Lab 2 - Refill.Me Product Specification Outline

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1. Introduction

Walk into any grocery store or supermarket and most of the products on the shelves will be in self-contained packaging materials. Most of these materials end up in landfills, and even products that end up in recycling centers are sometimes not eligible to be recycled or cost an astronomical amount of money to be reused. Society needs the ability to conduct sustainable shopping to reduce the burden of an overabundance of packing materials that end up in landfills.

Packaging waste accounts for approximately 82.2 million tons a year (EPA, 2022). "Modern food packaging is made from a variety of manufactured and synthetic materials, including ceramics, glass, metal, paper, paperboard, cardboard, wax, wood and, more and more plastics" (The Environmental Impact of Food Packaging, 2018). Much of this packing waste ends up in landfills where it sits until it decomposes, which can take hundreds of years to carry out. According to Hopewell (2009), "Approximately 50 per cent of plastics are used for single use, such as packaging, agricultural films and disposable consumer items…" (para. 3). This is not the right approach to being environmentally friendly.

Microplastic pollution is a significant problem. Most of the plastic and glass packaging containers are not biodegradable and will just sit in the landfills for eternity or until the material erodes enough until it becomes microplastics or micro glass, which then end up in the oceans, the soil, and have negative consequences towards the environment (Shen et al, 2020). The best solution to microplastics is to "control and prevent plastics from entering the environment" (Pinjing He et al., 2019). Paper packaging does not fare any better as it can only be reused a max of seven times before it is no longer recyclable (Sinai, 2017). This is due to paper being made up of fibers and after each reuse, these fibers become shorter and shorter making it effectively useless after the seventh time.

Creating packaging materials is not environmentally friendly. Each type of packaging material takes natural and manmade resources to produce. These resources include “energy, water, chemicals, petroleum, minerals, wood, and fibers". Many products also produce “greenhouse gasses, heavy metals, and particulates” (The Environmental Impact of Food Packaging, 2018, para. 14). For example, to make plastic, fossil fuels are used and to make aluminum, bauxite is used. There are an abundance of chemicals that are involved in creating plastic packaging that encounters food. Many of these chemicals are recognized by the EPA and through multiple international agencies as being hazardous to human health, can accumulate in the body, and disrupt the body’s natural processes (Groh et al, 2019).

Recycling has been shown to be an inadequate tool to combat waste. The current rate of recycling is failing. The recycling rates for glass is only 25%, paper is 68% and plastic is an abysmal 9% (EPA, 2022). According to the EPA, the current challenges facing recycling are that most Americans want to recycle but do not know what products are recyclable and this often leads to confusion. There is a growing demand for replacing single use plastic materials with reusable, compostable, or edible alternatives (Hoover, 2022). Shoppers want to reduce their environmental footprint and make a conscious choice in fighting climate change. According to the Consumer Brands Association, “the majority of Americans believe that the federal government should tackle plastic and packaging waste as its next “moon shot,” and “If given the option to buy products with recyclable or compostable packaging, 47% of Americans opt for recyclable products as their first choice and 20% prefer compostable products”. (Denis, 2021).

Refill.Me is the mobile software solution that is designed to enable shoppers to conduct package-free shopping. This will reduce the overall waste that ends up in landfills, reduce the burden of recycling, and prevent deleterious chemicals from entering foods and humans.

1.1. Purpose

The Refill.Me is the proposed mobile software application that is designed to reduce and eliminate packaging waste by supplying relevant and timely information to shoppers and helping shoppers to conduct package-free shopping through an innovative application. Refill.Me is designed to help consumers to reduce or eliminate the amount of packaging materials they purchase, which therefore means a reduction in the amount of packaging material that ends up in landfills. When shoppers use the application, they will be able to shop in local stores, know what products are available in their area, know what containers to bring with them to conduct package-free shopping, be provided with up-to-date pricing data, and lastly, make the experience enjoyable.

Refill.me is also intended for stores that sell package-free products. Stores will gain valuable information on customers, other package-free stores in the area, and crowdsourced data. Refill.me enables package-free stores to reach their target audience in a greater capacity through an innovative mobile application.

