Lab 2 – Refill.Me: Package-Free-Shopper Product Description

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Introduction

Grocery shopping is merged with the packaging, which is hard to separate. Is it shopping for food or the shiny, crinkled, colorful packaging material? Packaging is everywhere, from bulk items to single or loose items: plastic stickers to a wire that attaches the product with its description tag as an example of a pineapple. According to the article "The Environmental Impact of Food Packaging", "almost all food…, especially processed food, comes packaged" (EPA, 2018).

According to Shen, microplastics and nano plastics damage the ecosystem "evidence has emerged that microplastics not only … in the environment, but … in … our bodies." Furthermore, the packaging leads to the chemicals leak to the food supply (Groh, 2019) such as Forever' chemicals that comes from nonstick cookware and food packaging.

The FDA set the rules, but the guidelines haven't been reviewed lately. As a result, EPA resources the USA accounts for 28.1% of global trash waste generated in 2018. (EPA, 2022). The United States, apart from other countries, does not emphasize the mounting trash as a problem due to its vast land and water resources. As a result, "In …2016, the Washington Post published an article…, by 2050, there will be more plastic than fish in the world's oceans" (VanRemoortel, 2018). Recycling could be a partial solution for the problem; however, it is not a match to entire problem (EPA, 2022a) as recycling is only used a limited number of times depending on the material (Sinai, 2017). Many started to realize that the packaging is overused.

While big stores rely heavily on digital marketing, smaller or 'specialty' stores rely on word of mouth for clientele, as many cannot publish their store information online. Consequently, this prevents customers from the ability to search for products online for the type of products the store carries. On the other hand, while big retail businesses continue to rely on

what worked before strategies, other entities such as LIDL and ALDI began to alter shopping options by providing loose products without introducing excessive package materials. However, even in that case, customers get disappointed when faced with an ‘out-of-stock’ item or when the price is inaccurate from the weekly advertisement. Consequently, published, and digital advertising might work for some, but it is not as accurate as it would like to be.

1.1 Purpose

Refill.Me is a mobile/tablet web application designed to provide ‘directness’ to people who are on the lookout for alternative ways of shopping—such as package-free, or bulk shopping. Refill.Me is an environmentally friendly shopper platform that brings shoppers and vendors closer, connecting stores and farmers' markets with eco-conscious clientele and shoppers interested in package-free shopping. The app is a network for people with similar interest as customers. It is a hub that provides up-to-date information on package-free goods in the local material where the users reside. The app attracts novice and experienced shoppers with a new, more organized method of shopping that will alleviate numerous frustrations that customers currently experience: transparency on availability, price, and container' choice.

The app removes the frustration and ambiguity for unit prices and container recommendations that without Refill.Me would be very challenging. The Refill.Me application is a bridge that connects the shoppers and the store owners together by providing the needed guidance. For store owners’ app acts as a ‘word of mouth’ to potential clientele, especially those who do not provide GPS location information to agencies as Google.

Refill.Me focuses on reducing the number of questions the shopper might have when planning a package-free shopping. With one click of the button, the user of the app gets answers to numerous questions: where to go for package-free goods, store hours, are the items are

available today, what are the unit prices, what is needed to bring to the store, was everything purchased as planned or something is missing. Refill.Me eliminate most of the chaotic experience with the endless hours of package-free shopping and providing preparations by connecting the stores with the shoppers and even providing an option to create a shopping list. Lastly, the app offers shoppers a customizable recommendation container guide based on the shopping list to alleviate unnecessary container-related worries. To keep shoppers engaged in the app, Reward.Me option in the app collects points that can be converted to customer discounts and rewards.

The app is benefits not only customers but also provides transparency to supermarkets, and store owners, the application assists with providing the analysis on what items were more desirable for package-free options as well as the ability to track seasonal demands changes such as religious and holiday' shopping. Based on the provided analysis the store owners could adjust the inventory of the items. For vendors there is an option to access Refill.Me on a tablet with the bigger screen to provide more user-friendly experience.

