Project Deliverable G:
Prototype II and Customer Feedback

GNG 1103 - Winter 2021
Faculty of Engineering - University of Ottawa

uOttawa

Course Coordinator: Muslim Majeed
Teaching Assistant: Ebin Joseph & Jasen Lee
Client: Mitch Bouchard

Due Date: March 21th, 2021
Submission Date: March 20th, 2021

Team Name: GreenAR World

Group #6 Members:
Monica Harada (#300004298)
Branden Leung (#300005206)
Ethan Leung (#300160832)
Keera Moretti (#300050228)
Alexander Fournier (#300022050)

Table of Contents

1 Introduction

The objective of this deliverable is to continue developing our product. We will be creating our second prototype which will include improvements from our first prototype, adding new features and image targets. We are looking to improve the usability of our application and make it appealing to use for our targeted audience. In order to complete our second prototype, we will develop a prototype test plan that will include various test cases to determine if we achieved the desired results. Furthermore, we will take into consideration the problems we faced in the first prototype and fix these for the current prototype at hand. Also, we will speak to potential users and ask for their feedback and how our application can fit their specific needs. After completing the prototype, we will document the next steps required to improve the second prototype based on the feedback received from potential consumers.

2 Prototype Test Plan

2.1 Prototype Test Plan Chart

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	AR image recognition development.	Test to see if our new image targets are working in an efficient manner.	If the new targets are correctly recognizable and do not interfere with the previous image targets, the test is successful.	2021-03-12 (15 minutes)
1.1	Recognize the Pure Leaf plastic bottle. This will be used as a test if recycling information pops up.	Utilize Unity to recognize the Pure Leaf plastic bottle. The application will have a short description saying what the object is, what the disposal method is, and any other key notes.	If this target is uniquely identifiable with 100% accuracy, it is deemed successful.	2021-03-12 (5 minutes)
1.2	Recognize the instant ramen wrapper. This will be used as a test if recycling information pops up.	Utilize Unity to recognize the instant ramen wrapper. The application will have a short description saying what the object is, what the disposal method is, and any other key notes.	If this target is uniquely identifiable with 100% accuracy, it is deemed successful.	2021-03-12 (5 minutes)
1.3	Recognize the Spam can. This	Utilize Unity to recognize the Spam can. The	If this target is uniquely identifiable with 100%	2021-03-12 (5 minutes)

	will be used as a test if recycling information pops up.	application will have a short description saying what the object is, what the disposal method is, and any other key notes.	accuracy, it is deemed successful.	
2	Internal settings menu functionality.	Test every option we implement into the settings menu to see if they function the way they were designed.	Every setting should be independent of one another. Test is deemed successful if any combination of personalized settings is actually executed by the app.	2021-03-13 (35 minutes)
2.1	Track rewards function button is working.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.2	Test if the allow camera access button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.3	Test if the allow location access button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.4	Test if the allow notification button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.5	Test if the allow sounds button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.6	Test if the allow geo map button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)
2.7	Test if the allow municipality recycle practice button is functional.	Button clearly indicates whether it is on or off. This menu button will function in prototype III.	Test is deemed successful when the settings button clearly shows if it is on or off.	2021-03-13 (5 minutes)

3	Information menu functionality.	Information menu displays information such as statistics and recycling calendar.	Test is deemed successful if all information menus included displays	2021-03-14 (10 minutes)
3.1	To make sure navigation is possible and is smooth in the information menu (swiping between screens)	To ensure that the information menu can be navigated with swiping action.	If the application is able to move between different information screens by swiping left and right without issue, the test is successful.	2021-03-14 (10 minutes)
4	To make sure if user is able to navigate between the various menu options through the collapsible menu	To ensure that all menus can be accessed and are functioning.	Test is deemed successful when all menu options are successfully and easily accessible through the collapsable menu. All features included are functioning properly.	2021-03-15 (20 minutes)
4.1	Main screen Navigation	When the main screen button is selected, the application will lead to the main screen and all features are functional.	Test is deemed successful when the menu options are easily identifiable and upon clicking the specified menu will redirect to the appropriate screen. All operations are functional.	2021-03-15 (5 minutes)
4.2	Internal Settings Navigation	When the internal settings button is selected, the application will lead to the internal settings menu and all features are functional.	Test is deemed successful when the menu options are easily identifiable and upon clicking the specified menu will redirect to the appropriate screen. All operations are functional.	2021-03-15 (5 minutes)
4.3	Information Menu Navigation	When the information menu button is selected, the application will lead to the information menu and all features are functional.	Test is deemed successful when the menu options are easily identifiable and upon clicking the specified menu will redirect to the appropriate screen. All operations are	2021-03-15 (5 minutes)

			functional.	
4.4	Rewards Menu Navigation	When the rewards menu button is selected, the application will lead to the rewards menu and all features are functional.	Test is deemed successful when the menu options are easily identifiable and upon clicking the specified menu will redirect to the appropriate screen. All operations are functional.	2021-03-15 (5 minutes)
5	Analyze Button	When the analyze button is clicked, the information for the scanned item will be displayed on another screen by swiping to the right.	Test is deemed successful if the information is displayed on another page.	2021-03-17 (5 minutes)

2.2 Stopping Criteria

The following section is to set stopping criteria for each test objective defined in section 2.1 of this deliverable. Stopping criteria is defined as the criteria that will allow us to end each test we perform for prototype II. Each test will be deemed successful when we are satisfied with the results achieved from our testing objectives.

