Engineering Design - GNG 1103 [C]

Project Deliverable F

VR/AR for Recycling

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Section C03 – Group 11

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ABSTRACT

A prototype of the app has been created. The functions and capabilities of the app and website are described and discussed below, along with the design process used to create the app and website. The app and website were tested, and feedback was received and recorded. The app and website were tested, and the feedback was received and recorded. The feedback and results are then discussed and analyzed below.

Table of Contents

Table of Figures

Introduction

The project team has reached the prototyping stage for the product designed to increase household recycling habits for the client, Mitch Bouchard. While the team faced many difficulties, especially with coding aspects, a simple prototype that met the essential priorities set in the first client meeting was created. The app prototype features the main layout along with the manual sorting options through a search bar and the bar code AR scanning. However, while the first prototype has been finished the team's work is far from over.

The current design is only a rough sketch of what the team hopes to accomplish in the next few months. The first prototype was created as a proof of concept, that the ideas of the team could be generated in a mobile space, so many of the features require very specific inputs. With the goal of generating a working build, the current prototype is not polished, and the design will be subject to much change as the functionality of the build was prioritized over the aesthetics.

In this deliverable, the first prototype of the recycling app and website were constructed and discussed, a test plan for the different aspects of the prototype was constructed, and the prototype was tested with a small sample of potential users. The deliverable will thoroughly explain the prototype, how it was constructed and why certain choices were made in its construction. Then, a test plan for the different functions of the prototype will be elaborated on with specific steps to take to ensure good feedback. Finally, the feedback from a small sample group will be listed, along with how the group plans to improve the prototype based on the feedback.

Prototype I

App

The current AR design uses the image tracking ability of the Vuforia engine. Pictures of barcodes are stored on the app and the camera uses reference points on the bar codes to identify the object. Since each bar code is unique and corresponds to a given product the object can be distinguished using the bar code. Currently the app will display a colour coded background corresponding to the bin the object belongs in, accompanied by text telling the user which bin to dispose the object. Currently black corresponds to garbage, blue corresponds to the blue bin, and grey corresponds to paper.
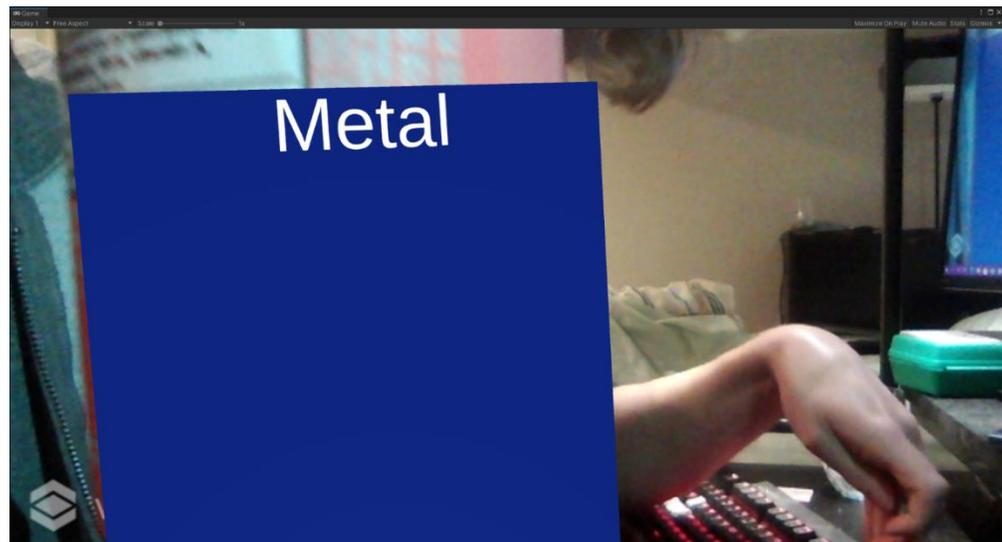
Figure 1: AR Garbage Notice

Figure 2: AR Blue Bin Notice

Figure 3: AR Paper Notice

Main Screen and Button Layout

When the app is launched, the user will be taken to the main screen (figure 4) from which they can access each section of the app: AR, Sorting, and Social. In this prototype, the buttons have been linked to the other pages and currently function by clicking the button to transition from page to page. Furthermore, each page will have their own set of buttons as to change pages without needing to return to the main screen.

