

**Lab 1 – Refill.Me Product Description**

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## 1. Introduction

Modern grocery shopping is incredibly convenient, but it is often also very wasteful. Nearly everything on store shelves is surrounded with one or multiple layers of plastic and cardboard packaging, all of which is unceremoniously tossed away upon use. Whether vendors use plastic, paper, aluminum, or even glass packaging, all come with their own environmental toll. The manufacturing of all this packaging is a source of greenhouse gas emissions, harmful microplastics pollution, non-biodegradable landfill waste, and use of non-renewable resources (EPA, 2022) (Shen, 2020). Even paper, when consumers choose to recycle it, can only be remanufactured around seven times before its fibers are too degraded for whole reuse (Sinai, 2017). Moreover, recycling rates are cataclysmically low – with just nine percent of plastic and 25% of glass being recycled (EPA, 2022).

Fortunately, a new market force is now emerging. Shoppers are starting to realize the wastefulness and environmental problems presented by frivolous packaging use, and some have successfully pushed for regulations regarding single-use plastics like shopping bags, takeout containers, and disposable drink containers. Some trailblazers are going a step further and avoiding all unnecessary packaging (Hoover, 2022). This is package-free shopping, which involves bringing reusable containers to grocery stores, and potentially more places like takeout restaurants, to stock up on fresh, unpackaged, or bulk goods. This practice saves all the waste that would otherwise be generated in regular shopping.

Presently, however, this is a tall order. Modern shopping culture makes the use of all this extra packaging something that is taken for granted, and even viewed as necessary. It follows that not many resources exist to break free of this modus operandi, to the point that even pricing and stocking information is often difficult to find. To successfully shop in this manner, shoppers

need this information to plan and ensure they can get what they need. As a result, potential package-free shoppers are dissuaded and sucked back into a system that generates tens of millions of tons of waste every year (EPA, 2022). These shoppers need an information hub to help them find the products and information they need.

Refill.Me is that hub. Refill.Me is an app that has a wealth of information on stores, products, availability, and other relevant information, to help shoppers shrink their packaging waste. Using the app, shoppers can plan a successful shopping trip, and stores can market effectively to these eco-conscious customers.

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## **2. Refill.Me Product Description**

Refill.Me aims to offer package-free shoppers a hub of information to make planning and research for package free shopping simple. Existing options suffer from an assortment of various problems, like vague product categories, out-of-date information, and limited store options.

Refill.Me offers features to fill this information void in an easy, accessible way that keeps shoppers engaged and encouraged, and helps store owners boost sales and optimize their product offerings. Ultimately, the goal is to provide relevant, detailed, and up-to-date information that helps connect shoppers with local and regional package-free stores while keeping packaging waste out of landfills and incinerators.

### **2.1 Key Product Features and Capabilities**

Refill.Me will offer capable search tools, including a proper ‘search by product’ feature, a barcode scan and search, and search by icon. The app will also provide a shopping list tool, a guide for what containers to bring for that shopping list, a system to collect reviews and ratings from shoppers, and a reward system to encourage continued use.

Refill.Me is a solution that will be designed to work for store management as well. The cross-platform app the team develops will encourage tablet use for on-the-go use that store owners need, while still offering more screen real estate. The app will offer a dashboard to input product details and prices, a coupon dashboard, rewards hub, store rating information, and even shopping trends to help optimize product offerings.

### **2.2 Major Components (Hardware / Software)**

Refill.Me will be constructed with a three-tier architecture. This involves the front end for shoppers and store owners, an application layer including the web server, algorithms, along with various Application Programming Interfaces (APIs), and a data layer to handle tables for

store, product, and user information, as well as analytics.

The web software for Refill.Me will be written in HTML with CSS and JavaScript, while databases will be programmed in MySQL. Refill.Me will include third-party software like Amazon RDS for MySQL and GitLab for version control and continuous integration/delivery (CI/CD), as well as the Junit and XCTest libraries for testing. The team will use Trello, Discord, and Zoom to stay organized and coordinated.

