Lab 2 – Refill.Me Product Specification Outline

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Lab 2

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1   Introduction

The 20th century saw countless cultural and technological evolutions regarding household consumerism. Considering grocery shopping specifically, the status quo in western society has migrated from a clerk and counter model to self-service bulk shopping over a single lifetime. This shift has immensely streamlined, consolidated, and simplified the shopping trip, but there are still issues that may require another paradigm shift.

Across many countries, thousands of warehouse-sized grocery stores are filled with millions of products, each meticulously wrapped in layers of plastic or cardboard. All this packaging waste is unceremoniously thrown away upon use, to the tune of 82.2 million tons in the United States in 2018 (EPA, 2022). Now, as we contend with climate and sustainability issues, some shoppers are starting to recognize the wastefulness of our current approach to grocery shopping.

This has led to the emergence of a new market force. Consumers are lobbying for regulations on single-use plastics like shopping bags and takeout containers, while some are trying to opt out of all unnecessary packaging (Hoover, 2022). Instead, these shoppers shop at specialty retailers with package-free offerings, and they bring their own reusable containers to hold their goods. For example, a package-free shopper may get olives from bulk bins at a package-free store and store them in a glass jar brought in from home.

This approach might confuse traditional shoppers, but it is followed by some environmentally minded consumers, especially in urban areas. Washington, D.C., for example, has dozens of stores selling goods in this fashion. They offer essentials like produce, grains, pasta, beans, oils, candies, baking needs, and even soaps and shampoos. However, this approach to shopping comes bundled with barriers that make it less popular than it otherwise might be.

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The package-free shopping movement suffers from a lack of awareness and resources. Not many people are aware of this approach to shopping, and even those who are interested in it face a lack of instructional and practical resources to start shopping package-free. In order to not be dissuaded, these shoppers need information on how to get started, where to find stores nearby, what containers to bring, what prices to expect, and more.
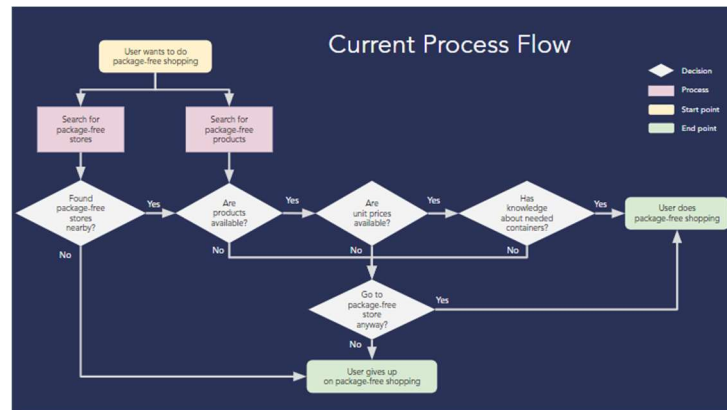

Figure 1. Current Process Flow

1.1 Purpose

Refill.Me is a mobile app is being developed to get package-free shoppers the information they need. It will be an information hub for these shoppers, and it will provide guidance on where to shop, what prices to expect, what products are available, how many containers to bring, and more. A rewards program will be developed to further encourage these environmentally minded shoppers to keep shopping, and crowdsourced ratings for stores will build community among users while providing useful insight on which stores other shoppers recommend. For interested shoppers without package-free offerings nearby, an advocacy and petition dashboard will serve to show grocery retailers the demand for package-free options in underserved areas.

Refill.Me is not just an app for shoppers. Store managers with package-free products will also stand to benefit from Refill.Me, through the app's features designed just for them. Refill.Me will offer managers a price and product dashboard, so managers can effectively communicate the latest new products and prices with the app's userbase. Refill.Me will also provide insight on what items shoppers search for most at their location, along with other shopper insights. Furthermore, Refill.Me will allow managers to run custom promotions on the app to further entice shoppers and boost sales volumes.