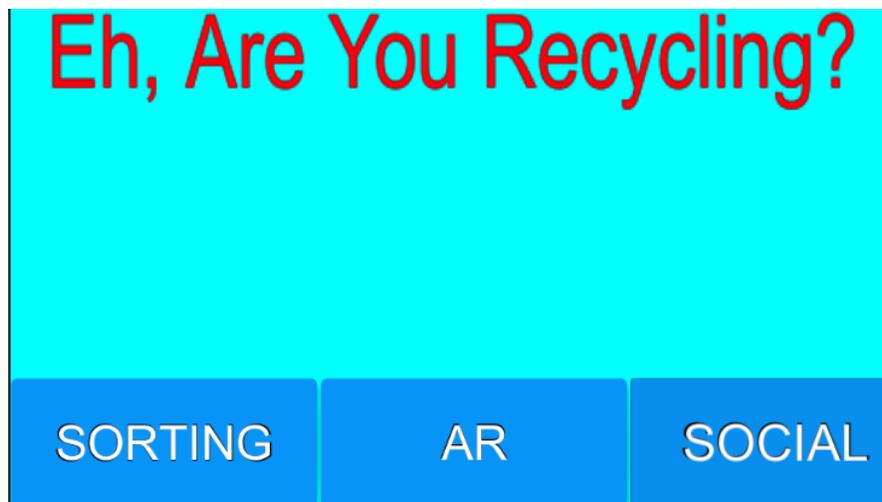*Figure 4: Main Screen after Launch Page*

This design is fairly simple and basic as to avoid overloading the user with pop-ups and an excessive number of options. Additionally, this design will be updated to display more illustrations to better catch the user's eye in a tasteful manner. Also, the current buttons include small animations when clicked to help show confirmation of the user's actions.

Search Bar
The search bar is at the top of the manual sorting page and is currently the only item
implemented (Figure 5). The search bar allows the user to input a value and returns the location
where the object belongs (Figure 6). To start, the user types their item into the search bar and
presses the search button. If the item exists in the database, the page reloads to present the user
with a screen, informing them what to do with their item. Once the user has been routed to the
correct recycling information, the user presses the return button to return to the search menu.
From there, the user can also press the return to menu button which will bring the user back to
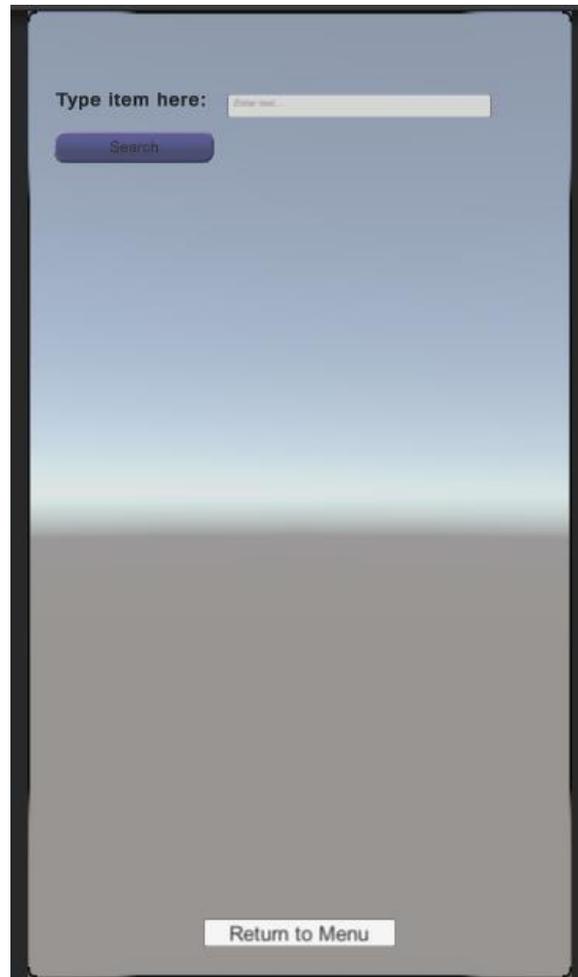the main interface page.

