

GNG 1103

Deliverable D: Conceptual Design

Group 13

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Introduction:

This deliverable consists of the generation of multiple conceptual solutions for a recycling mobile application that attempt to satisfy the design criteria and client needs established in the previous deliverables. Firstly, the final product was broken into six separate subsystems. Then, each group member was tasked with generating a concept for each subsystem as well as a global concept encompassing all design criteria. These individual global concepts were compared and evaluated against the design criteria with benchmarking in order to determine the most effective solution. Using the highest performing global concept as a base, our group collaborated to create a final concept that incorporated the best ideas from each group member's individual concepts. Our group moving forward will use this final concept as the basis of our final product's design and function.


Subsystem Definition and Concepts:

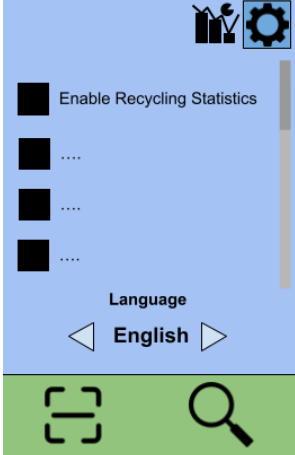
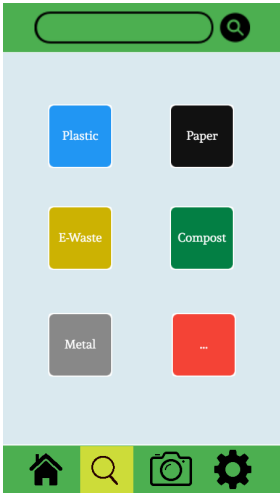
Our final application will consist of six separate subsystems defined in Table 1 that make up the core of the app's functionality. Each group member came up with a plausible concept for each subsystem as presented in Table 2. These subsystems can be mixed and matched with others to create a more suitable final solution. Each concept created by a group member becomes part of that group member's global concept, which will then be benchmarked under the design criteria detailed in the last deliverable. The six subsystems are as follows:

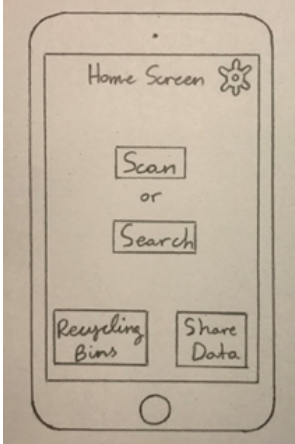

Table 1: Defined Subsystems for Final Product


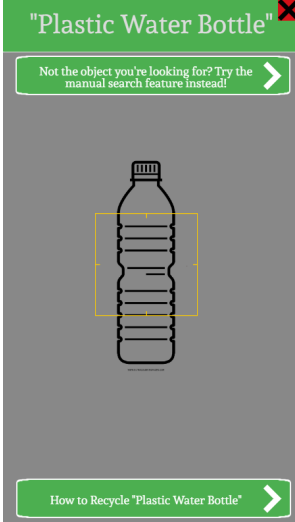
Subsystem	Definition
User Interface	The screens and tab user will navigate through while interacting with the app. This section includes the in-app tutorial.
Scanner	Feature that allows users to use their camera to identify an object. Allows users to access recycling information about the object they are viewing.
Manual Search	The searching method that the user will use if they want to look up the information in our database without using the scanner.
Recyclable Item Database	Contains all information about recyclable items. Accessible through the use of the scanner or manual search.
Directing User to Correct Recycling Bin	Method of ensuring that users place recyclable items in the correct bin once it has been identified what item they are trying to recycle.
Tracking User Recycling Activity	System for quantifying how much users are recycling and displaying their activity.

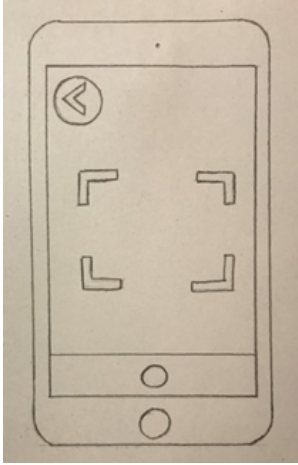
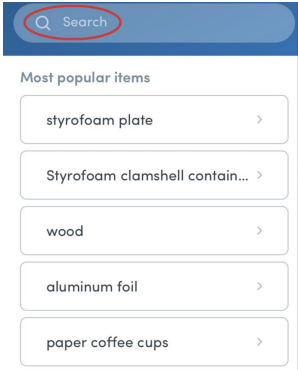
Table 2: Individual Group Member Concepts for Each Subsystem

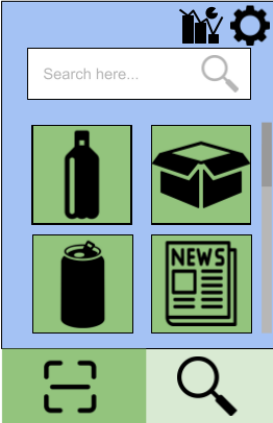
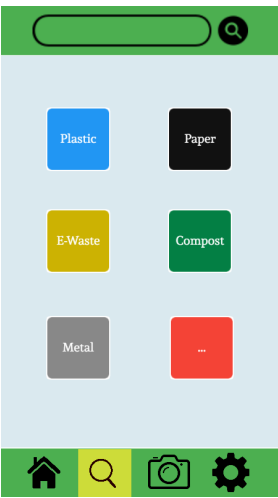
Subsystem	Person	Sketch	Concept
User Interface	Omar		<p>At initial contact, the user will be asked to input the device type and the region they are located in. Furthermore, a mandatory tutorial will commence guiding the users through the different parts of the app and how to maximize its utility. After the set-up process is over the main page will appear, the main page contains 4 main systems. A scan system, search system, settings system and a profile system. In the settings system you will be able to control everything in the app, from languages, to the type of device operating the app, to the region of operation. The setting system allows you to re-access content such as the tutorials. When it comes to scanning the item, our app utilizes the already existing scanning features on most smartphones.</p>
	Tahmeed		<p>When the user opens the app for the first time, they start off with an in-app tutorial showing the user how to scan, search and navigate the app.</p> <p>The main interface has two menu tabs for scanning and searching at the bottom with two buttons for statistics and options at the top right corner as shown in Figure 1. The statistics button (alongside with recycling tracking features) can be disabled in the options (Figure 2). The user will be able to switch between both tabs at any time except while scanning or when the scanning results are displayed.</p>