Refill.Me is an app for anyone, from the DoorDash to BlueApron service. Refill.Me provides an open-door access when an ingredient is needed on the fly. The app is first-of-its-kind that assist and benefits daily package-free shopping experience by connecting customers to stand alone stores, to mega supermarkets to farmers markets. "Everybody can strive for zero waste" (Hoover, 2022).

1.2 Scope

The implementation for Refill.me will start with the development of a prototype. The prototype will allow shoppers and eventually store owners to register and to login to their accounts. Again just for emphasis, the prototype will not cover features for store owners. At the

same time, the application will verify the validity of the address and email address before the account is created – in progress. The standard password standards will be in place to validate that the user used one capital, one lowercase, one number, and one unique character to meet the minimum number of digits – for the prototype; no verification will be implemented. The prototype will have the following screens: Register, Login, Welcome/Home (used interchangeably from one file to the next), Store Search (without the google map), Product Search, Container Guide, Advocacy and Petition sites, Container Recommendation screens will be partial to fully implemented for the prototype. Shoppers can search the store and find products that will allow them to add to their shopping list with the customizable container recommendation algorithm. Store search will use the location using Google map fully integrated script to display up to 5 stores for any location to restrict users from scrolling up and down (if applicable). Algorithms are used for register/login, container recommendations, search stores, product (search by icon and search by product) search screens. The detail information is coming in the next few sections.

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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.

Environmental Protection Agency (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: emissions of 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 familiarity with 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

The rest of the paper includes specifications on the major components, capabilities and constraints, hardware and software performances, external interfaces, architectural requirements, and functionalities of Refill.Me.

2. General Description

The Refill.Me protype will be a mobile / tablet application designed for mobile and tablet. The prototype will include all the major functionalities for the shopper account on mobile devices only. If the time will allow the analytical aspect will be taken into consideration for the prototype. The prototype will be different from the actual application as not all the functionalities and database records included. Some simulated/imitated data will be used instead of the actual data.