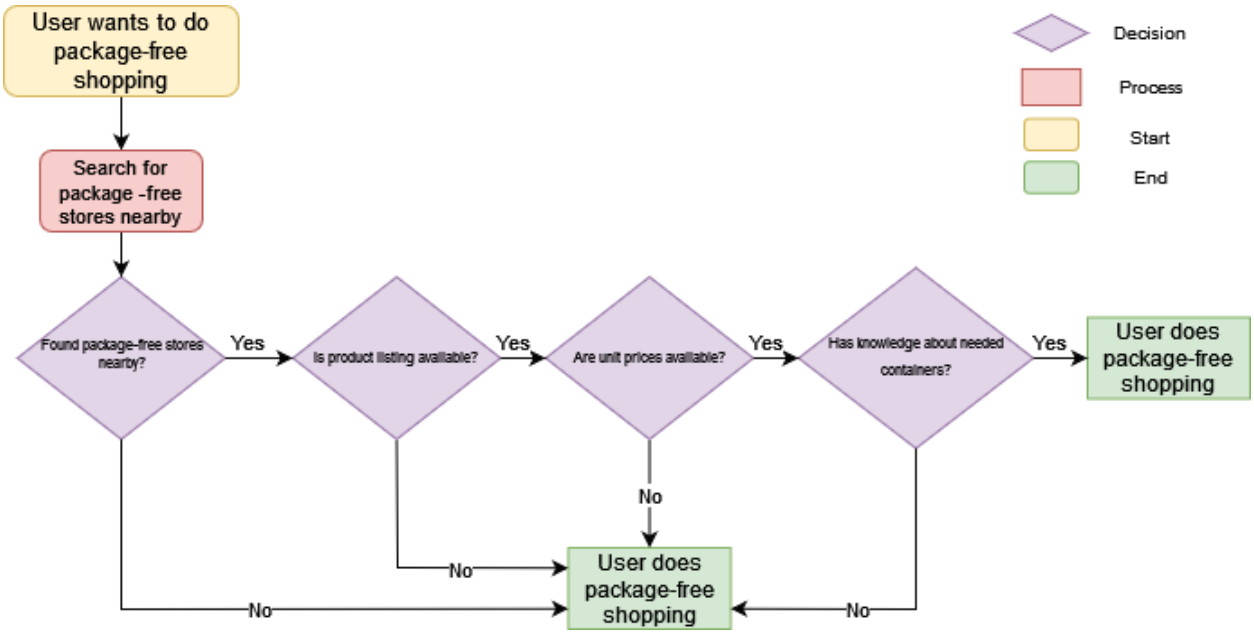
1.2. Scope

Refill.Me is designed to be used by individual shoppers and package-free stores. This will be accomplished through an innovative mobile application that will utilize several features so shoppers and store owners can get the best package-free shopping experience possible. Store owners will gain invaluable insight into their customers and how they can better serve them. Store owners will have the ability to store their inventories and pricing. They will have access to data relating to package-free shopping and how they can best maintain their inventories. This is accomplished through crowdsourcing information and knowing what shoppers are purchasing and/or putting it into their shopping lists.

In Figure 1, shown below, the current process for shoppers looking to conduct package-free shopping shows that shoppers can run into problems. Refill.Me's goal is to prevent the shoppers from getting discouraged and purchasing products that contain packaging materials.