While Refill.Me has no plans to be a stand-alone goods market or fully-fledged inventory tool, it still provides ample value for shoppers and store managers. By providing a platform for these shoppers and vendors to exchange information, build community, and learn, Refill.Me offers a feature-rich solution to the dearth of information and resources shoppers and vendors need. With these key innovations, Refill.Me could serve to incubate growth across the package-free goods market.
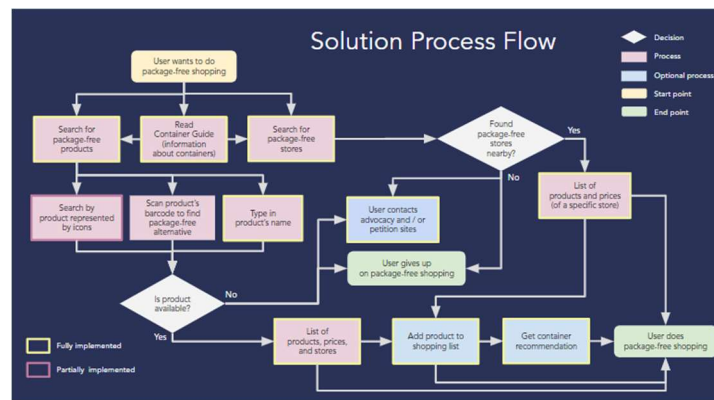

Figure 2. Solution Process Flow

1.2 Scope

The development of Refill.Me begins with a prototype. This prototype is being designed to demonstrate key innovative features and show the viability of the product to potential investors. More specifically, the prototype will include the community advocacy dashboard, which will leverage the app's user base to encourage their local entrepreneurs and governments to add sustainable shopping options near them. This feature is being included to demonstrate Refill.Me's potential as a market-expanding product. Also included is the container guide, which will analyze a user's shopping list and suggest the proper amount and type of containers to bring on the shopping trip. Searching a mock store by product and adding products to a shopping list will also be supported in the prototype to provide context for the app's innovations.

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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 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: gasses (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 details the need for a solution like Refill.Me as well as architectural configuration, interfaces, capabilities, and features of the Refill.Me prototype. The remaining sections of this product specification provide a description of the software and user interfaces required for the prototype; the main features of the prototype; functional requirements for each of these features; and nonfunctional requirements such as performance, accuracy, reliability, and usability for these features.

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2   General Description

2.1   Prototype Architecture Description

The Refill.Me app will be constructed following a three-tier architecture, which includes the following major components:

- Presentation Layer: holds the front-end of the application which provides the user interface and an organized view of any data requested. This component will be implemented using the React Native framework, which allows for a final product compatible with Android, iOS, and web devices.

- Application Layer: holds the APIs required for feature functionality. Implemented using Django on a virtual machine with Docker. Some APIs to be implemented in the prototype include the Customized Container Recommendation API and the Maps API for store selection.

- Data Layer: holds all the data for the application. Types of data held include data for users, products, stores, and containers. The database will be constructed in MySQL.
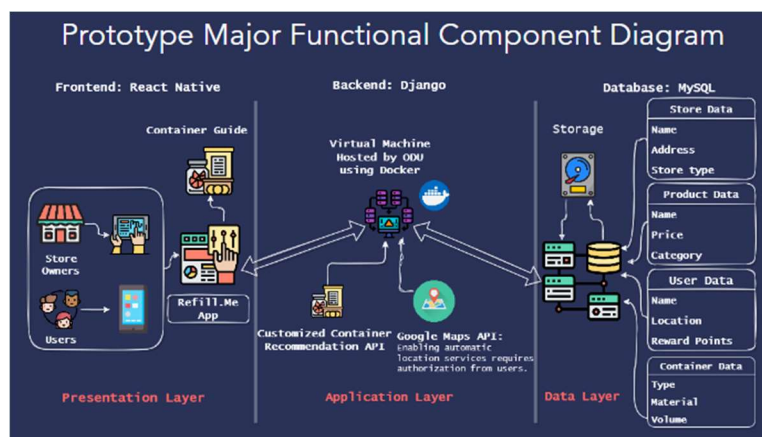

Figure 3. Refill.Me Prototype Major Functional Component Diagram

2.2   Prototype Functional Description

The Refill.Me prototype is intended to demonstrate core functionality only, so it will not offer all the features that would be present in the fully featured product. Key innovative features like the container guide, petition hub, and more will be fully implemented, but some features are not. Table 1 fully outlines the features and capabilities the team expects to complete in the prototype. Some features listed as partially implemented may operate using mock data or not have full functionality.