Test ID	Stopping Criteria
1	If all image targets (1.1, 1.2, 1.3) are recognized and the correct information is displayed while presented in random order, we can conclude this test.
2	If all the internal settings menu buttons (2.1, 2.2, 2.3, 2.4, 2.5, 2,6, 2.7) are operational (i.e: ability to turn on and off), these tests can all be concluded.
3	The information menu functionality is deemed successful if all of the subcategories of Test ID 3 (3.1) are successful. All information within the information menu must be accurate to the best of our ability. For 3.1, the test can be concluded when the navigation between screens is done at least twice to the right and twice to the left.
4	Menu navigation is deemed successful if all the subcategories of Test ID 4 (4.1, 4.2, 4.3, 4.4) are successful. Upon navigating to the main screen, internal settings menu, information and rewards menu, all options within each menu must be successful. For 4.1, the main screen must be able to function and analyze objects. For 4.2, the internal settings menu must have the option to turn on and off all settings options. For 4.3, the information menu must have all information and facts about recycling to the best of our ability. For 4.4, we can navigate to the rewards menu.
5	The analyze button and the items' displayed information are deemed successful if everything is

Test ID	Test Results
	displayed properly and in an organized way. This will conclude the test.

2.3 Test Results

Test ID	Test Results
1	It has been concluded that all of the test items have passed the stopping criteria. When putting the Pure Leaf plastic bottle in the camera view, the analyze button pops up and when clicked on, it displays relevant information on a separate page. When putting the Spam can and instant ramen wrapper in the camera view, the analyze button pops up and when clicked on, it displays information such as what the item is, the method of disposal (blue bin and garbage, respectively), and other key notes ("rinse before disposing). This was repeated 3 times in random order and the application functioned as desired.
2	All the tests within this section have been completed and successful in achieving the desired results. All of the buttons are present and clickable.
3	Test ID 3 as well as all of its subtests were successfully executed. The information menu displays all relevant recycling statistics and information that will aid users in developing better recycling habits. The pages within the information menu are easily navigated to with a swiping motion. The 2 pages we were not able to finish were the collection day calendar menu and the tutorial video on the "Getting Started with GreenAR World" page (page 5).
4	In this prototype, we have included a collapsable menu. This is to ensure that the menu doesn't overwhelm the screen and to maintain our simple aesthetic. Test ID 4 was conducted to test if all menus are smoothly and successfully navigated to. This test was successful since all menus were navigated to when the correct button was selected. Test ID 4.1, 4.2, 4.3, and 4.4 were fully successful and no issues were faced.
5	For Test ID 5, the testing for the analyze button was deemed successful. The analyze button only popped up when the item was displayed in the camera view. When the analyze button was clicked on, the recycling information for that particular item was displayed on a separate page. For example, for the Pure Leaf bottle, the bottle was presented in the camera view and then the recycling information was displayed on another page. This can be shown in Figure #3 and Figure #4. This has worked for all 3 image targets.

3 Prototype II

3.1 Analysis Strategy

Prototype I only consisted of a simple introduction screen, along with AR recognition of waste objects. For prototype II, the analysis strategy incorporated was to deem what was in need of modification or the addition of a feature which were based on the conceptual design along with a discussion regarding key components needed for prototype II. The key components added were all the separated screens, including the addition of the informational, rewards, and settings screen alongside the introduction and main screen.

Within all of the screens, modifications were made to improve the user experience and the app's functionality.

3.2 Improvements made from Prototype I

1. After testing the prototype 1, we found that the analyze button and the way the information was displayed was not appealing to users. Instead of the information being displayed on the main camera screen, once the analyze button is selected, the app redirects the user to another page where all recycle information is listed. This page will include visuals to assist users in placing the correct item in the correct location.
    a. For the last prototype, the application displayed the information directly on the main screen. This information would disappear once the object was out of the camera's view. Redirecting the user to another page allows the user to read the information presented to them at their own pace and can choose to leave the screen anytime they please.
2. A collapsible menu was included in this prototype. We now have the main screen, internal settings menu, information menu, and rewards menu. The application is easily able to navigate between all menus at any time, making the application user friendly.
3. From prototype I, more image targets were incorporated into the application. We are now able to detect more items with the image recognition. We are looking into using AI or reverse image search to be able to recognize recyclable objects. This is to have a wider variety of image detection. Due to time constraints, we may not be able to implement this.
4. The overall aesthetics of the application was improved. Our previous prototype focused more on the image recognition functionality. Since we were successful in executing object recognition, we had time to improve aesthetics for the other menu options.
    a. Our application is consistent in its simple recycle based colour scheme and design.
    b. All button icons indicate a clear meaning while maintaining simplicity.
5. The internal settings menu was created during this prototype. For this menu, we were able to add clickable on/off toggles for each setting we want to incorporate. So far, the only setting that is functional is the 'sound' option.
6. The information menu was created during this prototype. For this menu option, we have included all relevant recycle statistics. The application is able to navigate the information menu with a sliding motion. For the next prototype, we hope to add to the tutorial section of the application along with a video. We also hope to add an FAQ section as well as a garbage disposal calendar section.
7. The rewards menu was created during this prototype. For this menu, we were able to make the menu options navigate to this page. However, we were not able to incorporate the rewards just yet. We hope to do this in the next prototype.

3.3 Analytical/Numerical/Experimental Model

Analytical and Numerical models are inapplicable in this scenario, or are difficult to apply. The experimental model in this scenario would be prototype I, which is analyzed and discussed by team members to decide what is in need of improvement, and what is working. The analysis of the experimental model (prototype I) was used to improve and build prototype II. An example of this analysis is the identification screen of prototype I. This screen could be sometimes difficult to read, and depended on the object being in view of the camera. We decided to improve on this in prototype II by using another screen for when an object is identified, allowing the user to read the text on a solid background and

allowing as much time needed. This was also necessary and a building block for the rewards system to be implemented. Many more cases of such analysis were done to improve prototype II.