Figure 5: The Main Sorting Menu Page

Figure 6: One of the possible outputs when an item is Typed into the Search Bar

To sort the items properly, a database was created in C# with a HashTable. A Hashtable was chosen for its fast run time with a big n notation of 1, meaning that the Hashtable can retrieve information instantaneously. The Hashtable is filled with a uniquely created object called Recycleable. The Recycleable object takes in a string, Boolean, and another string as the name of the Recyclable, whether the object is recyclable, and the name of the bin that the item recycles to respectively. The HashTable is filled with these objects as the information and the name of the object as the key. The database has a single method applied to it where it searches through its keys for a matching key and returns the item associated with the key and returns null if the given key is not associate with an object.
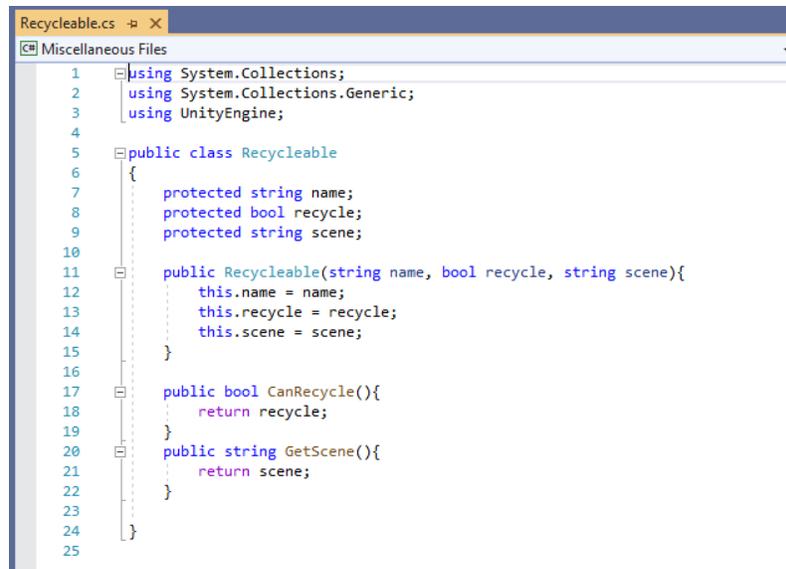
```
Recycleable.cs  ⇥ ✕
C# Miscellaneous Files                                                    ▾
      1    ⊟using System.Collections;
      2     using System.Collections.Generic;
      3     using UnityEngine;
      4
      5    ⊟public class Recycleable
      6     {
      7         protected string name;
      8         protected bool recycle;
      9         protected string scene;
     10
     11   ⊟     public Recycleable(string name, bool recycle, string scene){
     12             this.name = name;
     13             this.recycle = recycle;
     14             this.scene = scene;
     15         }
     16
     17   ⊟     public bool CanRecycle(){
     18             return recycle;
     19         }
     20   ⊟     public string GetScene(){
     21             return scene;
     22         }
     23
     24    }
     25
```

Figure 7. Recycleable object code

When the search button is pressed, the code associated with the button, InputToText, is run. The code first reads the value in the text bar as a string and runs the method IsRecycleable, which takes the string as an input. The method turns the input string to all lowercase before running the search function of the database with the input string as the key. If the item is not null, the method takes the scene name from the database object and changes the scene to the scene specified in the database object.