**Figure 1**

*Refill.Me Major Functional Component Diagram*

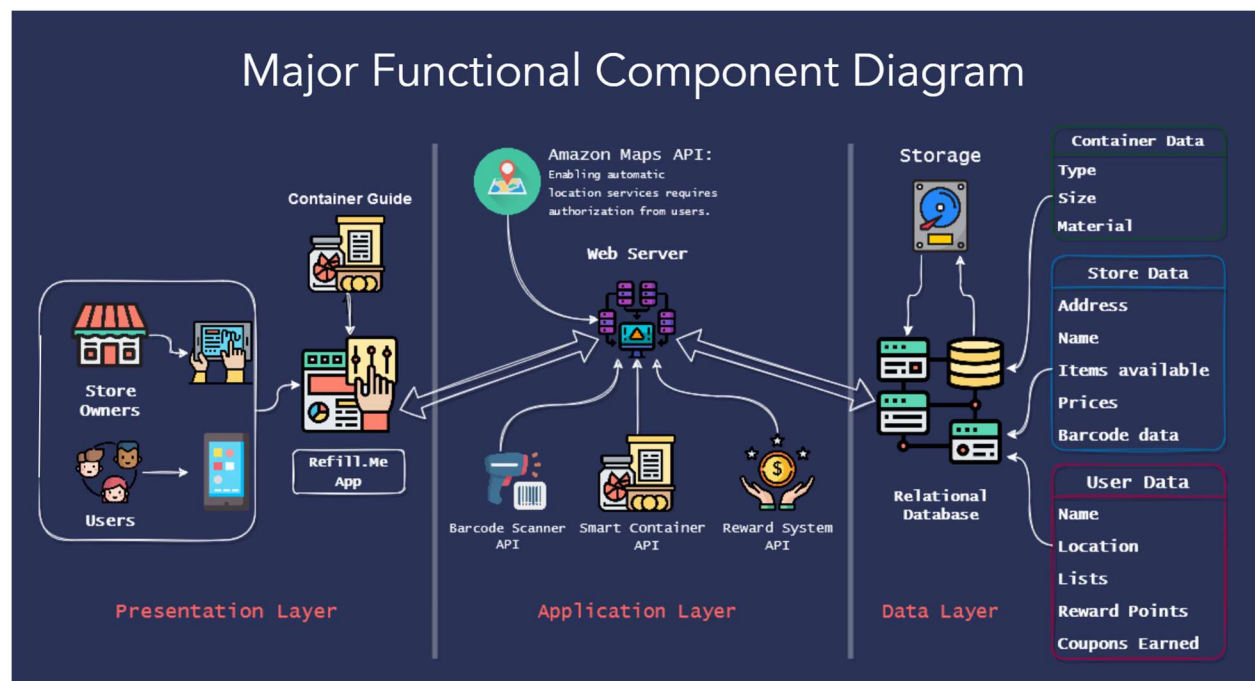


Figure 1 shows the structure of the application. Shoppers will be expected to interact with Refill.Me on a mobile device, where the responsive front-end design presents relevant information in an accessible manner. Similarly, Refill.Me customers will be provided with an intuitive, tablet-optimized experience to maximize screen size while allowing for portable use. Refill.Me will use a React Native and Expo framework to ensure tailor-fit content for any screen

size. The front end will also use HTML and CSS with JavaScript where needed. Requests from shoppers and customers will be sent to the data layer, which will use Amazon RDS for MySQL for database management. Additionally, the team will develop a Barcode Detection API to handle scanned receipts and leverage many third-party software products and APIs. These include open-source OCR support, reward management, and Amazon's products for data analysis.

### **3. Identification of Case Study**

Refill.Me is for eco-conscious shoppers, mainly women of all age groups, who are passionate about environmental responsibility. These are mostly highly educated shoppers on the east and west coasts in urban areas. These shoppers are from diverse income levels. The app will connect these shoppers with stores on the app. These stores sell loose products and have bulk sections. Examples include farmers markets and package-free stores. Two user profiles are outlined in Table 1 below for insight into Refill.Me's target users.

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**Table 1***Mock Users for Refill.Me*

Name	User Role	Description
Natalie Press	New Shopper	Natalie is concerned about the packaging waste she fills her kitchen trash bags with every week. She wants to focus on reducing this waste and hears about the concept of package free shopping. Natalie has a limited budget and needs to plan her shopping trips. After finding Refill.Me on Google, Natalie comes to appreciate the straightforward pricing, container guides, and nearby store suggestions.
Isaiah Smith	Experienced Shopper	Isaiah has often shopped package free but was frustrated by his local store's lack of selection and high prices. A friend told him about Refill.Me. Now, he uses the app to find a better grocer just outside his neighborhood that offers discounts and rewards for loyal shoppers. Isaiah shares what he learned with other friends.
Daija Stone	Store Manager	Daija manages a grocery store with an emphasis on organics and sustainable selection. She decides to expand her marketing efforts to get more shoppers through the doors. Daija posts her offerings on Refill.Me with small incentives and accepts loyalty points from regular shoppers. She gets new analytics from her own customers to better identify bestseller items, and where to expand next. She also sees an uptick in package free sales as new customers are guided to her store.