3.4 Prototype II Description and Screenshots

Figure #1: Screenshot of Introduction Screen with Improved Aesthetics

Description:
In Figure #1, we have created an introduction screen on Unity. This screen includes our application logo, the application slogan, and a physical start button that the user will have to press on in order to proceed to the main screen.
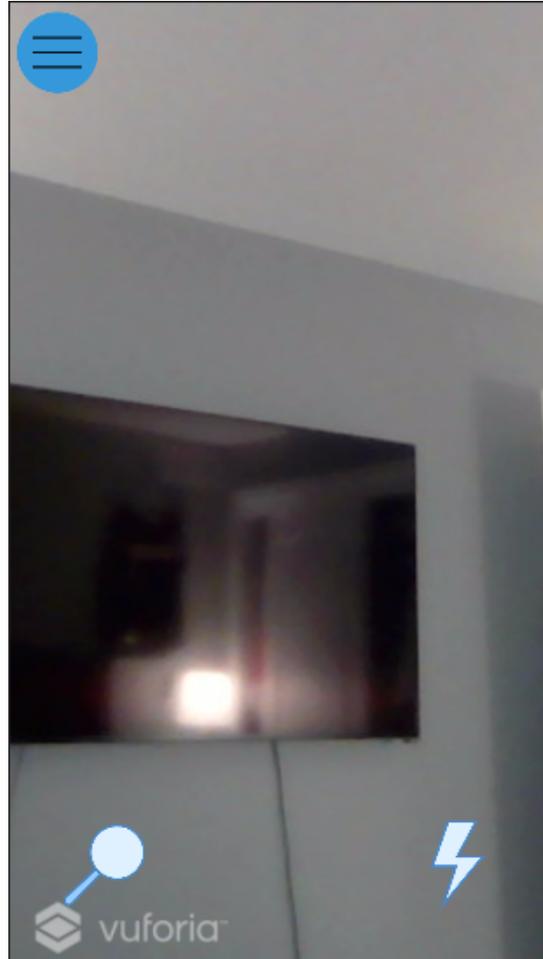
Figure #2: Screenshot of Main Screen with Improved Aesthetics

Description:
Figure #2 shows a screenshot of what the main screen looks like before any recyclable items are detected in its camera view. The bottom right features a flash toggle. If an object cannot be recognized, the flash toggle can be used to help the camera of a mobile device get a better view of an object. The bottom left of the screen has a search button. In Prototype I, when the search button is selected, the application will redirect to the City of Ottawa regular waste disposal practice website. In this prototype, it includes cosmetic improvements from prototype I.

Figure #3: Screenshot of Image Target (Pure Leaf) in Main Screen with Analyze button

Description:
Figure #3 demonstrates the information displayed before the analyze button is selected. In this example, the Pure Leaf bottle is displayed in the camera view.

Figure #4: Screenshot of Image Target (Pure Leaf) Displaying Corresponding Recycling Information (Redirected from Main Screen)

Description:
Figure #4 demonstrates the information displayed after the analyze button is selected. In this example of the pure leaf plastic bottle, it displays the name of the item, disposal method, and reminding the user to rinse the item before disposal. Alongside this shows an icon that represents where to dispose of these items. In this case, the disposal method is the blue bin so it shows an icon of the blue bin. At the bottom of the screen, it displays how many points were earned by this recycle. We have also implemented a "I Recycled!" clickable button. Upon clicking this button, the user is redirected to the main screen.

Figure #5: Screenshot of Image Target (Instant Ramen) in Main Screen with Analyze button

Description:
Figure #5 demonstrates the information displayed before the analyze button is selected. In this example, the instant ramen wrapper is displayed in the camera view.

Figure #6: Screenshot of Image Target (Instant Ramen) Displaying Corresponding Recycling Information (Redirected from Main Screen)

Description:
Figure #6 demonstrates the information displayed after the analyze button is selected. In this example of the instant ramen wrapper, it displays the name of the item, disposal method, and reminding the user to clean any residue left in the item before disposal. Alongside this shows an icon that represents where to dispose of these items. In this case, the disposal method is the garbage so it shows an icon of the garbage can. At the bottom of the screen, it displays how many points were earned by this recycle. We have also implemented a "I Recycled!" clickable button. Upon clicking this button, the user is redirected to the main screen.

Figure #7: Screenshot of Image Target (Spam) in Main Screen with Analyze button

Description:
Figure #7 demonstrates the information displayed before the analyze button is selected. In this example, the Spam can is displayed in the camera view.

Figure #8: Screenshot of Image Target (Spam) Displaying Corresponding Recycling Information
(Redirected from Main Screen)