Figure 1

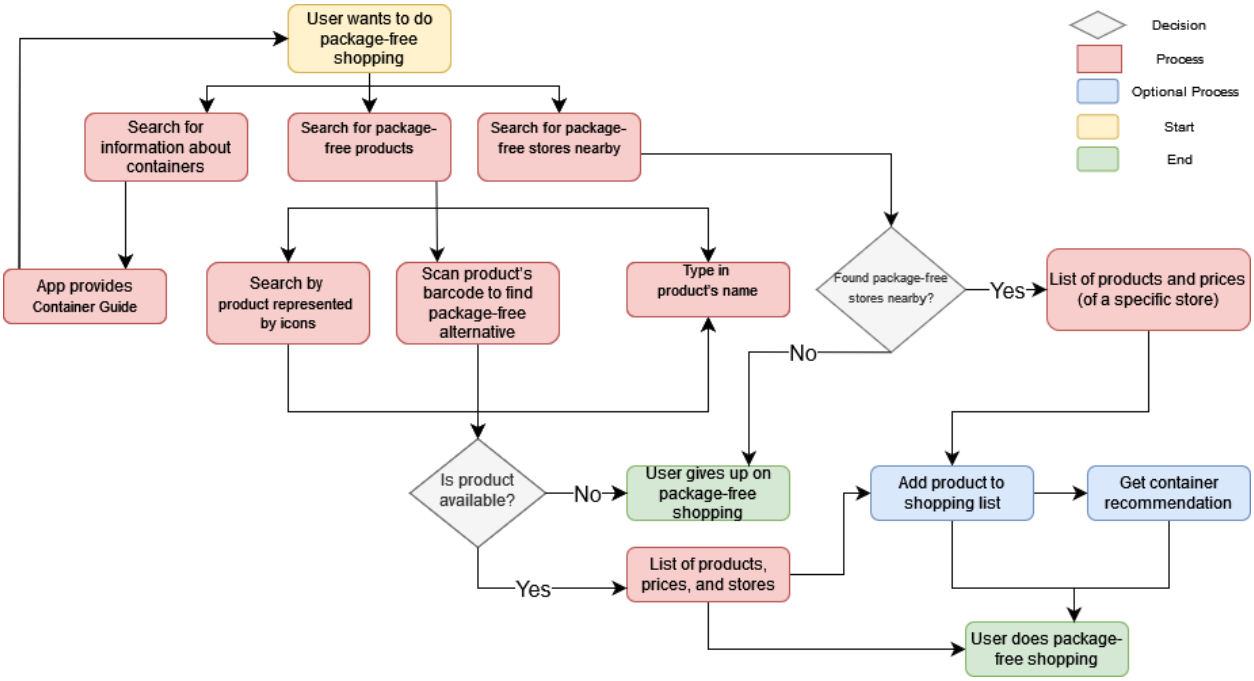
Current Process Flow



With the proposed solution, shoppers will be in a better position to make informed decisions on package-free shopping. Refill.Me will accomplish this through several features: the container guide, user's shopping list, the container recommendation tool, store and product searches, and Reward.Me. Refill.Me's goal is to reduce the complication of package-free shopping by enabling shoppers to conduct package-free shopping utilizing a mobile application. As shown below in Figure 2, users are now capable of getting package-free information, the tools necessary to conduct package-free shopping, and where they can find the products they need, this will enable the shoppers to conduct package-free shopping.

Figure 2

Solution Process Flow



Shoppers will be able to search for products in their area, the store location, hours of operations, and store those items in their shopping list. The user's shopping list will then inform the user of what type, size, and numbers of containers they will need to bring with them so that they are not overwhelmed. Users will also be able to enroll in the Reward.Me program, which will help both the stores and the users. Users will gain points to be used in future store purchases and the stores will enhance the overall numbers of shoppers purchasing at their stores.

Initially, users will gain access to Refill.Me through a trial period but after the initial trial period ends, users will need to purchase a subscription or remain as a guest with limited functionality. With this limited functionality, users will not have access to features such as their shopping lists, container guide, the container recommendation tool, and product searches.

After users have created an account and logged in, users will then be able to have access to their dashboard. The paid user's dashboard will have access to all the features listed above and can interact with applications to the full extent. Store owners will have access to their dashboard

after creating an account. The store owners will be able to interact with their products, update pricing information, and view their analytics for the store.

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1.3. Definitions, Acronyms, and Abbreviations

Amazon Relational Database Services (Amazon RDS): a web service to set up, maintain, and scale a relational database in the cloud.

Android: an open-source mobile phone operating system used on mobile devices such as smartphones and tablets.

Application Programming Interface (API): a set of rules for two different programs to communicate with each other.

Amazon Web Services (AWS): a cloud computing platform.

Amazon Maps API: a programming interface that allows developers to add mapping capabilities like interactive maps and custom overlays to android applications.

Application Layer: a layer where an application can effectively communicate with other applications on different computer systems and networks.

Backend: a computer system or application that is not directly accessed by the users but rather responsible for storing and manipulating data.

Bauxite: a naturally occurring mineral.

Biodegrade: to decompose and become incorporated back into the environment.

Bulk section: an aisle where products are available in dispensers or bins, and the shoppers can buy the exact amount they desire.

Bring Your Own Container (BYOC): an initiative to encourage shoppers to bring their own containers with them to the store in order to avoid creating packaging waste.

Cascading Style Sheets (CSS): a stylesheet language used to create the design (fonts, colors, borders, etc.) of webpages.

Compostable: breaking down into organic matter and not producing any harmful chemicals during that process.