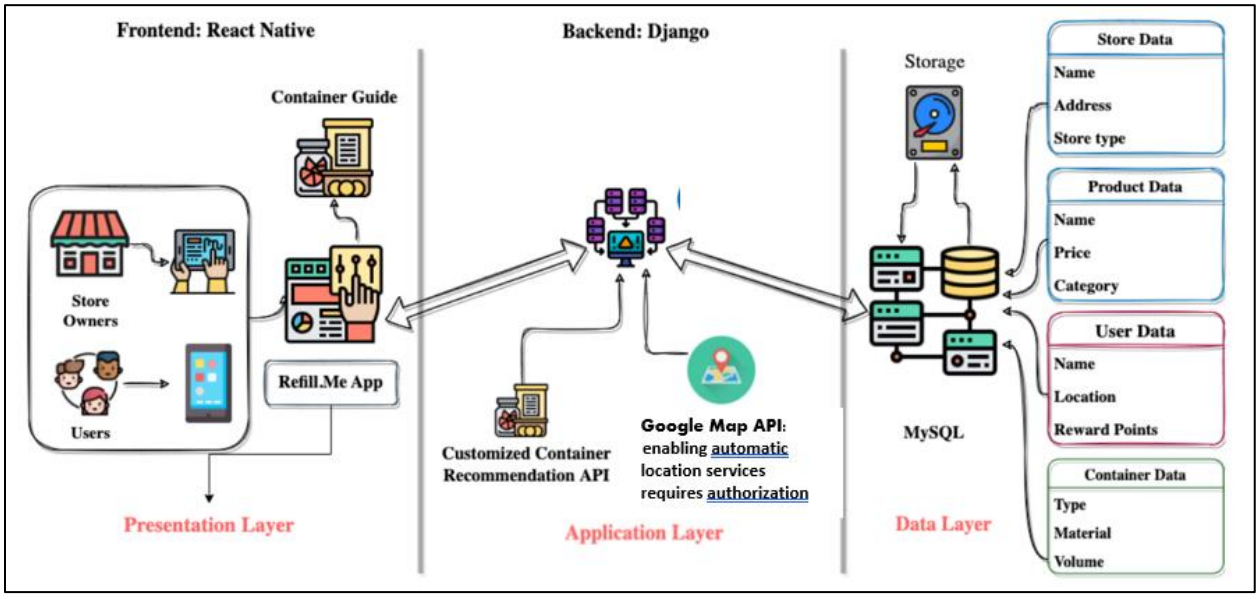
2.1 Prototype Architecture Description

Refill.Me requires an Android or iOS smartphone for use. Smartphones will be encouraged for shopper usage, and tablet usage for the store owners. The major Prototype Major Functional Component Diagram (PMFCD) presented in Figure 1 is set in three-tier architectural system layers: Presentation Layer (front-end or GUI), application layer (the integrations, “logical”, linked to APIs components), and Data Layer (back-end and DB access). The Google map which was initially planned to use converted to retrieval data page. The data is stored in a MySQL database which resided on ODU web-server. Communication actions are performed through messaging and APIs. React Native with Expo node-module framework and javacode language is used to develop Front End. The application layer holds the ‘logic’ of the application, all the API calls. Some of the APIs are partially implemented as on example: Login, Google

map, Registration; others are fully developers: Product Search, Shopping List. The application is developed using Python language using Django. Git is used for version control and Git Issues is used for issue tracking and team' development progress tracking. Team used MySQL database hosted on ODU Linux server. Initially the database was 100% remote, but later the database team' members set the scheduler for the data dump to have an ability to build the database locally without using Docker.

Figure 1

Refill.Me Prototype Major Functional Component Diagram



MFCD Presents its own challenges: a user interface where users interact with Refill.Me application. The logical tier is where the brain of the application resides, as it houses the design and algorithms: customizable container recommendation API, some Google Map API. Lastly, the data tier, where the data associated with the application is stored and managed using a relational MySQL database. The reasoning behind going with a three-tier architecture is scalability concerns. If the data infrastructure needs to be upgraded, then the logic tier and users

interface will not be affected. The presentation layer includes the user interface of the app which is designed to operate on both mobile and web to accommodate shopper needs respectively.

2.2 Prototype Functional Description

The purpose of Refill.Me is to provide a platform through which guests, registered shoppers and store owners could assist package-free shopping. The Refill.Me product prototype is demonstrating the key features and functionality of the Refill.Me as summarized for shoppers in Table 1 and for store owners in Table 2. All feature indicated by 'fully implemented' are going to be presented during the demonstrated in the Prototype Demo. The differences between the prototype and the real-world product are the prototype is presented in simulated environment with an occasion of a fake or static dataset. The development is performed in Visual Studio Code; the database used MySQL which is stored remotely on university' Linux server.

Table 1

Refill.Me Features and Prototype Implementation

Features	Description	Prototype Implementation
Account Creation	Users can create accounts to utilize Refill.Me's features	Fully Implemented (algorithm partial)
Store Search	Users can search for stores near their location	Fully Implemented (map is not implemented)
Container Guide	Shoppers can find information about container types	Fully Implemented
Container Recommendation	Shoppers can receive container recommendations for their shopping list	Partially Implemented (not the weight amount)
Shopping List	Shoppers can add desired products to a shopping list	Fully Implemented
Advocacy & Petition sites	Shoppers are connected with advocacy and petition sites if there are no stores near them	Fully Implemented