Description:
Figure #8 demonstrates the information displayed after the analyze button is selected. In this example of the Spam can, it displays the name of the item, disposal method, and reminding the user to clean any residue left in the item before disposal. Alongside this shows an icon that represents where to dispose of these items. In this case, the disposal method is the blue bin so it shows an icon of the blue bin. At the bottom of the screen, it displays how many points were earned by this recycle. We have also implemented a "I Recycled!" clickable button. Upon clicking this button, the user is redirected to the main screen.
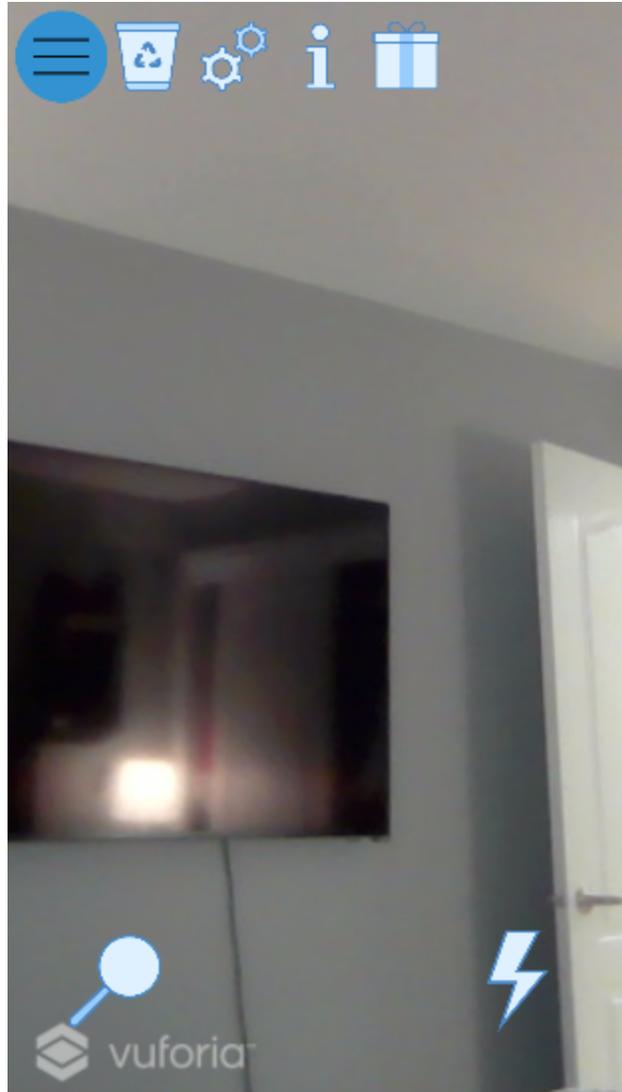
Figure #9: Screenshot of Main Screen with Collapsible Menu Opened

Description:
Figure #9 demonstrates the camera view with a collapsible menu located at the top left of the screen. These setting icons going from left to right are recycling icon, internal settings icon, information menu icon, and the reward menu icon.
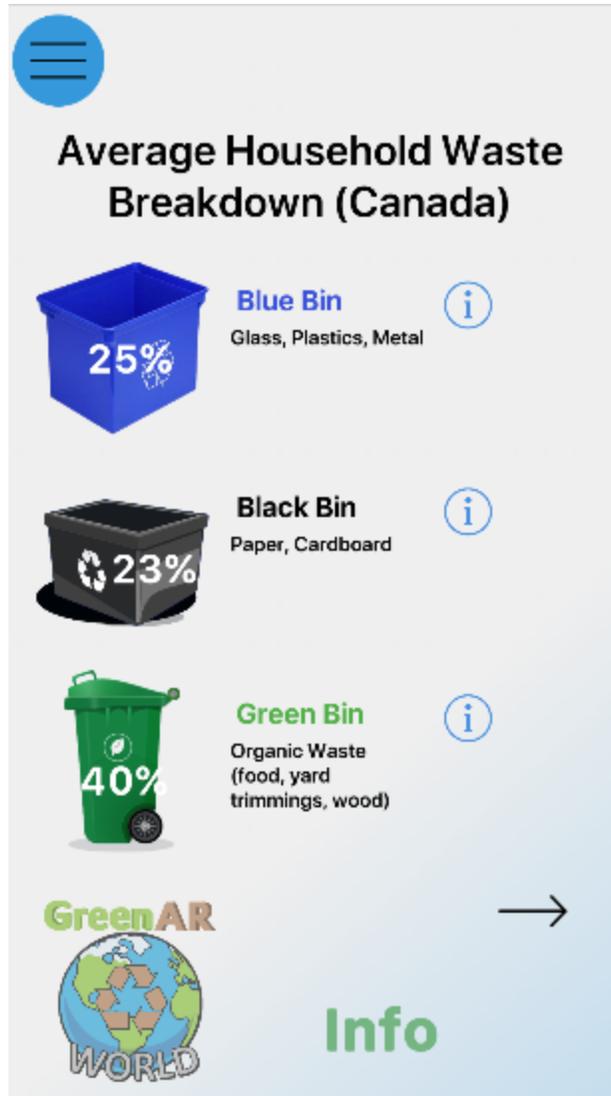
Figure #10: Screenshot of Information Menu (Page 1)

Description:
Figure #10 demonstrates the first page of the information menu. This page gives statistics about the average household waste breakdown in Canada. This page displays the percentage of blue bin waste, black bin waste and green bin waste produced by a Canadian household. Beneath each bin is a brief description of what items can be recycled in each disposal bin.
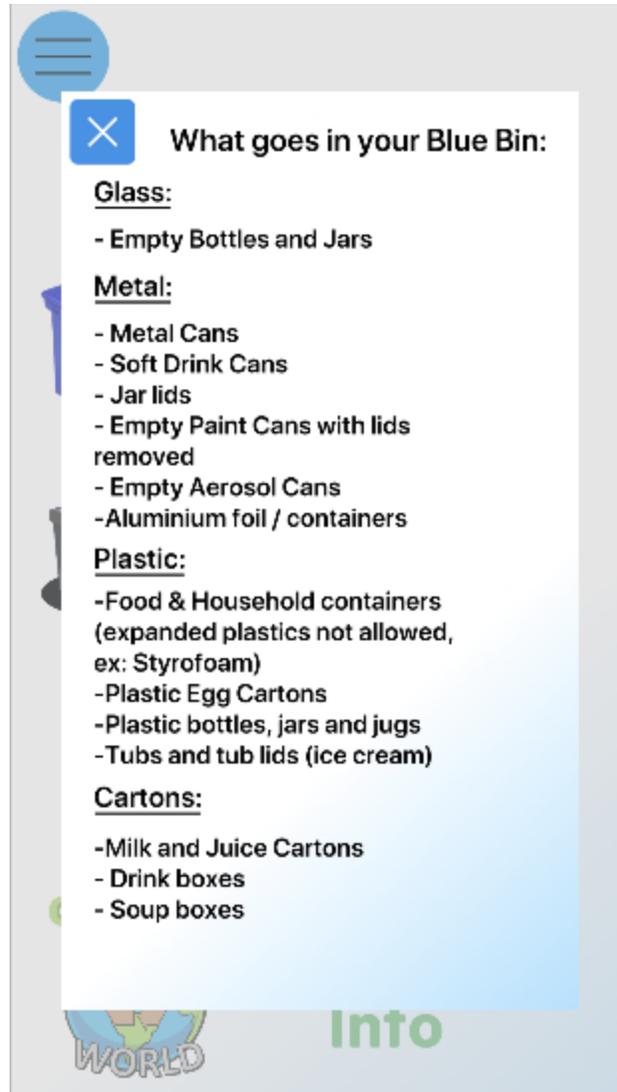
Figure #11: Screenshot of Information Menu (Page 1.1)

