

Lab 2 – Refill.Me Product Specification

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CS411W: Professional Workforce Development II

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March 15, 2023

Version 1

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1. Introduction

The huge amount of packaging waste generated every year as a result of mainstream grocery shopping is the main culprit of the omnipresent packaging waste problem that is harming the ecosystem, the health of humans, animals, and plants (Shen, 2020). Even though recycling became very popular over the years, it is still not efficient enough to deal with the huge amounts of packaging waste that is created annually (EPA, 2022 July). The demand for environmentally friendly practices and more legislation grows. At the same time, an increasing number of shoppers want to completely opt out of packaging, and aim to adopt a low-waste lifestyle (VanRemoortel, 2018).

Unfortunately, consumers who seek package-free options face many challenges. The lack of available information about package-free shopping, package-free stores, and loose products is a significant obstacle to those who would like to take action. A central hub where information related to package-free shopping is easily accessible, accurate, and up-to-date is missing from the lives of novice and experienced package-free shoppers.

The mobile application, Refill.Me is designed to fill this void by providing an easy-to-use interface where information about package-free stores, products, and their prices are readily available. Refill.Me connects package-free shoppers with nearby stores that have a bulk section. Also, it provides shoppers with information about the practicalities of package-free shopping. Store owners benefit from Refill.Me's simple user interface that enables them to manage many different aspects of their businesses on the go. Refill.Me's mission is to assist people in finding package-free alternatives, and to support local businesses – all while reducing packaging waste.

1.1 Purpose

Refill.Me is a cross-platform mobile application designed for package-free shoppers and for owners/employees of stores with a bulk section. It utilizes two different interfaces – one optimized for smartphone usage for shoppers, and one tailored for tablet usage for store owners.

The key features of Refill.Me are the store search, the product search, and the customized container recommendation that is based on the shopper's shopping list. Also, Refill.Me does not only connect shoppers with package-free stores, but also with advocacy and petition sites. Store owners can directly inform their customers about their products, and the prices of their products, and build a customer base by providing coupons or services in exchange for the reward points collected by the shoppers in the app.

Refill.Me is not an educational app, thus, it won't provide detailed explanations regarding all aspects of package-free living, rather it will focus on making the package-free shopping experience as seamless as possible. Package-free shopping requires shoppers to do their shopping personally, thus, the app will not have an online shopping, nor a delivery option.

1.2 Scope

Refill.Me aims to help novice shoppers who are about to transition into package-free shopping, and experienced package-free shoppers who would like to maintain their shopping habits. It allows shoppers to manage their package-free shopping in one application, instead of using several different applications for searching for stores and products, having a shopping list, etc. With Refill.Me, store owners can maintain the most important aspects of their business by managing their product offerings, communicating the needed amount of reward points for certain products or services, viewing statistics about their store, and receiving ratings from their shoppers.

As a case study, the Refill.Me prototype will focus on the main target group of the app, namely women between the ages of 18 and 65, who have diverse income levels, and are highly educated (Hoover, 2022; Kim, 2018; VanRemoortel, 2018). The hypothetical user of Refill.Me wishes to buy a few package-free items in a nearby store, create a shopping list with those items, and get a container recommendation for this specific shopping. Regarding store owners, the case study will revolve around a store owner of a package-free store, who would like to enter products that he or she offers.

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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 explains the hardware and software, the interfaces, and the product features of Refill.Me's prototype mobile application. The remaining sections provide a detailed description of the components of the Refill.Me prototype that are needed for demonstrating the capabilities of a real-world product. The functional requirements (Section 3) of the Refill.Me prototype are described in detail in a separate document.

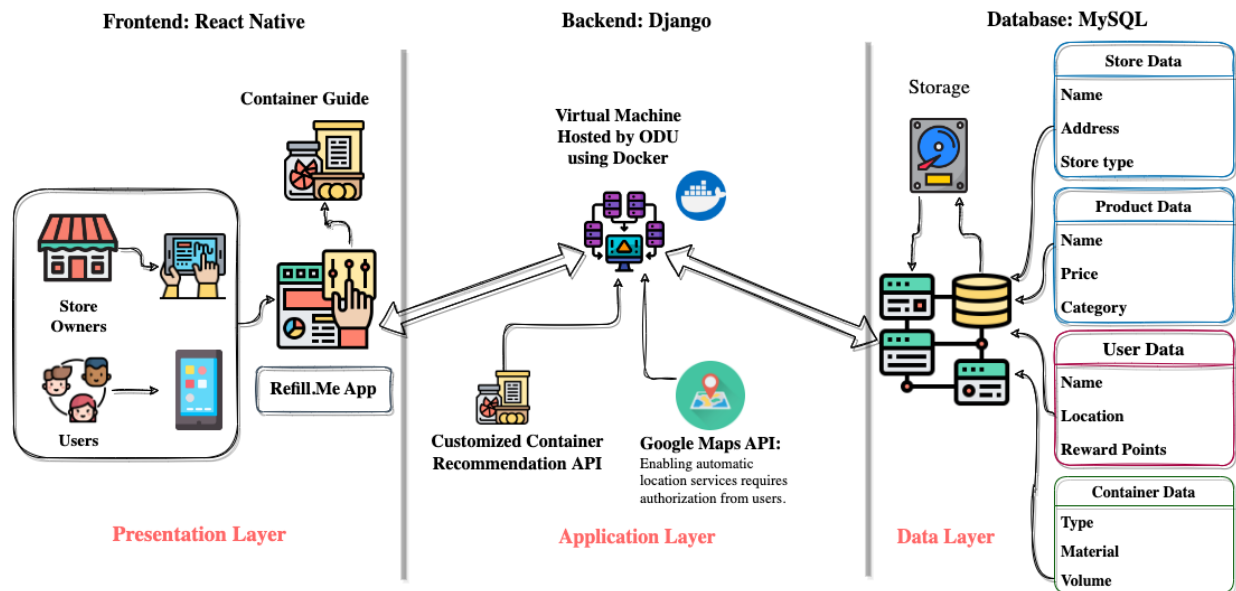
2. General Description

The Refill.Me prototype will be built as a cross-platform mobile application supported by a MySQL database. The prototype will incorporate the key features of the real-world product. It will include algorithms for account creation, store search, product search, shopping list, customized container recommendation, reward point collection, store rating, and for suggested edits. For store owners, the Refill.Me prototype will include algorithms for product upload, for entering reward point conversion information, and for viewing store ratings. Both shoppers and store owners will have access to a profile page, where they can edit profile information and change their settings.