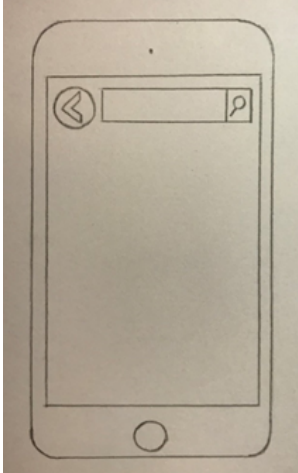
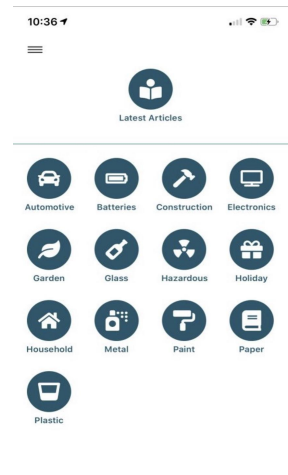
		<p>Figure 1: Tahmeed's Scanning Page</p> 	
	<p>Noah</p>	<p>Figure 2: Tahmeed's Options Page</p>  <p>Figure 3: Noah's Interface Concept</p>	<p>Starting the app for the first time will automatically begin the tutorial that teaches the user how to navigate the app and make use of the features. The user interface will consist of 4 central tabs, the home, manual item search, scanner and settings tabs. The home page will provide an overview of the user's personal recycling activity. The manual search and scanner tabs will be used to identify recyclable items. Options to change language preferences and change between municipalities will be found under the settings tab. Switching between tabs will be done with buttons at the bottom of the screen.</p>


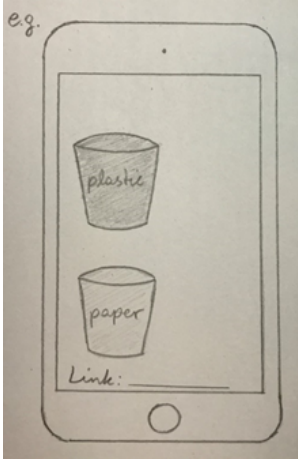
	Panagiota	 <p>Figure 4: Panagiota's Home Screen</p>	<p>As shown in Figure 4, the home screen of the application has five buttons. On the top right corner, the settings option is shown where the user has access to the language option (English or French), a tutorial which gives brief and clear instructions of the use of the application, the music, the sound effects, and the leaderboard. The scan and search buttons are located on the centre of the screen, and the recycling bins and share data buttons are located on the bottom.</p>
Scanner	Omar	 <p>Figure 5: Omar's Scanning Page</p>	<p>One of the methods would be implementing google reverse imaging while connecting it to Vuforia to determine our object. With reverse imaging major key factors such as shape and name would directly correlate a sample image from google, with that a basis of what the corresponding image to name (vise-versa) would be established generating a substantially bigger database with much more consistently accurate results. After the object has been identified, the app will run through the database that is provided and will present the result of the best match. As seen in Figure 5 the name of the object and the designated bin will appear below the scanned item. Clicking on the result would provide further information such as restrictions or limitations.</p>


	<p>Tahmeed</p>	 <p>Figure 6: Tahmeed's Results Screen</p>	<p>In Figure 1, the scan tab will allow for multiple options for scanning, such as scanning a barcode or recycling symbols. After scanning an object, a results screen (Figure 6) pops up showing the recyclable parts of the object, the name/colour of their respective recycling bin and nearby disposal facilities. Optionally, a user can check a box to tell the program that they recycled the scanned item. This is how the app tracks the user's recycling.</p>
	<p>Noah</p>	 <p>Figure 7: Noah's Scanner Concept</p>	<p>The scanner search option will make use of the user's camera and image recognition to identify the recyclable item. Upon opening the scanner tab, the user will be asked to center the recyclable item on their screen. The text at the top of the screen will show the name of the object the camera is looking at. The two buttons allow the user to either open the recycling database page for the item they are looking at or switch to manual search if the scanner is not correctly identifying the item.</p>

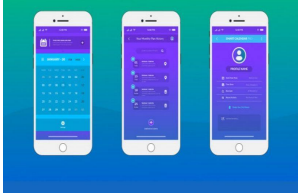
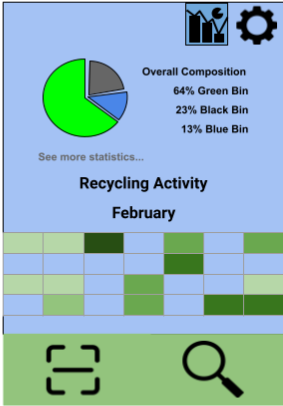
	Panagiota	 <p>Figure 8: Panagiota's Scanning Page</p>	<p>The user has to press the scan button in order to be taken to the scanning page where the barcode of the item needs to be scanned, as shown in Figure 8. After the user scans the barcode, a message will be outputted asking the user to confirm whether the item was identified correctly (the message will provide a yes or no option). If the user indicates that the item was identified correctly, the application will proceed on informing the user whether the item is recyclable and what type of recyclable material the object is composed of if it is recyclable. If the user indicates that the item was not identified correctly, the user will have the option to scan again or go back to the home screen by pressing the back button on the top left corner of the screen.</p>
Manual Search	Omar	 <p>Figure 9: Omar's Search Page</p>	<p>If the user wants a more specific search, a search bar in which the user can input a desired object, which will follow with a drop down menu containing the top 5 best matches with the inputted object. All results are name-image coordinated. Figure 9 will provide a visual representation of the search bar method.</p> <p>All the results displayed are directly taken from the database imputed correlating to the specific region and all the images are provided from google reverse imaging.</p>