Description:

Figure #11 demonstrates the first page of the information menu after the "i" button is selected beside the blue bin. It expands upon some examples of items that can be disposed of in the blue bin.
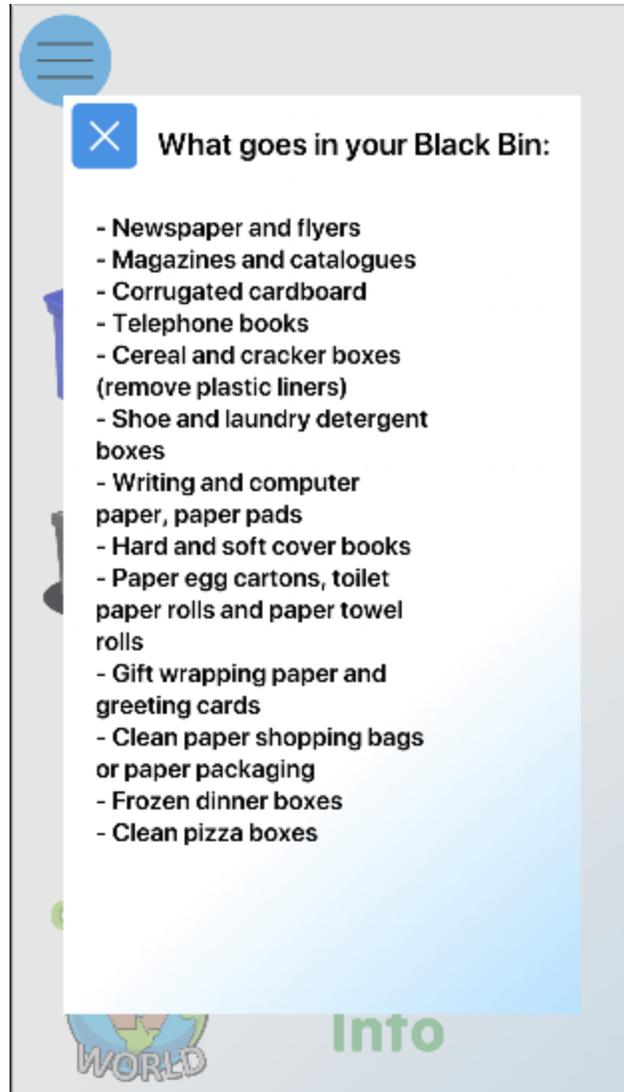
Figure #12: Screenshot of Information Menu (Page 1.2)

Description:
Figure #12 demonstrates the first page of the information menu after the "i" button is selected beside the blackbin. It expands upon some examples of items that can be disposed of in the black bin.
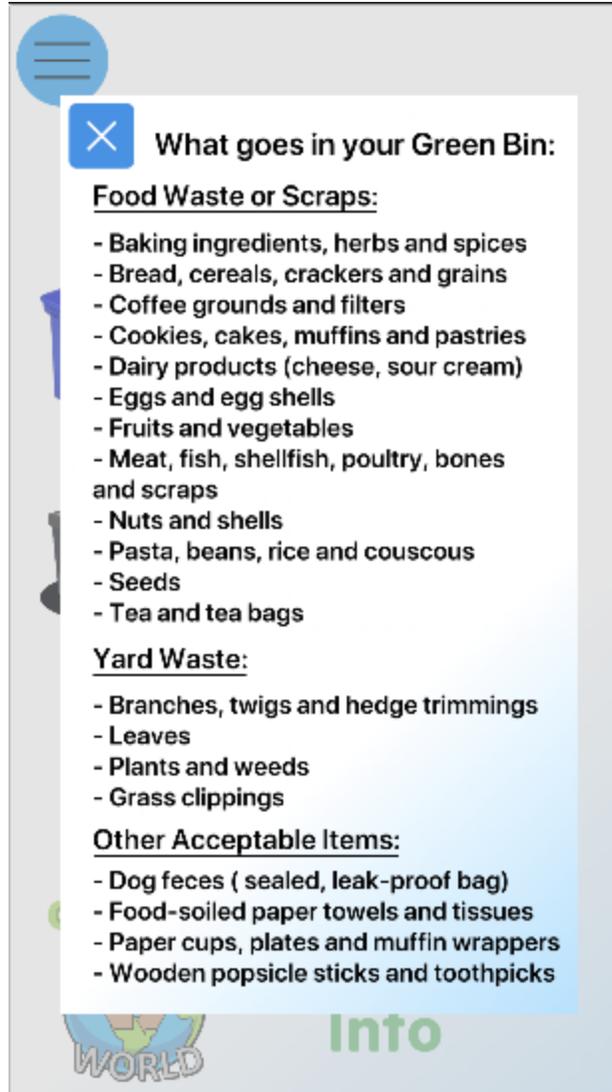
Figure #13: Screenshot of Information Menu (Page 1.3)