Container: tote bag, produce bag, glass or plastic jar, glass or plastic box, glass or plastic bottle that can be used for package-free shopping.

Container Guide: a small lexicon providing an overview of different types of containers and the types of products that could be stored in them.

Container Recommendation Feature: a feature of Refill.Me that suggests specific containers for products based on the type of product such as liquid or solid.

Continuous Integration and Delivery (CI/CD): a method for automatically merging contributions and deploying new stable software to a production environment.

Customized Container Recommendation Feature: a feature of Refill.Me that suggests all needed containers for a particular shopping list based on the items added to the list by the shopper.

Crowdsourcing: a way to solicit user feedback using surveys (either paper based or online).

Database: an organized collection of structured information, typically stored electronically in a computer system.

Data Layer: a layer of the application/website which contains all of the data that is generated by users engaging with the application/website.

Django: a high-level Python web framework that enables rapid development of secure and maintainable websites.

Docker: a platform designed to help developers build, share, and run development processes.

EPA: United States Environmental Protection Agency.

Experienced package-free shopper: a shopper who has knowledge of package-free shopping.

Expo: an open-source framework for creating mobile apps.

Farmers' market: a market where local farmers sell their products directly to consumers.

Frontend: a computer system of the website/application which is exposed to users for direct interaction.

GitHub: a hosting service for version control and development of software.

GitHub Issues: a GitHub repository feature that tracks issues, team-members' work, and the development process of an application.

Google Maps: a web mapping platform and application that provides street maps, satellite imagery, and real-time traffic information.

Greenhouse gas emissions: gases (such as carbon dioxide and methane) predominantly emitted through human activities that trap heat in the earth's atmosphere, and thus directly contribute to climate change.

Hyper Text Markup Language (HTML): a programming language used to create websites.

Integrated Development Environment (IDE): an advanced code editor with syntax highlighting, built-in debugger, and compiler.

iOS: a closed source mobile operating system used in iPhones and iPads from Apple Inc.

JavaScript: a high-level client-side scripting language to implement functionality on websites.

Loose product: product sold without any packaging.

Mainstream grocery shopping: grocery shopping that does not follow sustainable practices, thus, it entails buying packaged items, using plastic, and not considering environmental aspects.

Microplastics: tiny plastic particles that are less than five millimeters long and are created when larger plastic pieces break down.

MySQL: a relational database that uses SQL as its database language.

Node Package Manager (npm): a software-sharing repository for software and packages that are used for software development, especially software written in JavaScript.

Novice package-free shopper: a shopper who has no experience with, and thus, no knowledge of package-free shopping.

Optical Character Recognition (OCR): a software that recognizes and converts text from images to machine-readable format.

Package-free: without any packaging materials such as plastic, paper, cardboard, aluminum, or glass.

Package-free store (in the context of Refill.Me): a supermarket with a bulk section, a store exclusively selling loose products, and a vendor at farmers' markets.

Package-free shopper: a shopper who prefers to buy loose products by filling them into their own containers.

Package-free shopping: shopping using one's own containers, thus, shopping without creating packaging waste.

Package Manager: a set of software tools that automates the installation, updating, configuration, and deletion of programs in a systematic way.

Packaging: material used to protect a product from any damage during transportation or storage.

Presentation Layer: a layer where functions like data conversion, data encryption and decryption as well as data translation take place.

Produce bag: a reusable bag, usually with a window and tare weight label, that is used for buying fruits/vegetables.

Python: a high-level programming language that supports multiple programming paradigms, including structured, and functional programming.

React Native: a framework that allows for the building of native mobile apps using the programming language React.

Relational Database: a type of database that stores and provides access to data points that are related to one another.

Rest Framework(s): an application programming interface that conforms to the constraints of REST architecture.

Single use: designed to be used only once, and then to be discarded.

Structured Query Language (SQL): a widely used database language used for inserting, querying, and retrieving data from relational databases.

Tare weight: the weight of an empty container that should not be included when the price of the product is calculated.

Tote bag: a large bag, often made of cotton, used to carry many items.

Virtual Machine (VM): a digital version of a physical computer.

Visual Studio Code (VS Code): a source-code editor that can be used with a variety of programming languages.

Webpack: a software tool that bundles JavaScript files to be used in a web browser.