	<p>Tahmeed</p>	 <p>Figure 10: Tahmeed's Search Page</p>	<p>The search tab allows for users to look up items in the database by either using the search bar at the top right or scrolling through the categories of recyclable projects as seen in Figure 10. The app suggests items based on previous history and current input as the user types information into the search bar. When an item is selected, it should show the item's name, main category, and correct disposal bins.</p>
	<p>Noah</p>	 <p>Figure 11: Noah's Manual Search Interface Concept</p>	<p>The manual search feature will implement hierarchical search to identify an item. The search tab features contain buttons for different types of recyclable materials-plastic, paper, e-waste-which when pressed take the user to another scene to further filter down to their item. For example, clicking on plastics could lead to a scene with buttons for different plastic items (bottle, food tubs, pipes, etc.). The search tab also gives the user the option to type the name of their item into a search bar to take them directly to the database page.</p>

	Panagiota	 <p data-bbox="548 695 846 762">Figure 12: Panagiota's Search Page</p>	<p data-bbox="870 212 1419 663">The user has to press the search button in order to be taken to the search page where a search engine will be provided so the user can input the name of the item, as shown in Figure 12. The application will output information whether the item is recyclable and indicate the recyclable materials that the item is composed of if it is recyclable. The user can then go back to the home screen by pressing the back button on the top left corner of the screen (beside the search engine).</p>
Recyclable Item Database	Omar	 <p data-bbox="548 1318 786 1386">Figure 13: Omar's Database</p>	
	Tahmeed		<p data-bbox="870 1423 1419 1797">Ideally, each item in our database should have a barcode, main category, recyclable content, disposal bin and a recycling symbol associated with it if applicable. The main drawback with this is that we'd have to manually add information about each item before the app is launched and new items would need to be constantly added to update the database.</p>

	<p>Noah</p>	 <p>Figure 14: Noah's Database Concept</p>	<p>For the app, a database will be created containing information about common recyclable items and the procedure for disposing of them. Each database page will contain the item's name, an image of the item, the bin the item should be disposed of in and additional information relating to common contaminants that could disrupt the recycling process. A database page is closable by pressing a button in the top right corner of the screen.</p>
	<p>Panagiota</p>	 <p>Figure 15: Panagiota's Recycling Bins</p>	<p>Whether the user selects to scan the object or search it, they must press the recycling bins button to receive the necessary information for which recycling materials go into which bin, as shown in Figure 15. A link may also be provided if the user wants more information, such as recycling methods and locations for the disposal of contaminants.</p>

Directing User to Correct Recycling Bin	Omar	 <p>Figure 16: Omar's Results</p>	<p>After the object has been identified, the app will run through the database that is provided and will present the result of the best match. As seen in Figure 16 the name of the object and the designated bin will appear below the scanned item. Clicking on the result would provide further information such as restrictions or limitations.</p>
	Tahmeed		<p>As seen in Figure 6, the results screen will identify the correct color or name of the bin and list local recycling facilities that accept the item.</p>
	Noah		<p>The database page for any given recyclable item tells the user which bin to place the item in.</p>
	Panagiota		<p>Whether the user selects to scan the object or search it, they must press the recycling bins button to receive the necessary information for which recycling materials go into which bin, as shown in Figure 15. A link may also be provided if the user wants more information, such as recycling methods and locations for the disposal of contaminants.</p>

Tracking User Recycling Activity	Omar	 <p>Figure 17: Omar's</p>	<p>In regards to measuring how engaged the users are, recycling data tracking would be very beneficial for both the user and the developers. Statistics page: Has a calendar with highlights days you have recycled and when you swipe right you gets a more specific one that has dates and times and shows what you recycled that specific day. Swipe right one more time it will show the profile with all the necessary details and shortcuts across the app.</p>
	Tahmeed	 <p>Figure 18: Tahmeed's Statistics Screen</p>	<p>The statistics tab (Figure 18) will show the composition of items the user recycled and displays a calendar of what days items were recycled, colour-coded based on how many items were recycled that day. This tracking can be disabled in the options menu (Figure 2). For now, the options menu allows the user to switch their language and can be changed</p>
	Noah	-	<p>To track the user's recycling activity, the app will ask the user whether or not they recycled an item when they close an item's database page. If the user says yes, their recycling information on the homepage will be updated to show the total number time the user has successfully recycled an item using the app.</p>

Panagiota

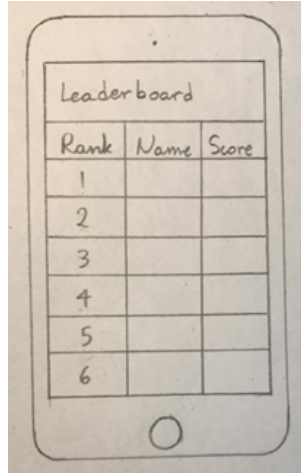


Figure 19: Panagiota's Leaderboard

If the user agrees to share the recycling data, they can send the number of items recycled each week and will collect points for each item. In order to ensure that the data is reliable, the application will be able to identify when the user is not honest, and a number of points will be taken away. As shown in Figure 19, the users can see the points they have collected and their ranking by going to the leaderboard which is accessed through the settings option.