Description:
Figure #13 demonstrates the first page of the information menu after the "i" button is selected beside the green bin. It expands upon some examples of items that can be disposed of in the green bin.
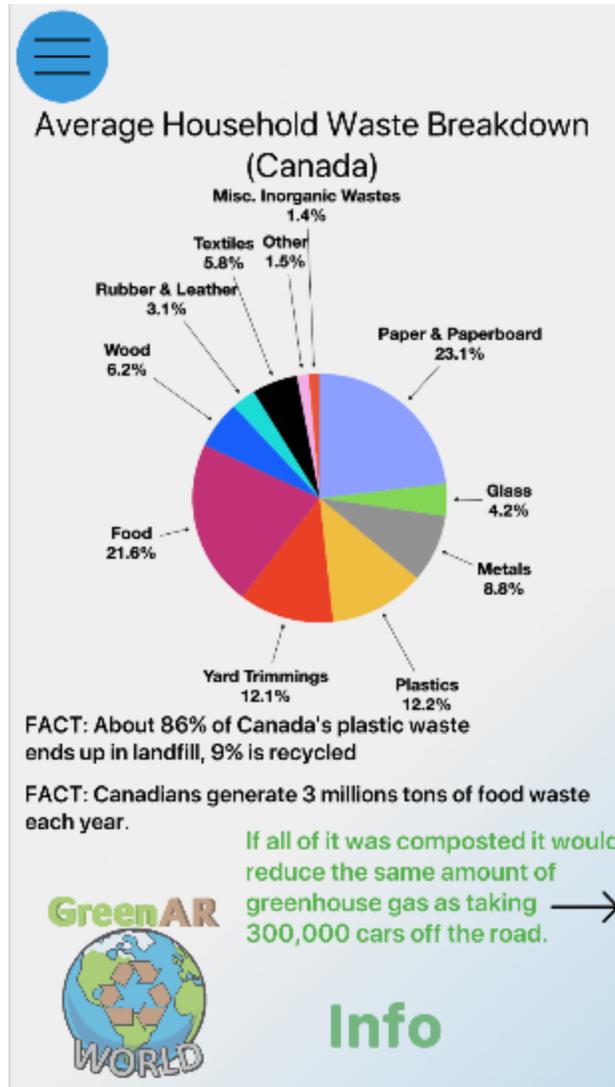
Figure #14: Screenshot of Information Menu (Page 2)

Description:

Figure #14 demonstrates the second page of the information menu. To navigate to this page from page 1, users can use a swiping motion to the left. This page shows more in depth statistics of the average household waste breakdown in Canada by utilizing a pie chart. Beneath the pie chart shows various facts about recycling. This information is included in hope of getting users to realize the importance of recycling.

Figure #15: Screenshot of Information Menu (Page 3)

Description:

Figure #15 demonstrates the third page of the information menu. To navigate to this page from page 2, users can use a swiping motion to the left. This screen displays information about items that cannot be recycled through municipality curbside pick up. We hope to add more information or a redirect on how these items can be properly disposed of in the future prototype.
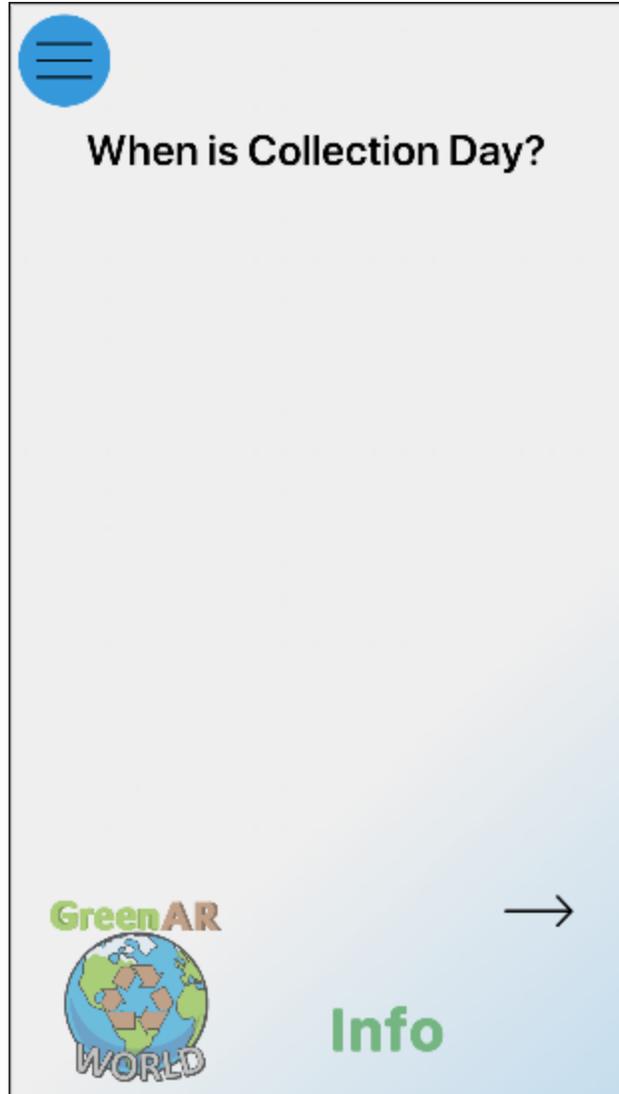
Figure #16: Screenshot of Information Menu (Page 4, calendar implementation soon)