Web Server: computer software and hardware that stores content for a website such as images, videos, and other data, and it operates on HTTP and other protocols to deliver the files for a website to clients who request it.

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1.5. Overview

This product specification provides a high-level overview of the objectives and structure of the Refill.Me prototype. It will establish the purpose of the project and will provide how the prototype will accomplish the intended purpose. The specification will go into detail regarding the architecture design of the prototype, the functional capabilities, and lastly the list of requirements with which the prototype must comply with.

2. General Description

Refill.Me is intended to help consumers conduct package-free shopping and to make the shopping experience as simplified as possible utilizing several in-app features. The intended purpose of the prototype is to express the real-world product (RWP) features in a streamlined prototype. Not every feature will be properly enabled in the prototype and will need to be omitted or shown with pre-generated data. As a proof of concept, the prototype will still look and feel as if it were the real product and will focus on the innovative goal of designing a mobile software application that will reduce the total amount of packaging materials that plagues the planet and the subsequent consequences.

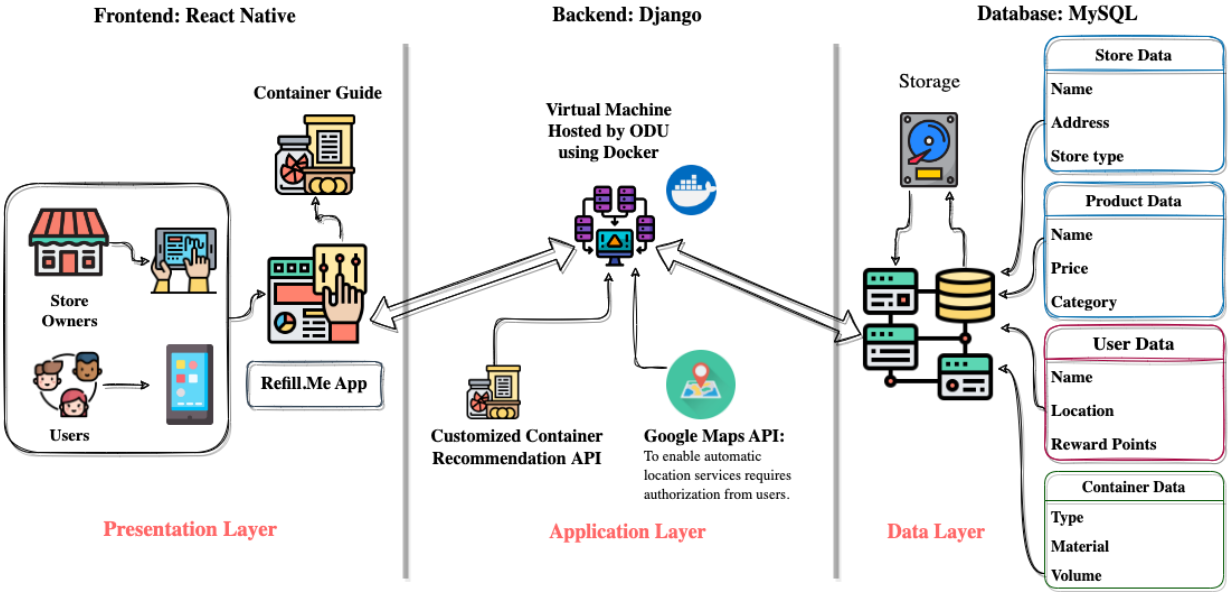
2.1. Prototype Architecture Description

The Refill.Me prototype will be developed using a three-tier architecture system, like the RWP. This is shown below in Figure 2. The prototype includes a presentation layer, application layer, and data layer. The database will be stored on a ODU Computer Science dedicated server using Docker, while the application and presentation layer will be developed locally. The application layer will be built using Django for the backend and will communicate with both the database and the presentation layer. The database will be built using MySQL Workbench. While the presentation layer will be designed using React Native. The real-world application was planned with two hard coded applications, Android, and iOS. Using React Native, the Refill.Me

prototype can still be used on any device with an internet connection without loss of functionality across devices.

Figure 3

Refill.Me Prototype Major Functional Components Diagram



Much of the project development will remain the same as the RWP. The Refill.Me prototype will still be developed using GitHub for the repository and version control. GitHub also enables project management through Projects and enables features such as issue tracking and sprint goals.

