons to incentivize them to continue living an eco-friendly lifestyle and tracking their trends (**task 5**; [mid-left fig.]). Finally, the breakdown of trash will be

converted into one unit, such as pounds of greenhouse gases generated so users understand their effect on the environment better (**task 6;** [Top left fig.]).
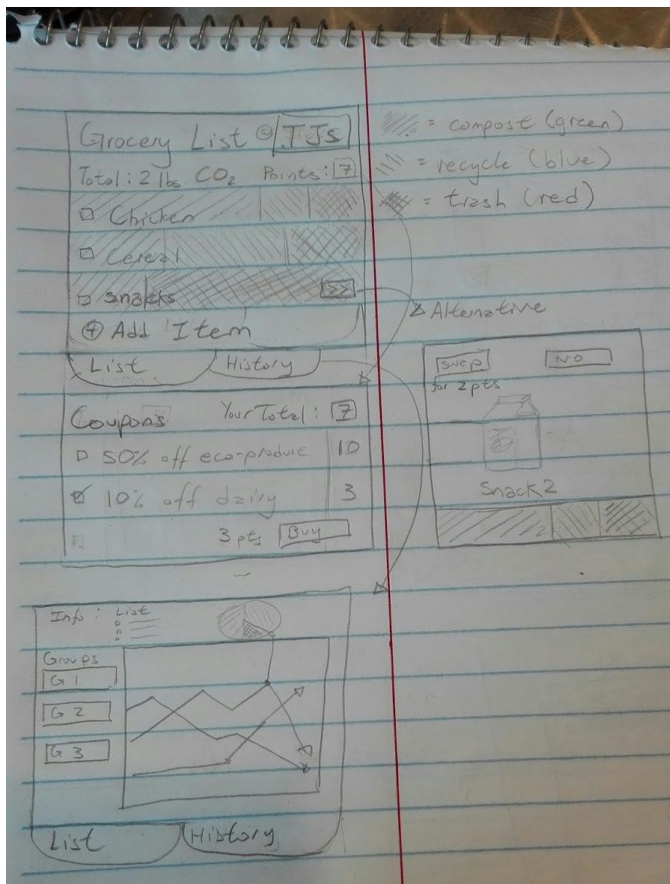
Design Choice

We chose design 1. The concept of augmented reality was enticing to seamlessly integrate useful information with the shopping experience. We decided to focus on the in-store shopping experience and design for tasks 1 and 5, to provide alternatives and to give motivation to continue living an eco-friendly lifestyle. By influencing what the user purchases, we can eliminate their personal trash production in the early stages. This was important given that our CI participants found manual trash tracking to be burdensome. Using augmented reality, information about the trash components of items can be easily learned in real-time so shoppers can fully understand what they are purchasing. We believe tasks 1 and 5 will be most useful for people who are new to eco-friendly living, as it encourages them to start learning how to become more eco-friendly, and motivates them to keep making lifestyle changes. Task 1 in particular helps people learn about eco-friendly alternatives as they shop, so they can start making lifestyle changes from that moment onwards. Our CI revealed that people who already consider themselves "eco-friendly" might not find use in a trash-tracking app, but the augmented reality aspect is interesting enough to attract veteran eco-friendly shoppers to learn more about certain products. We also chose to focus on task 5 because our CI revealed that many

people find the social aspect important when making lifestyle changes. Seeing other people's progress and allowing them to see yours is one way to motivate each other to keep going. Turning the shopping experience into a sort of social game using augmented reality, where your shopping cart into a "landfill" or a "garden" depending on how many eco-friendly goods are purchased, helps keep the task of buying as little trash as possible fun.

Written Scenarios -- "1x2"

Task 1: Providing suggestions for eco-friendly alternatives during shopping (storyboard 1)

Bob is a student at UW who wants to learn more about how to be eco-friendly. He just moved to Seattle to start school, and is not familiar with Seattle's trash sorting regulations. He wants to learn more about both how to sort the trash he currently produces, and how he can reduce his trash production overall. On one of his busy days, he stops by Safeway to pick up a pre-made rotisserie chicken for his dinner. In the store, he picks up a pre-packed rotisserie chicken, and scans the item with a set of Augmented Reality glasses. Ecotopia runs a quick analysis of the item, and provides Bob with a diagram detailing the trash components of his item. For example, the pre-packaged rotisserie chicken consists of a recyclable paper handle, a recyclable plastic lid, the compostable chicken itself, and a tray that goes into the trash. Learning about the trash components of the item in this way helps Bob see at a glance how much trash will be produced by his purchase, and teaches him how to properly dispose of each component (i.e. recycling, trash, compost, etc.). Ecotopia also provides him with a list of more eco-friendly alternatives, such as bringing your own reusable container and picking up take-out fried chicken from the Safeway deli, which would produce only compost. In this way, Bob can learn about his current trash production habits, how to properly sort his trash, and how to find alternatives and make more eco-friendly decisions.