Description:
Figure #16 demonstrates a visual representation of our GreenAR Collection day calendar for Ottawa. This will include which day is recycle day. This calendar will be created for prototype III. In this prototype, our goal was to have a blank page set up for this feature.
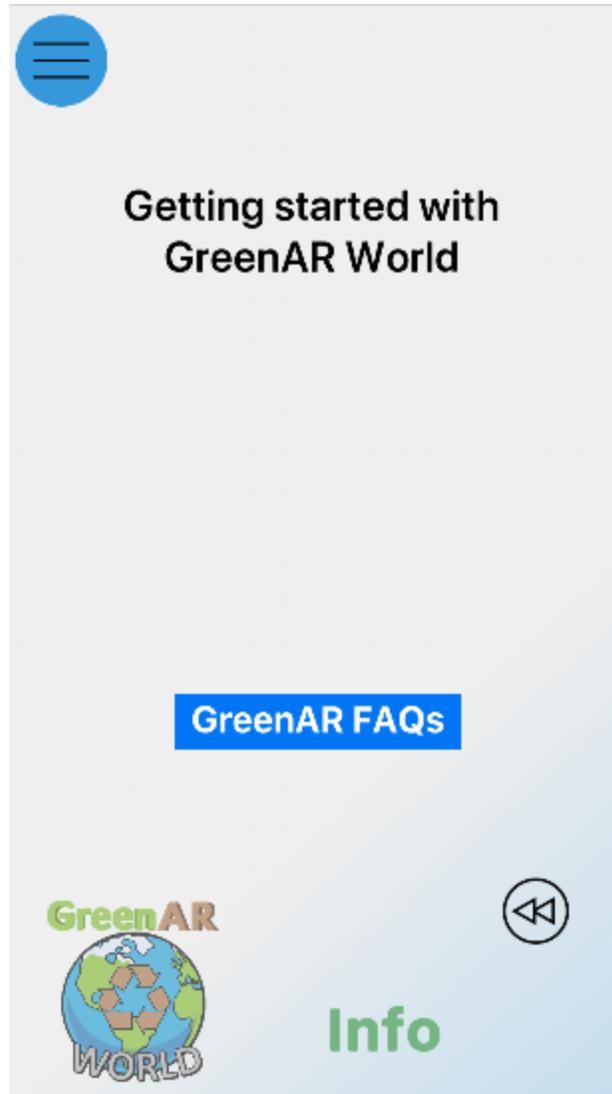
Figure #17: Screenshot of Information Menu (Page 5, Tutorial video soon)

Description:
Figure #17 demonstrates a visual representation of our GreenAR Frequently Asked Questions page which will include a tutorial video on how to use our application. This video will be created for prototype III. In this prototype, our goal was to have a blank page set up for this feature.

Figure #18: Screenshot of Settings Menu

Description:
Figure #18 demonstrates our settings menu. It displays 7 clickable settings. In prototype II, the only setting menu that is functional at the moment is the "sound" setting.
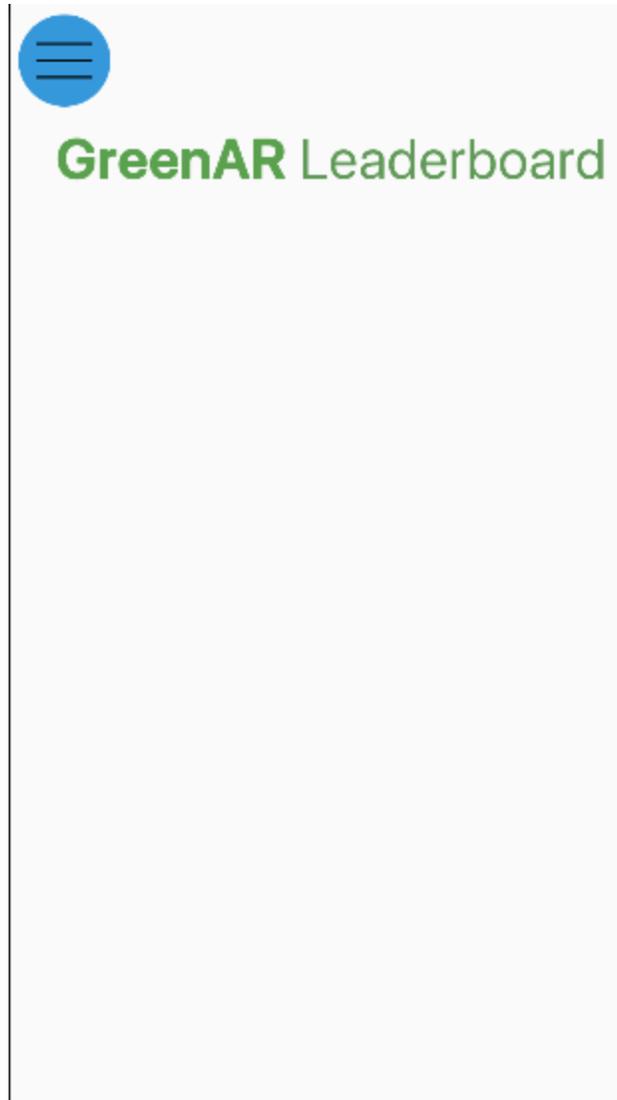
Figure #19: Screenshot of Rewards Menu (Still blank, hope to include rewards system in Prototype III)

Description:
Figure #19 demonstrates a visual representation of our GreenAR Leaderboard which will be used to track the user's scores and their added competitors. Due to the time constraint, we will be implementing this feature in Prototype III. In this prototype, our goal was to have a blank page set up for this feature.