Table 1

Implementation of Features for Refill.Me Prototype

Feature	Implemented	Notes
Create Account	Yes	
Store Search	Yes	
Product Search	Partially	Search by icon or barcode will not be fully implemented.
Container Guide, Recommendation	Yes	These are key innovative features that will be prioritized in early development.
Shopping List	Yes	
Reward Points	Yes	
Receive Coupons	No	
Suggest Info Edits	Yes	This is a key innovative feature that will be prioritized.
Store Rating	Partially	
Petition/Advocacy	Yes	This is a key innovative feature that will be prioritized.
Product and Price Dashboard	Yes	
Reward Point Conversion	Yes	May not be implemented fully based on time constraints
Coupon Dashboard	No	
Store Rating Info	Partially	
Search Information	Partially	

When a user first opens the Refill.Me app, the login and register page will be served. The user's actions on this page, either signing in or creating a new account, will be sent to the application layer, a Django that resides on an Old Dominion University (ODU) virtual machine. From there, the user is greeted with the homepage, which offers options for account information, viewing the user's shopping list, search for a product, and viewing general container information. Alternatively, a user may continue as a guest, which offers limited capabilities.

The account information page allows a user to view and update account information and delete the account. The shopping list page allows a user to view and remove items from the shopping list, as well as get customized container recommendations. The search page allows users to search for stores search for products using text, icons, or barcodes. Only a text search will be implemented in the prototype. The container dashboard allows a user to view general container information in the container guide. The Reward.Me dashboard allows a user to view their rewards points, see available rewards, and see coupons. Guest users only have access to the search dashboard, where they can search for stores, and the container dashboard, where they can read the container guide. The site map for shoppers using the prototype follows.
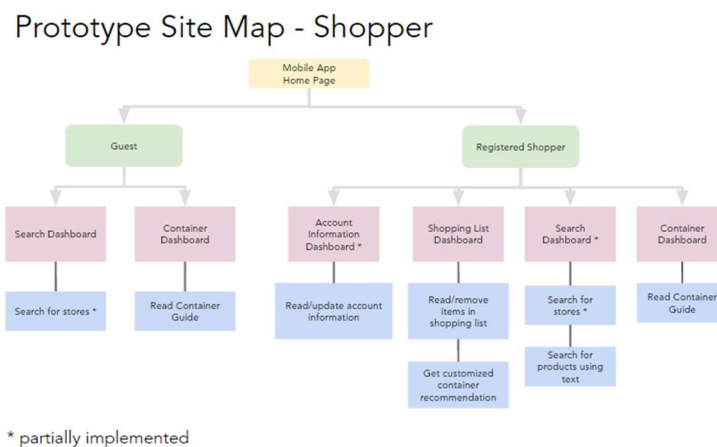

Figure 4. Refill.Me Prototype Shopper Site Map

When a store manager first opens the Refill.Me app, the login and register page will be served. Similarly, the manager's actions on this page, either signing in or creating a new account, will be sent to the application layer, a Django that resides on an Old Dominion University (ODU) virtual machine. From there, the user is greeted with the homepage, which offers options for store information, the Product and Price Dashboard, the Reward Point Conversion Dashboard, the Coupon Dashboard, the Store Rating Dashboard, and the Search Information Dashboard. These features are not to be implemented in the prototype due to development time limitations.

2.3   External Interfaces

The Refill.Me prototype is being designed as a responsive application. Shoppers are expected to interact with the application using an Android or iOS mobile device, while shop managers are expected to use the application on an Android or iOS tablet.

Refill.Me depends on custom-built application programming interfaces (APIs) for its functionality. For the prototype, a customized container recommendation is being developed, so container recommendations can be made for the items added to a shopper's list. Refill.Me also uses a variety of third-party software services like APIs to deliver a comprehensive experience to its users while avoiding repetitive development. Refill.Me uses Google's Maps API for store search functionality.