Task 5: A way to help motivate people to make eco-friendly purchases (storyboard 2)

Kylie considers herself an eco-friendly shopper and is proud of having reduced her trash footprint, but finds that it can be difficult to stay motivated in her eco-friendly lifestyle. Once in awhile she finds herself buying non-eco friendly products out of convenience (such as plastic water bottle), and would like to better understand the impact of these seemingly small decisions on the environment. When Kylie goes to the grocery store, her shopping cart is transformed into a "garden" via a set of Augmented Reality glasses with the Ecotopia app. Each time she places an item in her cart, her garden is affected based on how eco-friendly the product is. For example, purchasing a trash-producing item (such as plastic water bottles or bags of chips) makes those items appear in her virtual garden, turning it into a landfill, while buying eco-friendly products makes her virtual garden bloom. In this way, Kylie can see the direct impact of her purchases on the environment, which motivates her to make eco-friendly purchases. Kylie can also see the shopping cart gardens of other shoppers, or share photos of her shopping cart garden with her friends later, which provides further motivation to shop healthy and eco-friendly.

Storyboards of the Selected Design

Storyboard 1 -- Task 1: **Providing suggestions for eco-friendly alternatives during shopping**
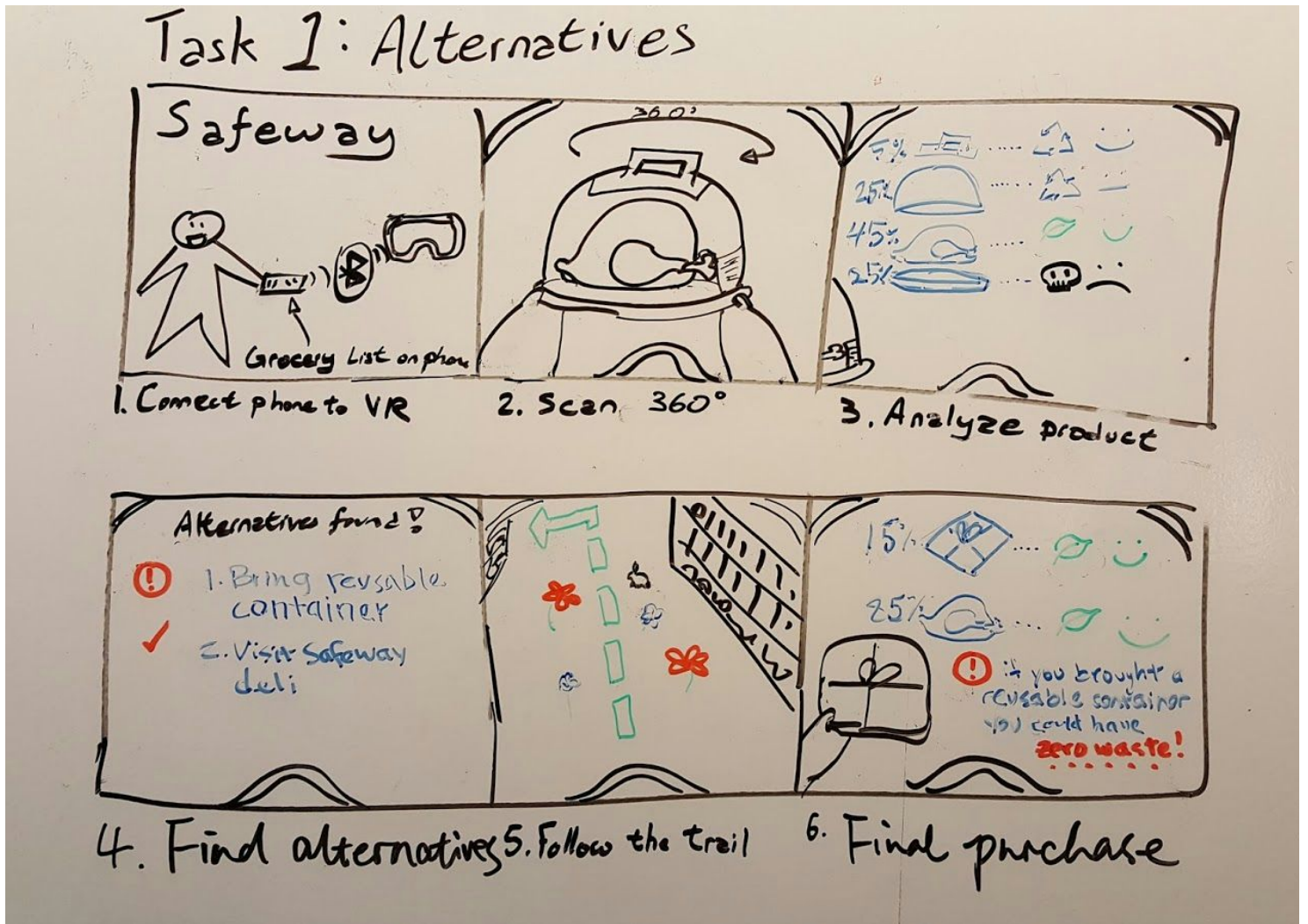
Storyboard 2 -- Task 5: **A way to help motivate people to make eco-friendly purchases**