4 Feedback and Comments from Potential Users

All test subjects prefer to be anonymous in their feedback/comments and do not want their name mentioned in our deliverable. Therefore, we have put in all feedback and comments we received and organized them by test subject number. All feedback and comments will be quotation based and will describe as close as possible to what was actually said. We have interviewed a wide variety of people including family members, friends and neighbours. We are unable to interview strangers since we are currently working remotely. We have received feedback through email, text, social media, phone call and in person for Prototype II.

Test Subject	Feedback/Comments
1	"Your application looks like it has more structure now compared to your previous prototype. Your additional screens make it seem closer to the finished product. I like that the design is simple and not overwhelming. The competition aspect is really cool and it would motivate me to use this application. When the application is fully developed, I would definitely use it!"
2	"My kids would definitely like the game/competition aspect of this app. They would also like the fact that they can compete with their mother and me along with some of the neighborhood kids too!"
3	"The app design is very intuitive and simple. I liked the fact that it displays the user's recycling schedule as I always forget which week is blue versus black. It's nice to be able to have all the information on one application. Not quite sure if a points system is necessary but overall I really like the application."
4	"I really like the smoothness between screens. Feels more organized and easier to perform the task you want it to perform. Also I like its simplicity as well as what it is meant for. Still not too sure how many people will go out of their way to use it but seeing how easy this app is to use, i don't see why the majority wouldn't."
5	"There are so many adults that could benefit from this. I'm always correcting my husband and kids on where to put certain recyclable items and they always seem to forget still! If they had this app, then they would have absolutely no reason to not put their recyclable material in the correct bin. It's really cool to see the progression this application is making."
6	"This application is such a handy tool to have. Not only does it let me know where to put my item, it also has the recycling schedule for my area which would definitely help me out. Also think my kids would even use it on their tablets. They love little games and I can see them wanting to beat me and their siblings on the leaderboards that's added within the app."
7	"The information page alone is beneficial. I do like the idea of being able to scan an item and it telling me how to recycle it but personally i really like the information page that's added. Reading through simple items that belong in the green bin vs black bin shocked me and made me realize how i've been recycling certain items wrong this whole time. It's safe to say this application has already helped me recycle better and will continue to do so."

8	"I love how simple the design is. Nothing too fancy and the application is easy to use. I like how literally anyone can not only use it, but use it effectively. This app also gives you no reason to not recycle properly as it contains all the tools and information you need to do so. Only thing I would recommend is maybe making the scanner be able to scan multiple items at once, but other than that this app is amazing."

5 Plans for Prototype III Based on Prototype II Results

Prototype 2 expanded upon the foundational framework that was developed for prototype 1, while prototype 3 will refine and bring our app to completion. In prototype 2 we introduced templates for supplementary subpages such as settings, information and rewards pages. Our team now aims to program these pages to be fully functional and integrated with the application. Furthermore, our highest priority for prototype 3 will be to increase the image target capacity so that the app can recognize and accurately sort a wide variety of common household items, well beyond its current capability.

5.1 Analyze Screen & Results Screen

Our team improved upon the results screen for prototype two, and marginally increased the app's image recognition capabilities. In prototype 3, we will continue improving upon the aesthetics by upgrading the icons and other small tweaks to enhance the overall appeal of the app. We will also incorporate a reverse image search so that the app recognizes a much wider variety of recyclable and non-recyclable materials.

5.2 Settings Menu

Prototype 2 simply included a template for the settings menu. While the user can turn the toggles on and off, they have no real effect. In prototype 3 we will program these toggles and settings to be fully functional and have an actual effect on the app experience. Upon evaluating all proposed settings, our group has concluded that we have been slightly over-ambitious by including geo-mapping. With the limited amount of time left to complete prototype 3, we have decided that this low priority item may have to be eliminated from our final design.

5.3 Rewards Menu

While prototype 2 introduced the navigation component to the rewards menus, the actual functionalities of this page have yet to be executed. For prototype 3, our team will be preparing a breakdown of the points allotted for each recyclable item. The points will be dependent upon the recyclable material corresponding with its adverse environmental impact. For example, plastic is among the most environmentally destructive material, therefore plastic items will acquire the highest points per item. We

must program the analyzer function to automatically display the potential points following the scan of the item and then accredit the user with the points once they have pressed the 'I recycled!' button. In the rewards menu itself, we will display a leader board of those who have collected the most points. The leader board will display the leader for all users, the specific user's friends, and the specific user's household. The rewards section will also include a short profile, where the user can view his points and recycling history.

5.4 Information Menu

While a large majority of the informational menu has been implemented, there remain a few outstanding features that are not yet complete. Prototype 3 will include a fully functional collection calendar that displays the user's garbage and recycling pick-up days dependent upon their home address on info page #4. This calendar will be specific to the City of Ottawa residents only, however, development to include other Canadian municipalities is possible in the future. Moreover, a short instructional tutorial video outlining how to use the app will be filmed and uploaded to info page #5. A basic FAQ section will also be added to info page #5.

6 Conclusion

In conclusion our team has developed our second prototype of our design and have improved some of its main functionalities based on tests and feedback provided from prototype 1. Our team has improved the interface within the app as well as how accurate our recognition is when scanning different items. On top of this, more information regarding the item being scanned is available, and additional options such as having a rewards screen and a recycling calendar have also been implemented. With this new prototype, tests were performed and feedback was collected, as this will be used to improve our next prototype. Moving forward our team will create a third prototype with all the improvements we feel are necessary and try to have a near complete design of our final product.

7 Wrike

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=mgJ0DCKTwh18pnhnCr17MxqXpJcr YZWS%7CIE2DGNJVGY3DALSTGE3A