Global Concept 1:

Omar's Idea:

At initial contact, the user will be asked to input the device type and the region they are located in. In order to achieve maximum efficiency a specific device must be imputed to accommodate for device speed, ram and screen resolution. Providing this information will allow the app to adjust its settings to provide a seamless smooth operation and not to overload both the app and the device. Inputting the specific region will help the app drastically improve its accuracy. When a region is inputted, its corresponding recycling database will be automatically integrated into the app. The database will include information such as the name of the object, its material, the corresponding recycling bin, instructions to recycling and any relative information regarding its recycling process. If we take a plastic water bottle for example, it will show the corresponding bin (blue bin) and it will specify any necessary information. Furthermore, a mandatory tutorial will commence guiding the users through the different parts of the app and how to maximize its utility.

After the set-up process is over the main page will appear, the main page contains 4 main systems. A scan system, search system, settings system and a profile system. In the settings system you will be able to control everything in the app, from languages, to the type of device operating the app, to the region of operation. The setting system allows you to re-access content such as the tutorials. When it comes to scanning the item, our app utilizes the already existing scanning features on most smartphones. Scanning the item will follow major characteristics to exactly pin-point the object, firstly using the camera with the vision integrity



scanning feature of unity, objects will be determined using their density and overall shape. This method of determining an object based on its density wont provide maximum efficiency as many objects can be deformed and the camera might provide inaccurate results due to the surroundings where the image was taken. The better alternative would be implementing google reverse imaging to determine our object. With reverse imagining major key factors such as shape and name would directly correlate a sample image from google, with that a basis of what the corresponding image to name (vise-versa) would be established generating a substantially bigger database with much more consistently accurate results. After the object has been identified, the app will run through the database that is provided and will present the result of the best match. As seen in figure 1 the name of the object and the designated bin will appear below the scanned item. Clicking on the result would provide further information such as restrictions or limitations.

With scanning an Item being the most convenient and efficient way to recycle, sometimes it wouldn't provide an exact match between the scanned item and the presented result. To overcome this issue a manual search option will be provided. There are two ways a user can operate this feature. The first being providing a list of possible items divided into each respective category. This option will allow for a more versatile approach and a broader search option with more results to be presented. However if the user wants a more specific search, a search bar in which the user can input a desired object, which will follow with a drop down menu containing the top 5 best matches with the inputted object. All results are name-image coordinated. Figure 22 will provide a visual representation of the search bar method.

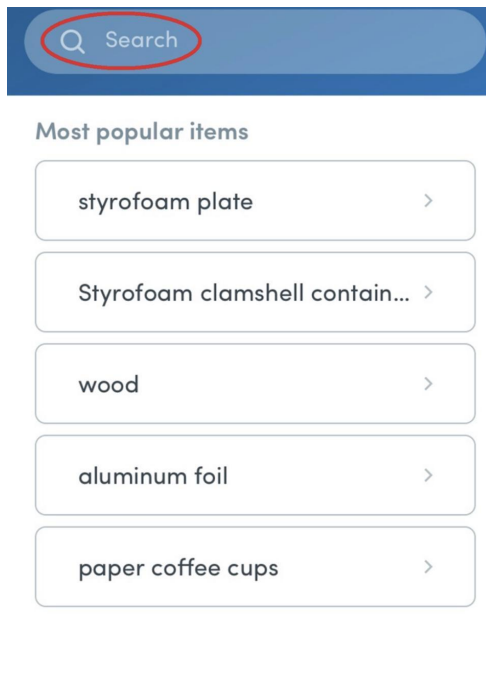


Figure 22;

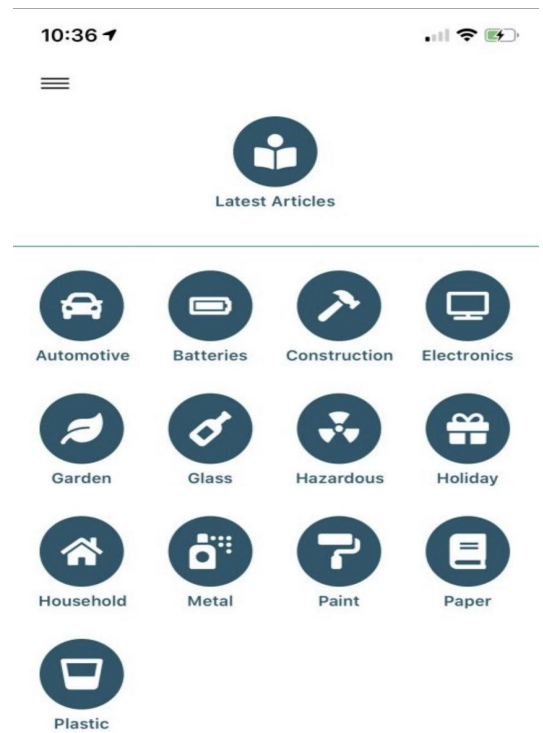


Figure 21;

All the results displayed are directly taken from the database imputed correlating to the specific region and all the images are provided from google reverse imaging.

In regards to measuring the success of the app and how engaged the users are, recycling data tracking would be very beneficial for both the user and the developers. Statistics page: Has a calendar with highlights days you've recycled and when you swipe right, gets a

more specific one that has dates and times and shows what you recycled that specific day. Swipe right one more time it will show the profile with all the necessary details and shortcuts across the app.