Most of the functionality and capabilities will be retained for the prototype application for Refill.Me. There will be a limited number of features that will be partially implemented as shown below in Table 1. The features listed show the RWP and the prototype and how it is being implemented. The limited functionality includes the search by icon. This section will be pre-generated data and will be partially implemented. The search by name will be omitted from the prototype altogether. The crowdsourcing store rating system will be implemented partially. This is due to stores being pre-generated data; this will be the same for the store owner users.

Table 1
Refill.Me RWP v. Prototype Features

Feature	RWP	Prototype
Account creation	Fully Implemented	Fully Implemented
Store Search	Fully Implemented	Fully Implemented
Product search		
By Icon	Fully Implemented	Partially Implemented
By Name	Fully Implemented	Omitted
By Barcode	Fully Implemented	Fully Implemented
Container Guide	Fully Implemented	Fully Implemented
Container Recommendation	Fully Implemented	Fully Implemented
Shopping List	Fully Implemented	Fully Implemented
Reward.Me		
Collect Reward Points	Fully Implemented	Fully Implemented
Receive Coupons	Fully Implemented	Fully Implemented
Crowdsourcing		
Suggested Edits	Fully Implemented	Fully Implemented
Store Rating	Fully Implemented	Partially Implemented
Connect shoppers	Fully Implemented	Fully Implemented
Product/ Price Dashboard	Fully Implemented	Fully Implemented
Reward Point Conversion	Fully Implemented	Fully Implemented
Coupon Dashboard	Fully Implemented	Fully Implemented
Store Rating Dashboard	Fully Implemented	Partially Implemented
Store Information Dashboard	Fully Implemented	Fully Implemented

Although some features will not be fully implemented, the final prototype will still allow for a full display as if it were the RWP. A user will be able to log in to their profile, look up items that are available in their area (the data is pre generated and will not be actual products that are available for purchase), sign up for reward me, see stores in the area (also pre generated data), submit crowdsourcing information, read the container guide, create a list, view the container recommendation based on their lists, and submit crowdsourcing recommendations.

2.2. Prototype Functional Description

2.2.1. External Interfaces

The Refill.Me prototype's MySQL database will be hosted on and accessed through an Old Dominion University's Computer Science Linux server.

2.2.2. Hardware Interfaces

The Refill.Me prototype requires minimal hardware to operate and includes a computer, web browser, or mobile device with internet connection capabilities. The backend and frontend will be built on local devices, while the database will be accessed through the ODU Linux server as mentioned above. These connections will need to be made through a local router/modem device, as communication with the database is an important aspect of the project.

2.2.3. Software Interfaces

The Refill.Me prototype will include several software interfaces. They include the Rest framework APIs that will handle the Reactive Native (frontend) communication with Django (backend), and subsequently the database. React Native will communicate its database requests using the Rest APIs. The Docker software will be utilized for the

database initialization on the ODU department server. MySQL workbench software will be utilized in setting up and managing the database.

2.2.4. User Interfaces

The Refill.Me prototype will enable users to connect to the application through any device that can connect to the internet. Once a user is logged in, each user and/or store will be able to create an account and access their dashboard. These dashboards can be viewed in the Appendix under the Site Map for Refill.ME.

