GNG 1103 Project Deliverable H

Universal Recycling Sorting

Prototype 3, Feedback, and Prototype Testing

Submitted by

GNG 1103-C01, Group 2

Kristen Janzen, 300107082

Usama Shahzad, 300111792

Griffin Worboy, 300119873

Nader Mrad, 300118507

Cem Kiyik, 300073910

Date: 07/03/2021

University of Ottawa

Table of Contents:

List of Figures:

List of Tables:

1. Introduction

The project of "Waste Management" was a project assigned to the teams by the client Mitch Bouchard. Mitch Bouchard is part of a family business in the field of mechanical part supply. This project has a goal of improving the quality of recyclables and decreasing waste in landfills by creating a system to assist people in sorting their recyclables properly. Though many individuals believe that recycling is enough to make a change in the world this is not the case when looked at on a large scale. Many recyclables are missorted and end up in landfills and/or shipped overseas to countries that have more room for landfills than Canada does. In fact, many people do not know how to recycle and opt for throwing everything into the garbage instead resulting in further pollution in our environment. Creating a product to help people learn and understand how to sort their recyclables and garbage easily could help in the big picture of managing and reducing the amount of waste on the planet.

Previously the team was tasked with identifying and developing the client's needs and wants, the problem statement, a list of metrics and some benchmarking of similar products on the market. The client's needs were identified during the client meeting in the form of statements, these were then used to develop a list of needs and wants for the product (user friendly, cost effective, determines eligibility of items to be recycled, determines items respected disposal location and that the product is versatile and can be used by a wide variety of people) the need and want statements would guide the team in creating a product that would meet the client's expectations. From these needs and want statements a problem statement could be developed: A need exists for people to reduce waste in landfills by creating a user friendly, cost-effective product that helps customers and users to recycle correctly and efficiently. Once the problem statement was defined metrics were determined to express the client's needs in the form of attributes that are measurable. Benchmarking was done to explore other products on the market that may meet the client's needs and wants then target specifications and determined a set of design criteria were determined. Then a brainstorming session was held to identify the main subsystems and concepts for them, a final design idea was also determined. Following this the prototyping and testing phases, analysis of the systems critical components, a detailed design of the system as well as the bill of materials (BOM) were created. Then, the first prototype was developed, tested and some feedback was received. Finally, the second prototype was developed and tested prior to the third client meeting and feedback was received.

This report has the focus on reporting on the development creation and testing of the third prototype. A stopping criteria was also defined and an analysis of the feedback from the testing was also summarized.

2. Analysis of Critical Subsystems

The main focus for this prototype was to determine the bins and to implement a button to take a picture of the item you're scanning. Once you push the scan button the scanner will scan

and tell you the material. Once the material is determined, the scanner will tell you which bin to put it in.

3. Prototype Development

For this prototype, we worked on finalizing the user interface by making it more organized and design friendly. Shown below are examples of what the user interface currently looks like.

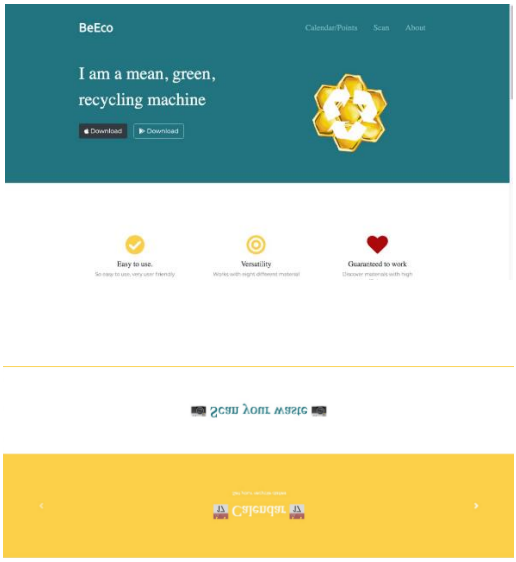

Figure 1: Home Page for BeEco Recycling

The design and functionality of the calendar were also developed. The website can now have you input the day of your recycling pickup so that you can have a reminder of when to take it out.

Figure 2: Calendar Page on BeEco Recycling Website

The bin identification system was also coded into the interface as seen below, this uses the material identified using the IBM Watson visual recognition software and then sorts it using the webpages coding.