In future installments of the manual sorting page, the objective is to fill the database, so that more objects and items are recognized. Similarly, as the person begins typing in their item, the search bar with provide a list of options that exist in the search bar with the same beginning letters. This will help the user find the item they are looking for easier. Additionally, the manual search bar will also add buttons below with common categories for the user to click on to easily sort to the item's recycling criteria even if the user does not know the specific name of the object.

Website
Home Page
The home page (figure 8) has a very basic look with a small paragraph description about the website. The navigation bar is pinned at the top of the page throughout the website and can be used to navigate through all pages.
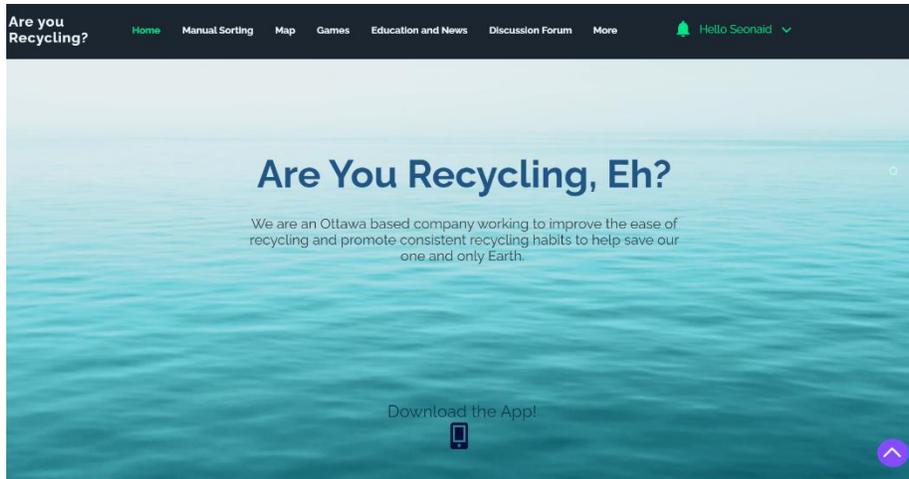
Figure 8: Home Page

Manual Sorting
The Manual Sorting page (figure 9) is a step-by-step breakdown of categories of items including plastic, carton, paper, and cardboard. The list and breakdown will become increasingly more detailed (figure 10) through the progressing prototypes. The categories can be found in a drop-down menu in the navigation bar to show all categories that can be selected (figure 11).
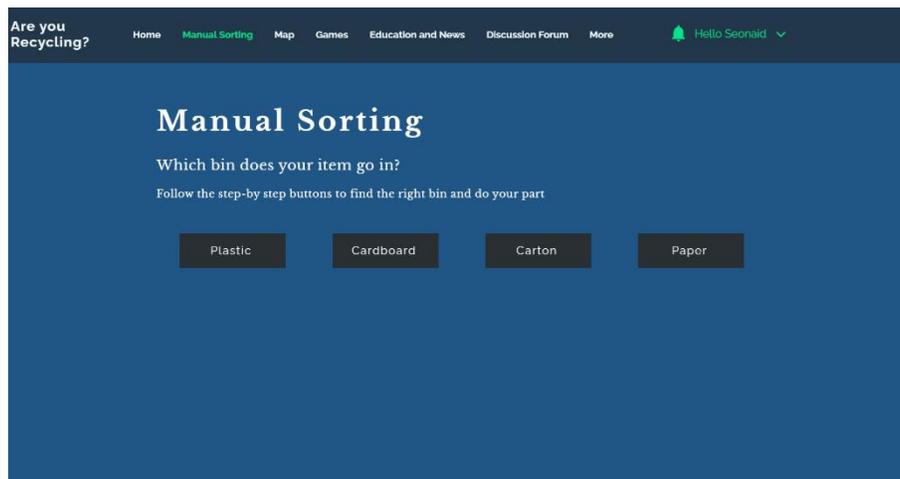