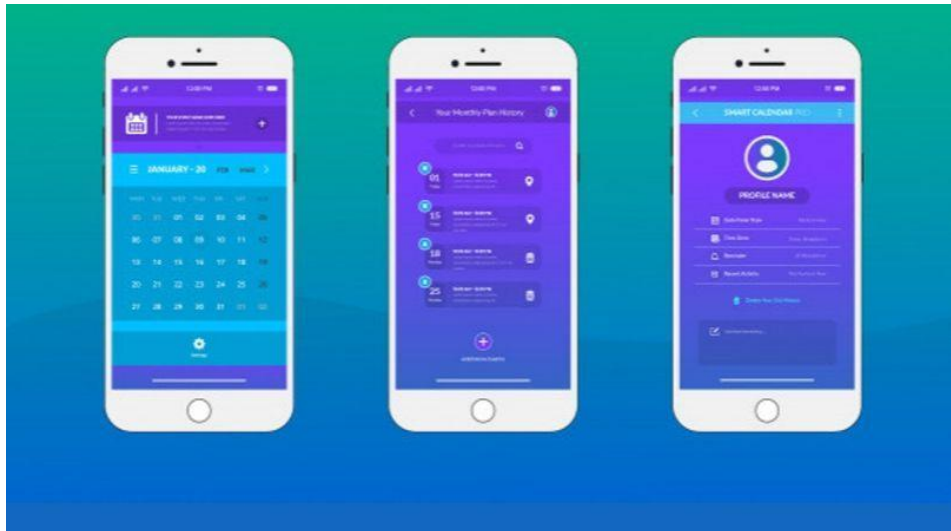


Figure 23;

Global Concept 2:

Tahmeed's Idea:

This concept emphasizes simplicity and functionality. The main interface has two menu tabs for scanning and searching at the bottom with two buttons for statistics and options at the top right corner as shown in Figure 24 a). The statistics button (alongside with recycling tracking features) can be disabled in the options. The user will be able to switch between both tabs at any time except while scanning or when the scanning results are displayed.

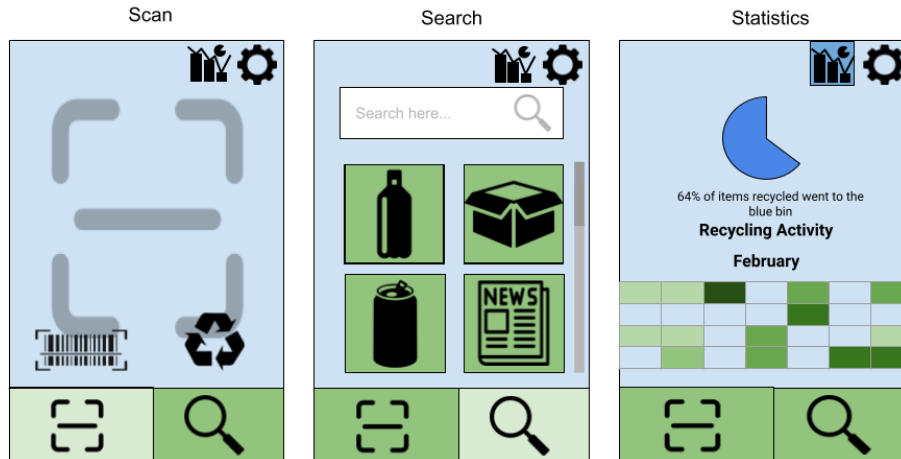


Figure 24. a) Scanning Screen b) Search Screen c) Statistics Screen

In Figure 24. a) The scan tab will allow for multiple options for scanning, such as scanning a barcode or recycling symbols. After scanning an object, a results screen (Figure 25. b.) pops up showing the recyclable parts of the object, the name/colour of their respective recycling bin and nearby disposal facilities. Optionally, a user can check a box to tell the program that they recycled the scanned item. This is how the app tracks the user's recycling.

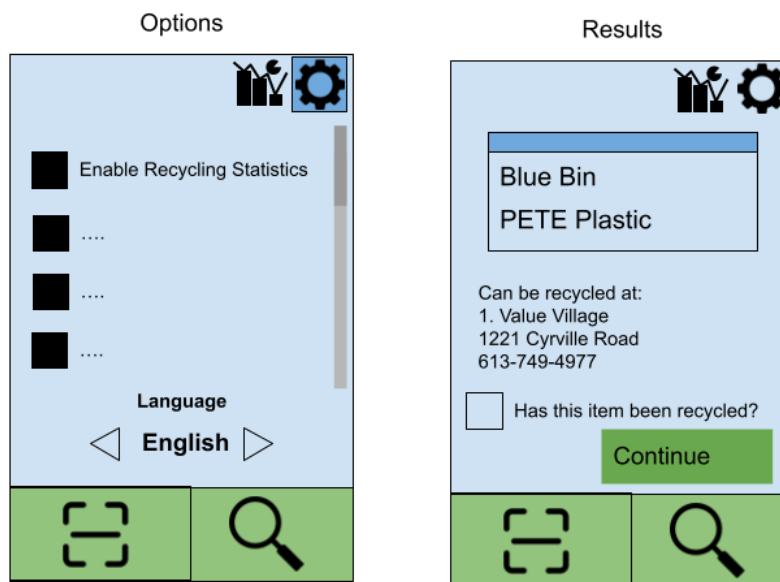


Figure 25. a) Options Screen b) Results Screen

The search tab allows for users to look up items in the database by either using the search bar at the top right or scrolling through the categories of recyclable projects as seen in Figure 24. b. The app suggests items based on previous history and current input as the user types information into the search bar. When an item is selected, it should show the item's name, main category, and correct disposal bins.