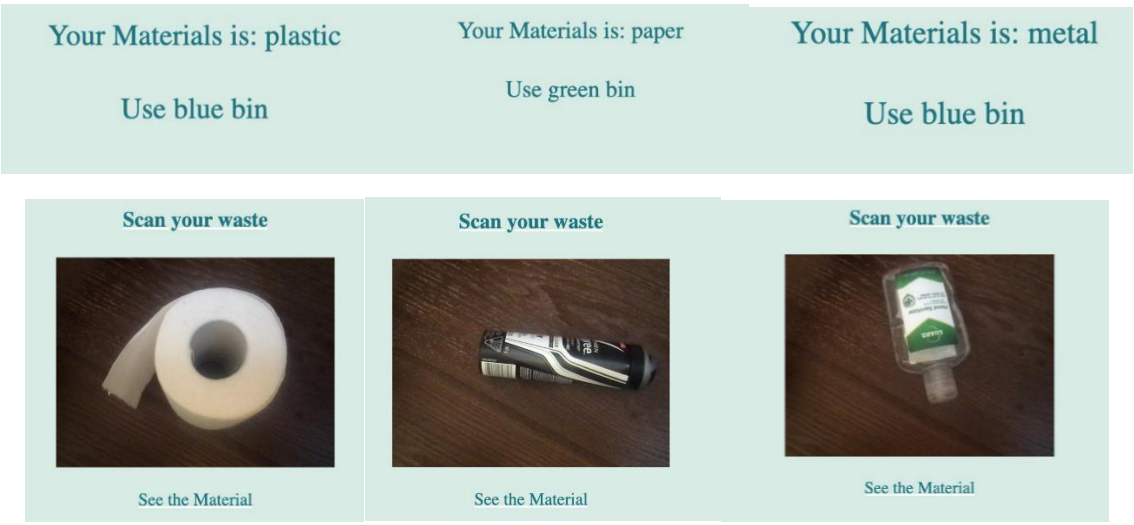

Figure 3: Material Identification and Recycling Bin Sorting

4. Prototype Testing

Prototype testing is done to ensure that the prototype fulfills the function that it is created to accomplish. This is done in order to ensure that the product will respond to the problem statement and meet the client's needs and wants. To ensure accurate testing a set of stopping criteria were defined, both alpha and beta testing are preformed, and the results are analyzed.

4.1.Stopping Criteria

The stopping criteria is criteria that must be met in order to stop iterating on the prototype development and testing. This set of criteria will be set based on the critical assumptions and features being tested as well as on the client's needs and wants in order to ensure that all important factors and requirements of this prototype are being met.

The critical component being tested and developed in the third prototype was the ability of the prototype to detect the correct recycling bin to place the scanned object in. The third prototype was also being used to increase the accuracy of the material identification system. This is to ensure that the system can correctly identify the object and direct the user to place it in the correct bin.

Table 1: Stopping criteria and assumptions or needs being tested

Assumption or need being tested	Stopping Criteria "Unit"	Stopping Criteria
BeEco can be used to identify the correct recycling bin that should be used for a certain scanned recyclable material	Binary (yes/no)	Yes

As this is a critical component to the function of the system as well as to the success of the project and meeting the client's needs and wants as well as solving the problem statement the stopping criteria would be based off of a binary (yes or no) criterion. The stopping criterion would be "yes", meaning that the BeEco can identify the correct recycling bin in which the scanned material must be placed.

4.2.Testing Analysis and Results

Overall the system was able to scan relatively accurately the different types of recyclable materials. Below is the list of materials and the accuracy of the AI to recognize each different material.

Table 2: Testing the materials and bin placement accuracy

Item	**% Accuracy**
Paper	7%
Glass	90%
Cardboard	90%
Metal	85%
plastic	83%

4.3.Feedback from Testing on Prototype

After designing our third porotype, we introduced it to a few other people in order to receive feedback on its quality and effectiveness. The overall feedback we received from the users was positive, and it seems that our improvements from the previous prototype were appreciated by the testers.

Table 3: Beta Testing User Feedback Results

Name	Feedback	Rating (out of 10)	Identifies object and Recyclable material (Y/N)
Stuart	The app/site functions properly as it was intended to, and it can properly identify the material being scanned	**9**	**Y**
Emily	Great app/site overall; the design looks nice and appeals to users with its simplicity	**10**	**Y**
Zack	The user interface of the app/site looks simple, clean, and organized. The app works great.	**10**	**Y**

5. Conclusion

We focused on the sorting system for this prototype and the implementation of a button to take a picture of the item the user is scanning. Once the scan button is pushed the scanner will scan the image and tell the user the material and tell the user which bin to put the garbage in. We also tested the prototype against our peers and compiled feedback from them to improve the scanner and overall user experience.