2.1. Prototype Architecture Description

The prototype for Refill.Me will include the front-end user interfaces, which will interact with the back-end algorithms and the database. These major components are shown in Figure 1. React Native is used for the user interface, while the back-end utilizes Django. The MySQL database of the prototype is run on a virtual machine in a Docker container.

The models created in Django will make the communication with the database possible. Query sets in Django will allow the querying and retrieval of data from the MySQL database. The Django REST Framework will be used for building the APIs that are needed for the

Figure 1*Refill.Me Prototype Major Functional Component Diagram*

prototype. Integration of the Google Maps API will ensure that mapping functionalities can be used.

2.2. Prototype Functional Description

To provide a product that is able to prove the usability and practicality of the application, the prototype will focus on the following functionalities: the store search, product search, the shopping list, the customized container recommendation, the reward point collection, and the crowdsourcing feature of the app. The static pages of the container guide and the advocacy and petition site will be completed at the very beginning of the development. Table 1 provides an overview of the features for shoppers that will be fully or partially implemented in the prototype, while Table 2 shows the features for store owners.

Table 1*Refill.Me Features Description and Prototype Implementation - Shoppers*

Feature	Description	Prototype
Account Creation	Users can create an account	Fully implemented
Store Search	Users can search for nearby package-free stores	Fully implemented
Product Search		
Search by Icon	Users can search for package-free products by tapping on icons that represent product categories	Partially implemented
Scan product's barcode	Users can search for package-free products by scanning the barcode of packaged products	Eliminated
Enter product's name	Users can search for package-free products by entering the product's name	Fully implemented
Container Guide	Users can get information about container types that can be used for package-free shopping	Fully implemented
Container Recommendation	Users can get container recommendation regarding specific products, and customized container recommendation for a specific shopping based on products in their shopping list	Fully implemented
Shopping List	Users can create a shopping list by adding products to it	Fully implemented
Reward.Me		
Collect reward points	Users can collect reward points, which they can redeem at the stores	Fully implemented
Receive coupons	Users can receive coupons from the stores, and redeem it	Eliminated
Crowdsourcing		
Suggested edits for products and prices	Users can report new or closed stores, new or eliminated products, and price changes	Fully implemented
Store rating	Users can rate package-free stores	Partially implemented
Connect shoppers to advocacy and petition sites	Users can get information about advocacy and petition sites related to package-free shopping and other topics related to protecting the environment	Fully implemented

Table 2*Refill.Me Features Description and Prototype Implementation - Store Owners*

Feature	Description	Prototype
Product and Price Dashboard	Users can enter, modify, and delete entries regarding products that they offer in their stores	Fully implemented
Reward Point Conversion Dashboard	Users can specify the amount of reward points that are needed for specific products or services offered by the store	Fully implemented
Coupon Dashboard	Users can enter coupons that can be later redeemed at the store	Eliminated
Store Rating Dashboard	Users can review store ratings and reply to feedback	Partially implemented
Search Information Dashboard	Users can get information about statistics regarding product searches made in their area, and use it to improve their product offerings	Partially implemented

In the real-world product, store ratings have a quantitative and a qualitative part; a rating on a scale from 1 to 5, and a detailed description of the shopper's experience. The prototype will not have natural language processing capabilities, which would be needed if the prototype would allow users to enter feedback about stores into a free-text field. Therefore, the prototype will allow only store ratings on a scale from 1 to 5.

The store rating dashboard and the search information dashboard will be partially implemented as the main focus of the prototype is to allow store owners to enter information about their products. They still will be able to view recent ratings that they received, but there will be no option for communicating with customers. The search information dashboard will

include entries about the latest searches, but the prototype will not provide detailed analytics on searches.

2.3. External Interfaces

As a mobile application, the Refill.Me prototype will employ various external interfaces to allow the different components and features to function. The prototype will use a MySQL database stored on an ODU server in a Docker container. The main features of the app will use APIs built using the Django REST Framework. The Google Maps API will be used to provide mapping functionalities.

2.3.1. Hardware Interfaces

In order to run the Refill.Me prototype, a smartphone or a tablet with Android or iOS operating system using an internet connection shall be necessary. The app is customized for handheld devices.

2.3.2. Software Interfaces

The prototype product will be developed using the React Native software framework. Django, a Python web framework will be used for the backend functionalities. The Google Maps API will provide the mapping functionalities that will be used in the store search feature. The database shall be implemented using MySQL.

2.3.3. User Interfaces

The Refill.Me prototype will be downloaded to a mobile device. There are two main interfaces: the shopper interface and the store owner interface. The main landing page of the app is the login or registration page. Users will be prompted to enable location services, or optionally, they can opt out of it.

2.3.4. Communication Protocols and Interfaces

The Refill.Me prototype will need to connect to a network that provides HTTPS protocol for communications over the internet. The prototype shall have a TCP/IP internet connection.

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