Ideally, each item in our database should have a barcode, main category, recyclable content, disposal bin and a recycling symbol associated with it if applicable. The main drawback with this is that we'd have to manually add information about each item before the app is launched and new items would need to be constantly added to update the database.

The statistics tab (Figure 24 c.) will show the composition of items the user recycled and displays a calendar of what days items were recycled, colour-coded based on how many items were recycled that day. This tracking can be disabled in the options menu (Figure 24 a.). For now, the options menu allows the user to switch their language and can be changed

Global Concept 3:

Noah's Idea:

Starting the app for the first time will automatically begin the tutorial that teaches the user how to navigate the app and make use of the features. The user interface will consist of 4 central tabs, the home, manual item search, scanner and settings tabs. The home page will provide an overview of the user's personal recycling activity. The manual search and scanner tabs will be used to identify recyclable items. Options to change language preferences and change between municipalities will be found under the settings tab. Switching between tabs will be done with buttons at the bottom of the screen. A database will be created containing information about common recyclable items and the procedure for disposing of them. Each database page will contain the item's name, an image of the item, the bin the item should be disposed of in and additional information relating to common contaminants that could disrupt the recycling process. A database page is closable by pressing a button in the top right corner of the screen. To identify an item the user will have two options, manually searching or scanning. The manual search feature will implement hierarchical search to identify an item. The search tab features contain buttons for different types of recyclable materials-plastic, paper, e-waste-which when pressed take the user to another scene to further filter down to their item. For example, clicking on plastics could lead to a scene with buttons for different plastic items (bottle, food tubs, pipes, etc.). The search tab also gives the user the option to type the name of their item into a search bar to take them directly to the database page. The scanner search option will make use of the user's camera and image recognition to identify the recyclable item. Upon opening the scanner tab, the user will be asked to center the recyclable item on their screen. The text at the top of the screen will show the name of the object the camera is looking at. The two buttons allow the user to either open the recycling database page for the item they are looking at or switch to manual search if the scanner is not correctly identifying the item. To track the user's recycling activity, the app will ask the user whether or not they recycled an item when they close an item's database page. If the user says yes, their recycling information on the homepage will be updated to show the total number times the user has successfully recycled an item using the app.

Global Concept 4:

Panagiota's Idea:

When the application will be first opened, the home screen page will open. As shown in Figure 26, the home screen will include five buttons: the settings button, the scan button, the search button, the recycling bins button, and the share data button. On the top right corner, the settings option is shown where the user has access to the language option (English or French), a tutorial which gives brief and clear instructions of the use of the application, the music, the sound effects, and the leaderboard. The scan and search buttons are located on the centre of the screen, and the recycling bins and share data buttons are located on the bottom.

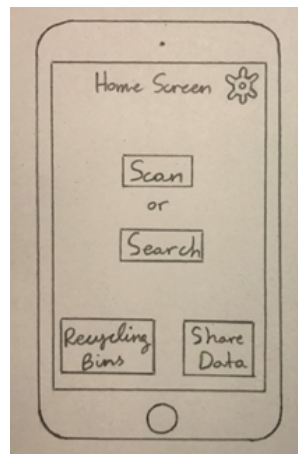


Figure 26: Panagiota's Home Screen

In order for the user to use the scan, they must press the scan button and then they will be taken to the scanning page where the barcode of the item needs to be scanned, as shown in Figure 27. After the user scans the barcode, a message will be outputted asking the user to confirm whether the item was identified correctly (the message will provide a yes or no option). If the user indicates that the item was identified correctly, the application will proceed on informing the user whether the item is recyclable and what type of recyclable material the object is composed of if it is recyclable. If the user indicates that the item was not identified correctly, the user will have the option to scan again or go back to the home screen by pressing the back button on the top left corner of the screen.

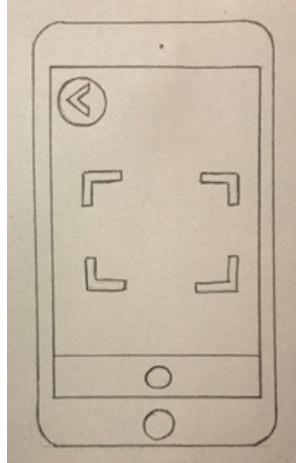


Figure 27: Panagiota's Scanning Page

Moreover, if the user wishes to search the object, they must press the search button and then the search page will open. A search engine will be provided on the top of the screen so the user can input the name of the item, as shown in Figure 28. Similarly as the scanner, the application will output information whether the item is recyclable and indicate the recyclable materials that the item is composed of if it is recyclable. The user can then go back to the home screen by pressing the back button on the top left corner of the screen (beside the search engine).

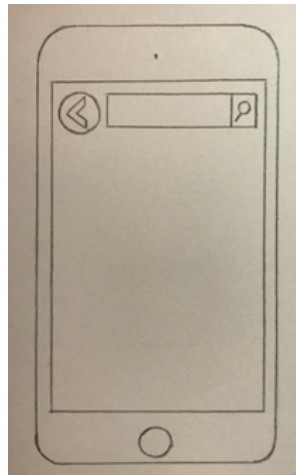


Figure 28: Panagiota's Search Page

Whether the user selects to scan the object or search it, they must press the recycling bins button to receive the necessary information for which recycling materials go into which bin, as shown in Figure 29. A link may also be provided if the user wants more information, such as recycling methods and locations for the disposal of contaminants.