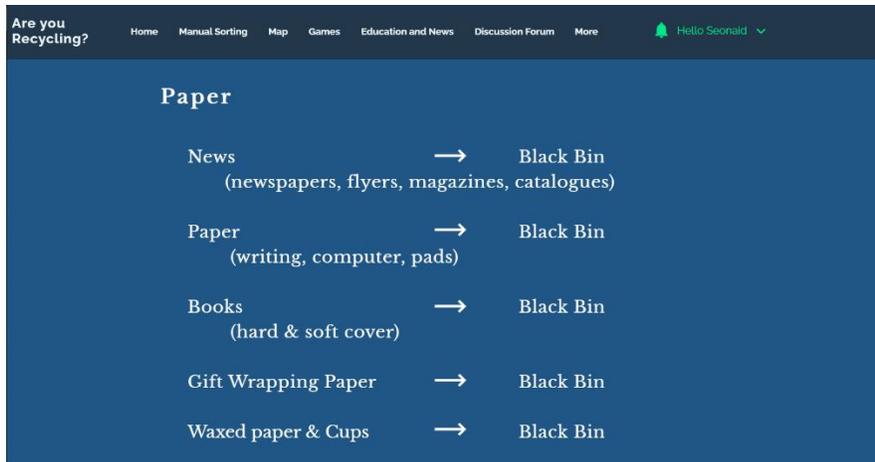
Figure 9: Manual Sorting Main Page

Figure 10: Manual Sorting - Snapshot of Paper Breakdown

Figure 11: Manual Sorting Drop Down Menu
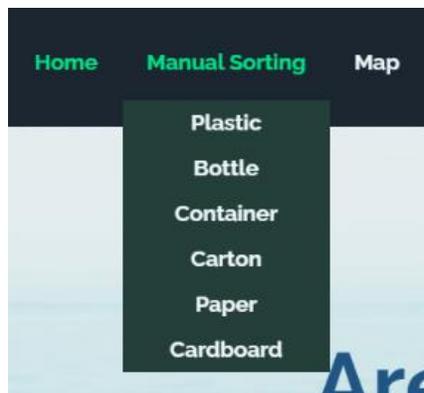
Map

The Map page (figure 12) is embedded with an interactive map with 5 locations for specialized recycling centers that take in items that cannot be tossed into one of the four household bins. More locations will be added through the prototypes to build a better database to help the users. The addresses and phone numbers for the centers are attached to each location (figure 13).
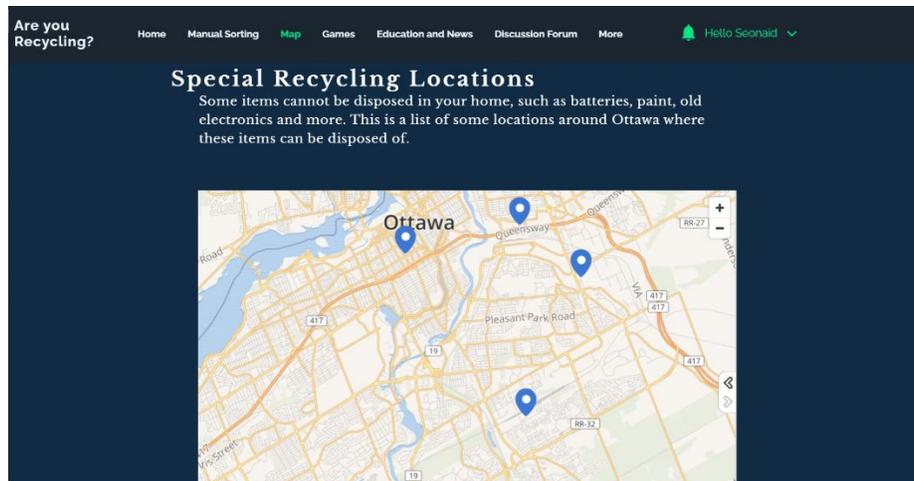
Figure 12: Special Recycling Interactive Map