2.2.5. Communications Protocols and Interfaces

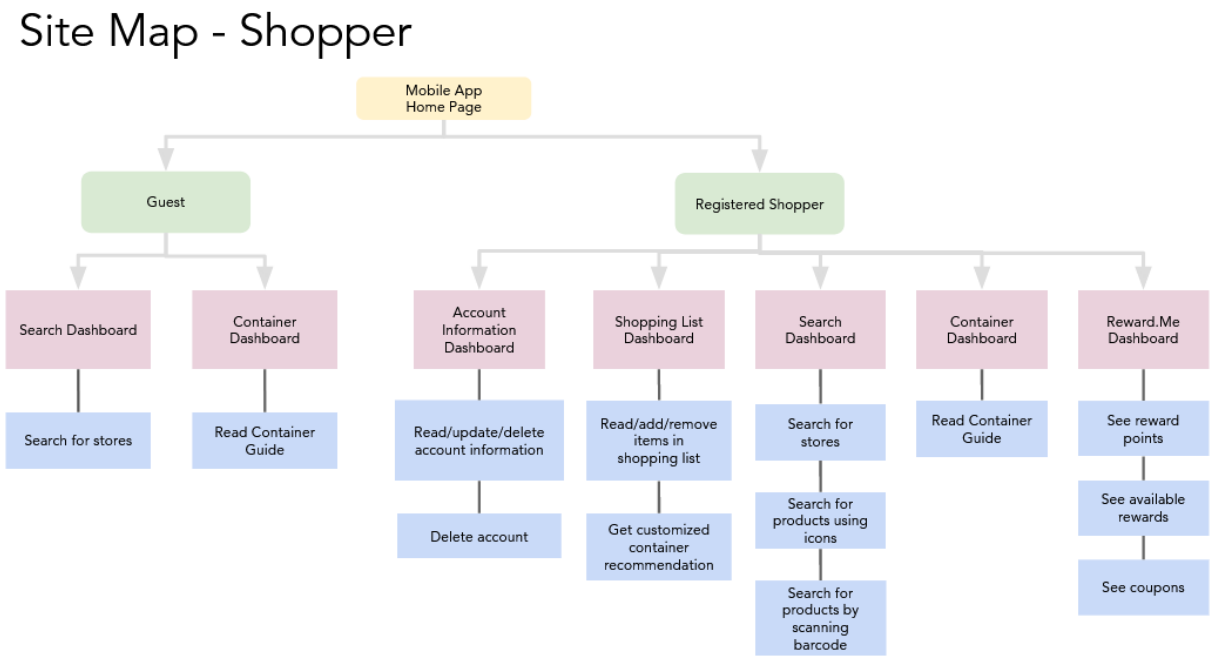
The Refill.Me prototype will enable user security and connectivity through tokenization access. Each user will create their account and be assigned a specific token that is backend dependent. The user will be able to log into or out of their account with minimal effort but also ensure security.

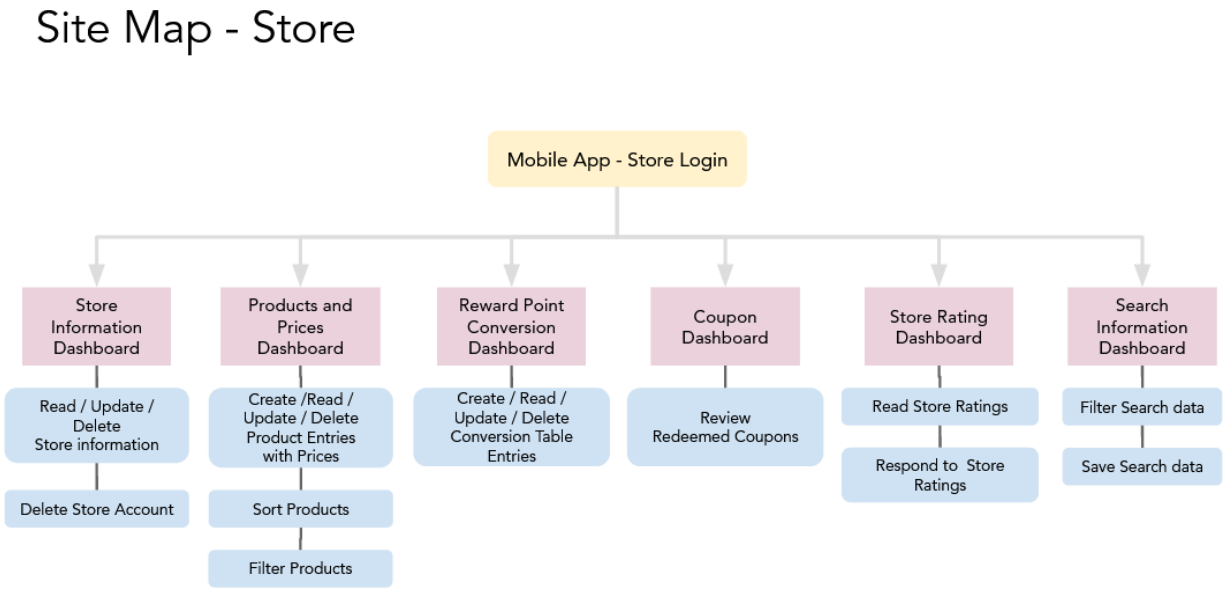
3. Specific Requirements

[Currently in group collaboration efforts]