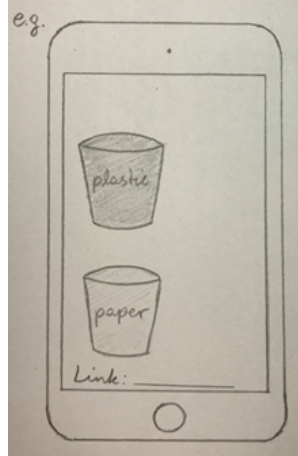


Figure 29: Panagiota's Recycling Bins

In addition, the user's recycling activity may be tracked. If the user agrees to share the recycling data, they can send the number of items recycled each week and will collect points for each item. In order to ensure that the data is reliable, the application will be able to identify when the user is not honest, and a number of points will be taken away. As shown in Figure 30, the users that have shared their data can see the points they have collected and their ranking by going to the leaderboard which is accessed through "Settings."

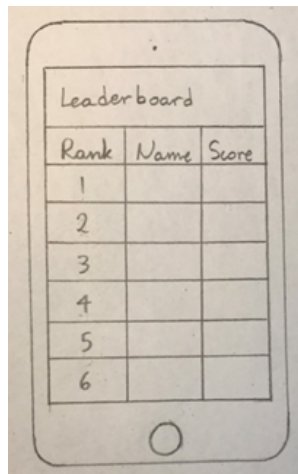


Figure 30: Panagiota's Leaderboard

Benchmarking:

Table 3: Global Concepts benchmarking:

Specification	Importance (1-5)	Global Concepts (Score 1-3)			
		Omar	Tahmeed	Noah	Panagiota

Compatible with common operating systems (IOS & Android)	5	Yes	Yes	Yes	Yes
Uses camera features to facilitate recycling	4	Yes	Yes	Yes	Yes
Ability to accurately identify a waste item	5	Google reverse imaging, 3d scanning, Vuforia (All require testing)	Vuforia	Reverse google image search to find name of object	Vuforia for scanning barcode
Outputs recycling method for a waste item	5	-Name of object -designated bin -further information regarding recycling (restrictions/limitation) -Related items	Somewhat Shows recycling materials and shows bin for each material	-Color of Bin -Information About common contaminants	- Shows the corresponding recycling materials for each bin - Link provided for more information
Provides information about locations for disposal of irregular recyclable items	4	No	No	No	Link provided
Identifies which bin to use for different recycling methods	5	Provides object name and designated bin	Displays Material Name, Bin and Nearby Recycling Facilities	If an object is recyclable, the app tells user which bin to place it in	Shows the recyclable materials the item is composed off and provides information for each bin

Adjusts recycling method for contaminants	3	Displays specific actions to do before recycling(how to treat food contamination, and separations)	None	Provides notes in an item's database page that explain how to treat contaminated items	None
Cost	3	Free	Free	Free	Free
Storage	2	Unlimited	Unlimited	Unlimited	Unlimited
Device Requirements	4	>Iphone 6 >Samsung S7	>Iphone 6 >Samsung S7	>Iphone 6 >Samsung S7	>iPhone 6 >Samsung S7
Display Size	3	Dependant on specific device Min 5.7" Max 6.8"	Dependant on specific device Min 5.7" Max 6.8"	Dependant on specific device Min 5.7" Max 6.8"	Dependent on specific device Min 5.7" Max 6.8"
Capture and Display Resolution	4	Dependants on specific device Min 1080p Max 4Kp	Dependants on specific device Min 1080p Max 4Kp	Dependants on specific device Min 1080p Max 4Kp	Dependants on specific device Min 1080p Max 4Kp
User-friendly navigation and interface	5	Yes	Yes	Yes	Yes
Clear tutorial	4	Included, step by step, with the physical test at the end.	7-slide tutorial detailing the function of each tab and page	Explains how to search for an item and understand recycling database page	Will be brief and give clear instructions
Multi-language	2	English and French	English and French	English and French	English and French
Usable in multiple places	3	Only in Ottawa region (for now)	Ottawa Region	Ottawa Region	Ottawa Region
Tracks how	2	Calendar	Composition	States how	A leaderboard

much user is recycling		which shows activity and specific recycled items. Has three different views. A profile tab to condense all the information.	of what type of items the user has recycled ever. Has a calendar that shows when and how much a user has recycled in a given day.	many items user has recycled in total	where the points and ranking of the user are shown based on the number of items recycled
Total Score (Out of 189)		176	164	158	169

Benchmarking Results

Based on our conceptual design benchmarking, Omar’s global concept is the most suitable basis for our application, reaching a score of 176 out of 189. His concept consistently met all of the requirements alongside unique features such as scanning an object using scanning features on newer phones and a detailed breakdown of what the user recycled over time. In addition to these, Omar’s concept addresses the our database subsystem with a complete and usable online database for recyclable items, saving huge amounts of time and effort. However, our group should implement solutions from other global concepts into our final product to improve its overall quality and exceed the client’s expectations. For example, Panagiota’s leaderboard is a unique idea that may be attempted but will take much time to produce given that each individual must provide an account or phone number, and the leaderboard must be updated.

Final Concept:

After comparing and evaluating the various global concepts and subsystems individually, a final concept was generated combining what appeared to be the best aspects from each group member.

Our final concept is an app that facilitates recycling by allowing the user to identify any item they come into contact with and the appropriate recycling bin to place it in. The app’s interface will be centered around a main menu which allows the user to search for an item, check their recycling activity and modify any relevant settings. To search for an item, users will be given the option to either scan with their phone’s camera or manually input information about the item into a search bar. Upon opening the app for the first time, a skippable tutorial will begin automatically that explains how to navigate through the interface and invites the user to scan and search for a recyclable item in their possession.

Identifying an item through scanning will be done either through reverse google image searching or by using the Vuforia augmented reality software kit. Reverse google image searching compares the image viewed through the user’s camera to millions found by Google

online to determine what is being viewed by the user. This method would theoretically cover any possible item but internet connection would be mandatory and implementing reverse google image searching into the app may not be possible with free software. Vuuforia by contrast is free and can reliably identify physical objects based on image targets. The items able to be identified by Vuuforia would be limited however as our group would need to make image targets for each recyclable item we wish to include.