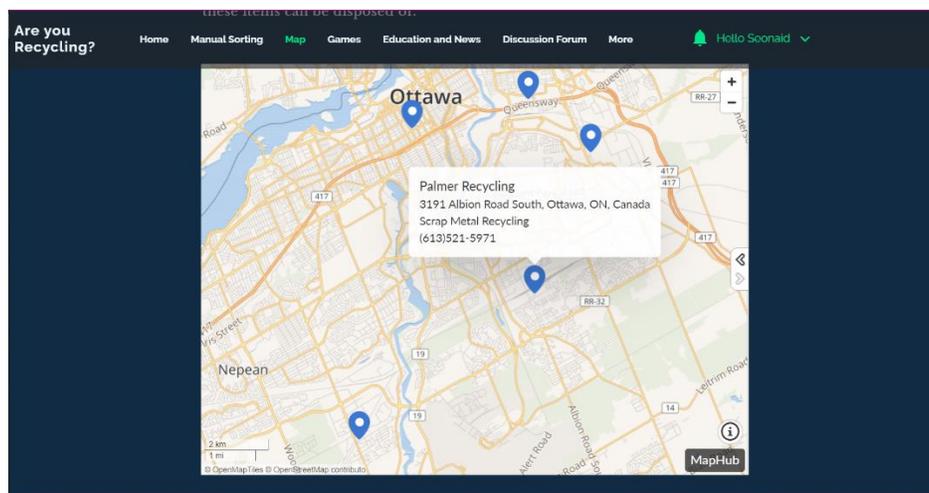*Figure 13: Location example on Map*

Game
No games have been developed for the first prototype. It has been determined to be a lower need for the final product and is planned to be looked into further into development.

Education and News
The Education and News page (figure 14) currently has four buttons that lead to external resources about recycling in Canada and the important of recycling.
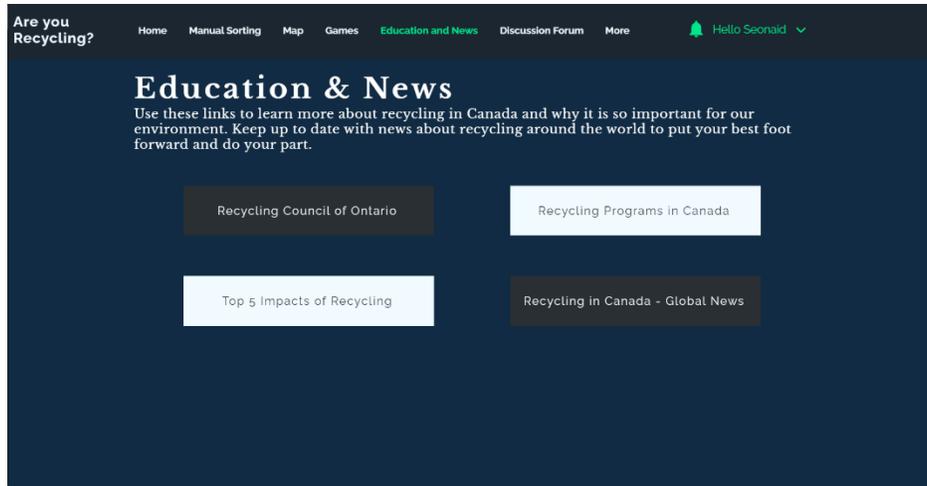
Figure 14: Education and News Page showing four buttons leading to external resources