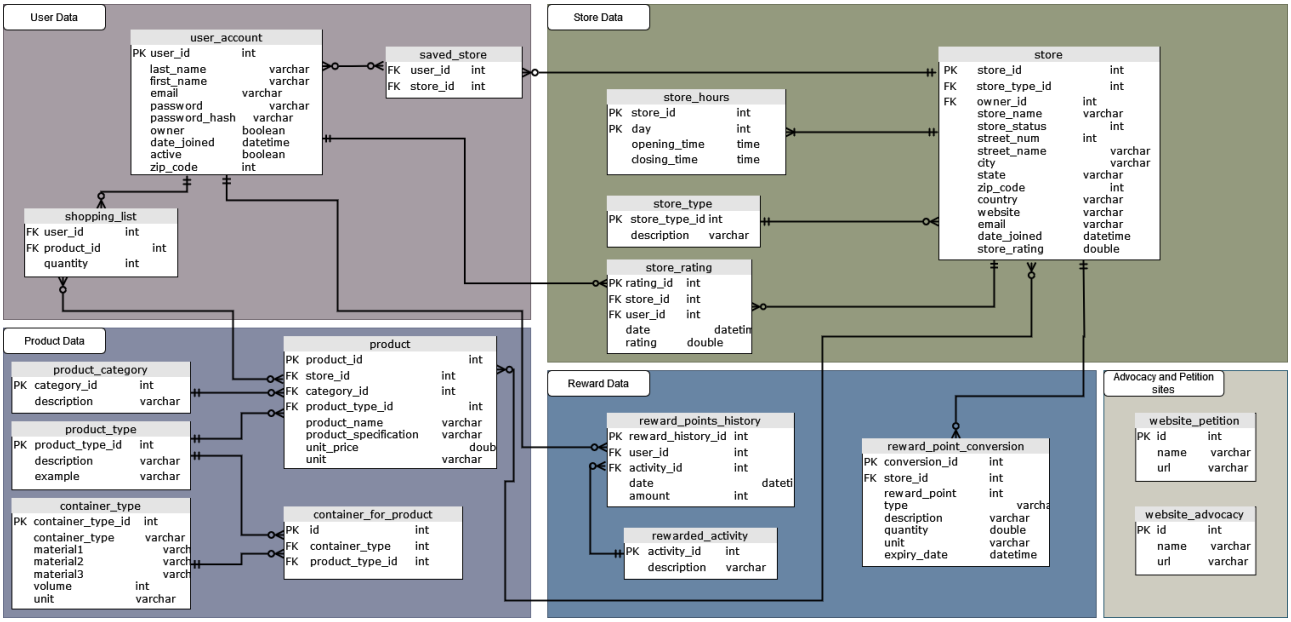
Appendix

Site Maps (O: Hull)





Appendix B: Database Schema (O: Hull)


User Data
user_account
PK user_id int
last_name varchar
first_name varchar
email varchar
password varchar
password_hash varchar
owner boolean
date_joined datetime
active boolean
zip_code int
saved_store
FK user_id int
FK store_id int
shopping_list
FK user_id int
FK product_id int
quantity int
Store Data
store
PK store_id int
FK store_type_id int
FK owner_id int
store_name varchar
store_status int
street_num int
street_name varchar
city varchar
state varchar
zip_code int
country varchar
website varchar
email varchar
date_joined datetime
store_rating double
store_hours
PK store_id int
PK day int
opening_time time
closing_time time
store_type
PK store_type_id int
description varchar
store_rating
PK rating_id int
FK store_id int
FK user_id int
date datetim
rating double
Product Data
product_category
PK category_id int
description varchar
product_type
PK product_type_id int
description varchar
example varchar
container_type
PK container_type_id int
container_type varchar
material1 varch
material2 varch
material3 varch
volume int
unit varchar
product
PK product_id int
FK store_id int
FK category_id int
FK product_type_id int
product_name varchar
product_specification varchar
unit_price doub
unit varchar
container_for_product
PK id int
FK container_type int
FK product_type_id int
Reward Data
reward_points_history
PK reward_history_id int
FK user_id int
FK activity_id int
date dateti
amount int
rewarded_activity
PK activity_id int
description varchar
reward_point_conversion
PK conversion_id int
FK store_id int
reward_point type int
description varcha
quantity varchar
unit double
expiry_date varchar
Advocacy and Petition sites
website_petition
PK id int
name varchar
url varchar
website_advocacy
PK id int
name varchar
url varchar