Manually searching for an item would be an alternative available to users if the scanner feature is not working for a particular item. The manual search page will have buttons for broad categories which allow users to filter down to the exact item they are looking for. A search bar input field will also be included to allow users to directly type the name of the item they are trying to recycle if they already know what the item is. The search bar will suggest items based on what is currently being typed.

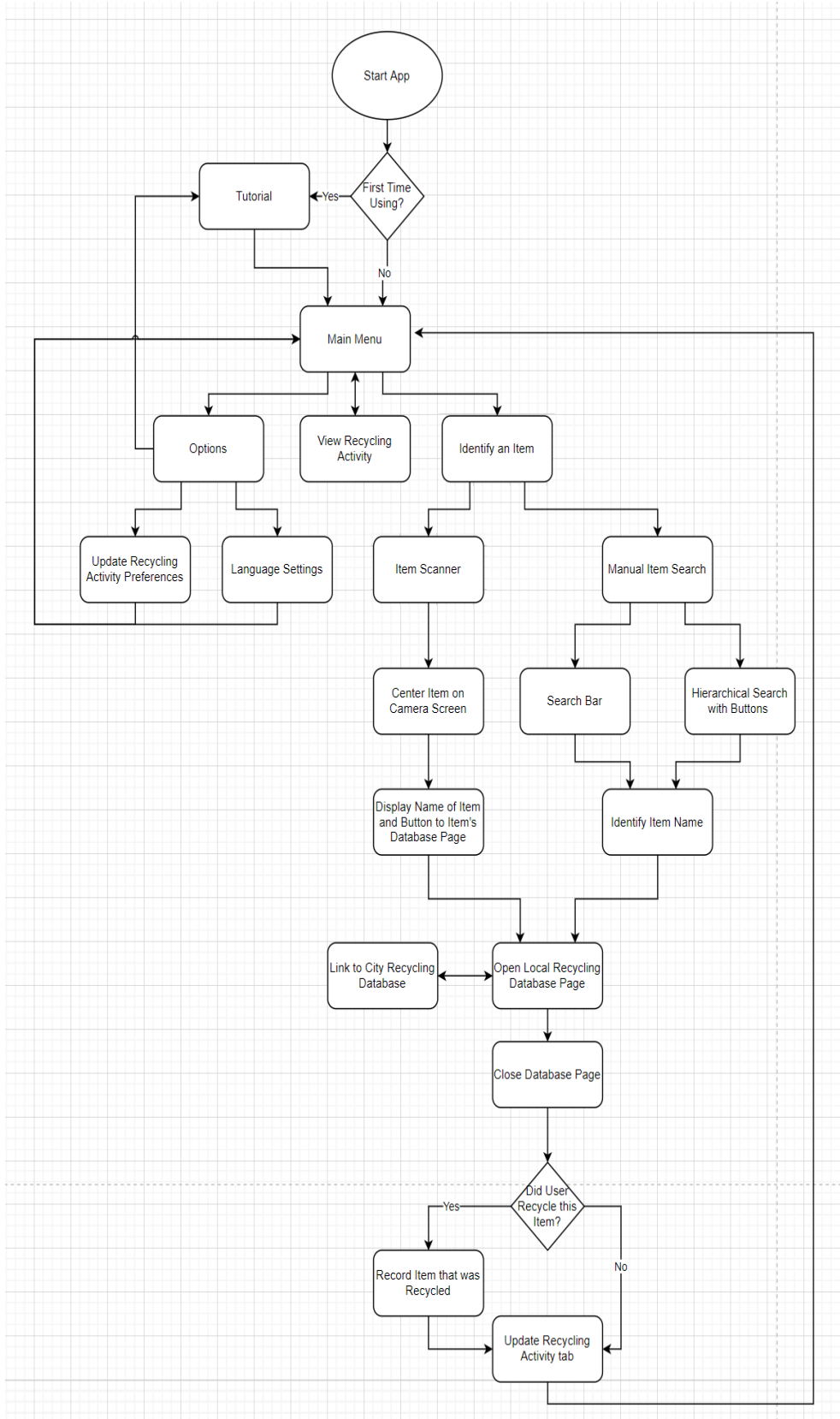
Information about common recyclable items will be stored in a local database which consists of pages with the name of an item, an image of the item, what bin to place it in and any additional recycling information such as dealing with contaminants. Each database page will also provide a link to the city's more extensive recycling database that will open in a web browser.

When the user closes a database page, they will be asked if they recycled the item on the page or not. If they choose yes, their recycling activity will be updated in their activity tab accessible through the main menu. In the recycling activity tab, personal recycling information will be displayed in a calendar format showing how many items the user recycled on any particular day. The activity tab will also feature a breakdown of the types of items the user has recycled if the user swipes right. This tab may also feature an online leaderboard comparing personal recycling activity to other users of the app.

Any additional actions will be covered under the options tab from the main menu. Features such as language settings and replaying the tutorial will be accessible from here.

Flowchart:

Figure 31: App Navigation Flowchart



Conclusion:

In this deliverable, we looked at four different global concepts that serve the purpose of developing an idea as to how our final app would look like with the design criteria from the last deliverable. Using the same benchmarking methodologies from the last deliverable we designated evaluations (from 1 to 3) for each need and these evaluations were weighed according to their design priority and summed to give an absolute rating for each global concept. From this, Omar's global concept idea number one has the most noteworthy aggregate and will be the basis for our future work alongside . Further improvements, adjustments and additions to the app will be implemented as there is always room for improvement.

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