Discussion Forum

The Discussion Forum (figure 15) is a page where all members can post discussion questions, respond to posts, and like posts by other members. There are currently no posts on the discussion page but as the website reaches more people and becomes common use, the discussion page will fill with community chatter as it can be filled by anyone. The discussion page presents the users with a place to interact with others and learn more about recycling. The team would also monitor the discussion board for any harassment and to ensure that people's recycling questions are answered.
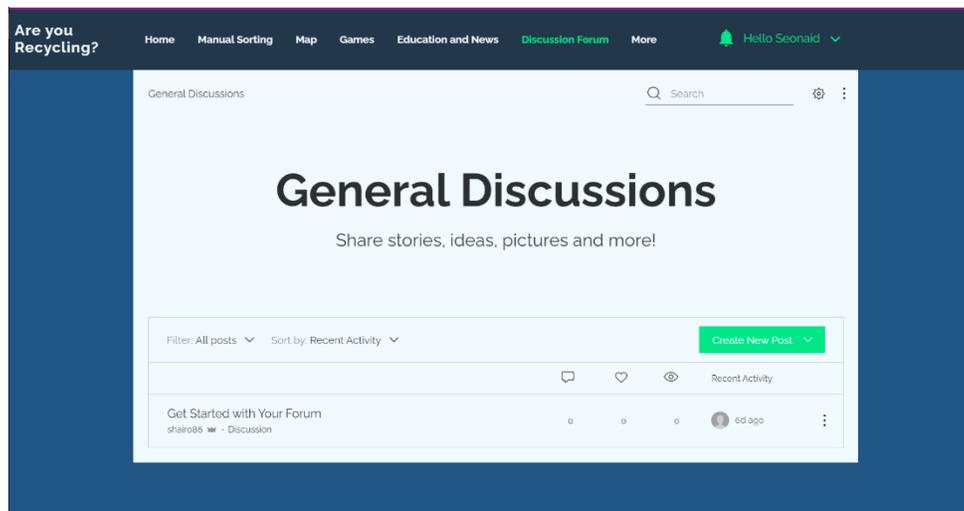

Figure 15: Discussion forum for members to interact with

Members

The Members Page (figure 16) is for those who have created an account where the profile, posts, notifications, settings and more can be found. Accounts can be edited to show the preferred name and email linked to the account. Along the left side of the page, there is a drop-down menu to navigate through the 'members' page.
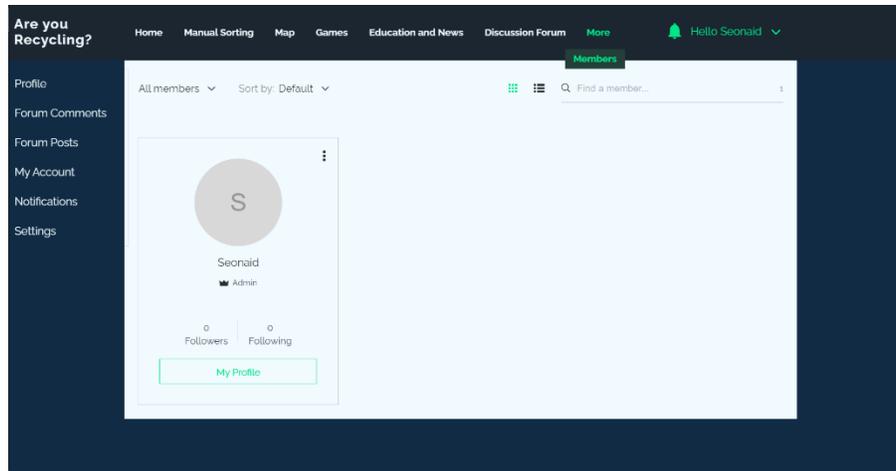
Figure 16. Members Page

Test Plan

After completing previous deliverables and designs, the first prototype has been created. This is a very basic prototype to test some fundamentals functions that are being created within the app and the website for the final design. The subtasks for the prototype have been distributed through the members of the group and put together for the initial prototype.

Why are we doing these tests?