### 3.2 What will Refill.Me be used for?

Shoppers like Isaiah Smith will use Refill.Me for its capable search features, container guides, thorough product and store information, and rewards system, whereas newer shoppers like Natalie Press will make use of the container guides, store locator, and pricing information. Store owners like Daija Stone will use Refill.Me to communicate products and prices, increase their digital footprint, and get information on what customers are searching for in their area.

In the future, Refill.Me could eventually be used by grocery shopping apps and trucks selling package-free products on the go.



## 4 Refill.Me Prototype Description

The prototype will demonstrate the essential features and functionality of Refill.Me. In particular, it is intended to demonstrate the app's unique contributions to specialized, eco-conscious shopping. These include the community advocacy dashboard, which leverages the app's user base to encourage their local entrepreneurs and governments to add sustainable shopping options near them. This expands the market for package free shopping and could potentially expand the app's user base. Also among these contributions are the container guide as well as customized recommendations, which will be designed to reduce the knowledge barrier to entering the world of package free shopping and simplifying some of the planning required for going on a shopping trip.

### 4.1 Prototype Architecture (Hardware/Software)

The major components of the Refill.Me prototype will differ from the fully featured product, but the three-tier architecture seen in the RWP (real world product) will be retained.

**Figure 2**

*Refill.Me Prototype Major Functional Component Diagram*

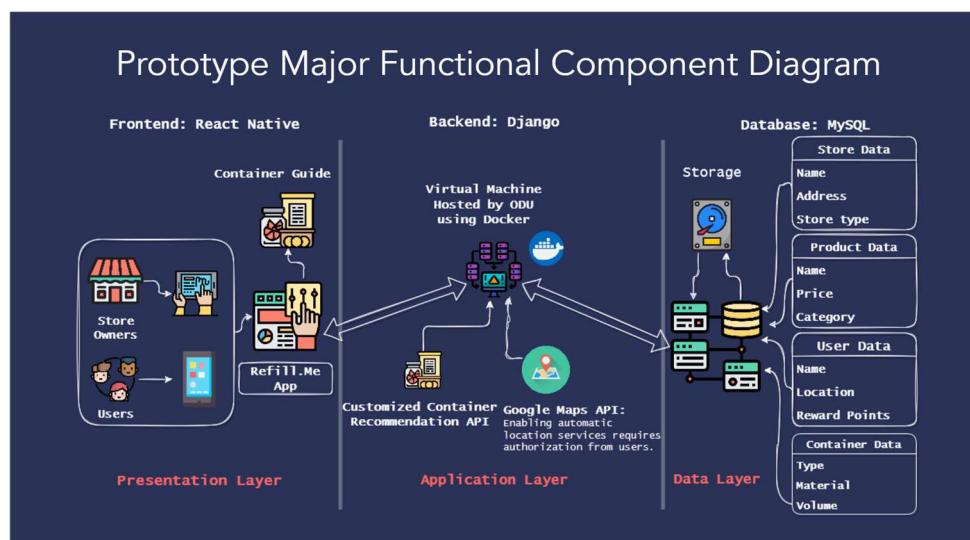


Figure 2 shows the structure of the prototype. The front end will be constructed with React Native for adaptability to different platforms, and content will be served from a Django, Docker, and MySQL backend. Focusing more specifically on the backend, the application layer will exist on a Docker container hosted on Old Dominion University's virtual machines. The store locator will utilize Google's Map API, and container recommendations will be made using a custom-built API. The data required for all this will reside on a MySQL data layer hosted on a virtual machine. Data will be required for stores, products, users, and containers.

## 4.2 Prototype Features and Capabilities

The capabilities and features of the Refill.Me prototype will differ from the fully featured product. Key innovative features like the container guide, petition hub, and more will be fully implemented, while features regarding coupons and rewards may not. Table 2 fully outlines the features and capabilities the team expects to complete in the prototype.

**Table 2**  
*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	

### **4.3 Prototype Development Challenges**

The development team anticipates various challenges with development, including a short development time frame and a steep learning curve. These challenges have been planned for by strategizing to execute innovative, core product features first, ensuring delivery of an impactful prototype by the deadline. The team has also organized subcommittees that will target development on each of the different architectural tiers of the prototype. Doing so allows the team to specialize knowledge, which should shrink the learning curve and increase the quality of the results.

## 5. Glossary

**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:**

**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 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 based on the items added to the shopping 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:** a 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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