Testing prototype is an important aspect of the design process for multiple reasons. It can show the faults in the product and areas where further development is needed and it can be shown to the client and potential users for feedback about aspects that should be added, removed, improved, or changed. Prototyping also allows the creators to gain a better understanding of the software and materials that are being used for the final product, since there is no previous experience. Creating the prototype will also allow for a better understanding of what can be accomplished in the predicted timeline and it will highlight problem areas early so they can be fixed for the final product.

What is the test objective and what is the prototype description?

The testing of the first prototype has many objectives, split into small tests of a comprehensive prototype of almost all desired functions of the final design. The physical prototype was split into two parts, the app and the website, so many tests were performed on both while some tests only applied to a single platform.

What is the test?

The tests to be conducted focus on determining the functionality of the prototype with its existing abilities. Some key tests to ensure the prototype operates as desired include:

- Can the app scan barcodes and provide recycling instructions with accuracy?
- Can the search mechanic return the specified items?
- Can the manual sorting mechanic guide the user to the correct item?
- Can the app be accessed on all platforms? If not, which ones are available?

Tests will be conducted by allowing family members and friends to try out the app in its first prototype stage and provide feedback on their initial impressions. Once received, further information on specifications and planned improvements will be provided to ascertain further feedback from the testers.

At this stage, the degree to which the prototype can perform these tests is not important, rather the focus is on whether these tests can be performed in the first place. Later iterations of the prototype will concentrate on improving the functional systems and implementing more complex and desirable systems.

How will the results be used?
The results from these tests will be used to help improve upon functional aspects of the prototype and to reevaluate parts that do not work as intended. These results will aid in indicating the project's progress and provide ample feedback on the current abilities of the prototype. The assessments received from these tests will be kept in mind for all successors of this design to encourage improvement in all areas. Baseline improvements will be the range of items available within the recycling database and the ease of use when scanning and navigating the app.

When is the testing happening and how long will it take?
Testing will occur over a day to allow multiple people to try the product at a time that it is convenient for them. The tests will likely take less than an hour for each person and feedback should be received immediately after or during. This testing is being performed before the second client meeting for adjustments and improvements based on feedback before the presentation.

Feedback and Results

App – AR function
The potential users interviewed on the AR functionality of the app liked the convenience of being able to quickly scan an item's bar code to sort it. However, a potential user expressed concerns that the AR scanner was heavily dependent on the lighting conditions as well as the condition of the bar code. The user also noted that the indicator appearing on the object would flicker and it would be nicer if the projected indicator was more stable.

App – Manual Sort and Search Bar
The potential users interviewed for the manual search feature asked for more ease of access, commenting on the small font, and requesting audio queues and search bar autofill functionality. The user would like buttons linking to different categories as well as a scroll bar to navigate the database to be able further educate themselves on recyclables. The user suggested having more vibrant colour pallet and more effectively using space to clearly indicate button locations and avoiding empty space.

Website
The potential users interviewed on the website would like a more expansive database covering a larger number of materials and specialty recycling plant locations. The users asked for further elaboration on topics such as washing materials to be recycled, the functionality of each type of bin, and adding more information on specialty recycling plants, such as operating hours and more contact information. The users suggested adding information on chemicals and the safety of pouring them down the sink, information on garden waste and, clothing recycling. The users asked for further functionality such as a search bar to search items and a tab for unusual items. The users also noted that the website should be clearer that the information is specific to the Ottawa region.

Conclusion

The prototype of the app is simple, and it is far from the final app design that is planned out. The current app does, however, contain some of the basic functions that were planned in the conception. These functions include the AR scanner and the search function which are both used to determine whether an item is recyclable or not and which recycling bin the item belongs in if it is indeed recyclable. The website was also designed with its intended functions such as a sorting function, a map, a discussion forum and an education and news section. A test plan for the product was made and feedback is be listed, analyzed, and will be used to further improve and design the final product.