Product and Price Dashboard	Store owners can update products and prices in their stores	Fully Implemented
Reward Point Conversion Dashboard	Store owners can add rewards for their customers to redeem	Fully Implemented
Store Rating Dashboard	Store owners can view their store rating	Partially implemented, ratings will be simulated
Search Information Dashboard	Store owners can view what their customers searched for	Partially implemented, search information will be simulated
Product Search		
Search by Icon	Users can search for products by clicking on an icon image representing the desired product	Partially Implemented, icons will not be implemented for every kind of product
Enter product's name	Users can search for products by typing in the product's name	Fully Implemented
Reward.Me		
Collect reward points	Shoppers can collect reward points for completing package-free shopping	Partially Implemented (algorithm)
Receive coupons	Shoppers can redeem reward points for coupons	Partially Implemented
	Potential for Crowdsourcing	
Lemme.Know	Shoppers can suggest edits or corrections for products and prices.	Partially Implemented
Store Rating	Shoppers can rate stores based on their services and give feedback.	Partially implemented, shoppers can only give a numeric rating

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Almost all of the functionalities planned to Refill.Me will be fully or partially implemented in the prototype. Account creating will be fully implemented as a feature in the prototype; when the user creates an account, the account information will be entered into MySQL database.

2.2 Key Product Features and Capabilities

Refill.Me is a mobile application available on Android and iOS smartphones as well as tablets or computers. User interaction with Refill.Me is performed through GUI (Graphical User Interface) on the user's smartphone for the majority of the content: user profile, map display and the option for search, customized container recommendation list, container guide, information about the stores, available product information. Refill.Me includes the ability to integrate to a larger screen for an extra features that are available to the vendors.

The app allows the user to select the items sold in their areas by comparing the unit price and adding the desired item to the shopping list. The list then automatically adjusts with the container recommendation for the specific item in mind—a Reward.Me reward system created to keep shoppers' enthusiasm going for package-free shopping and, in return, rewards them with the points that shoppers accumulate by uploading the receipts and that could be converted into discounts or certain benefits depending on the store. To clarify, Refill.Me has two container guides: one is static – basic information on containers as specific for the item assistance and another one is dynamically populated depending on the item selection.

Regardless of if the user connection to Refill.Me using their phone or tablet, the app supports four roles: administrators, package-free shoppers (later shoppers), store owners or employees (later store owners), and guests. The assumption is that shoppers are more susceptible to mobile app access than the tablet. The roles on the app allow overlap so the same user can

have a store owner and the shopper accounts but not at the same time; consequently, two accounts for the same user.

Reward.Me allows users to create user profile when signing up in the application. Profile information includes name, email, creates password, enters date of birth to validate that the user is older than eighteen years old, address is entered through the GUI. For the store' owners an extra level of details is needed: store information, address, contact information, hours of operations. For guest/public user no account creation is needed. User verification is performed by the user. Upon login an email and a password required to authenticate the user. Regardless of the user access, the session is timed out after 20 minutes of inactivity if left open. Upon first login to the app, a message will appear to enable the Location for an accurate store search.

Shoppers have a vast access on the app: such as 'Store Search' with three options for search, 'Product Search' with three options for search, 'Shopping List', and 'Profile' with Reward.Me feature. Some features might not be available during the presentation session. A search will only work accurately if Location is enabled. When turned on, it will provide a detailed listing of nearby stores: supermarkets with bulk sections and farmers markets locations. The results for search for stores are limited to five stores due to mobile display limitations.

The home tab has quick navigation to speed up the familiarization time so shoppers will start using the app sooner. The profile provides the user with the option to update profile information; preview shopping lists history, and store list history, as well as keep track of the accumulated points and rewards. Note: the points do not expire on the app, but discounts do; thus, shoppers need to be cautious on when to transfer points into discounts. The 'Reward.Me' will require shoppers to scan their receipts, and it will scan and assign a preselected number of

points for each receipt that shoppers upload. ‘Reward.Me’ feature is unavailable to guests, store owners, and farmers markets.

The web or table version will have an additional feature that is hidden from shoppers; it has ‘products & prices’, ‘reward point conversion,’ ‘coupons,’ and ‘store analytics’ features. In ‘products & prices,’ store owners/farmers markets could update/delete their inventory records of the items they carry and are available for package-free shopping. Only ‘product and prices’ will be displaying during the prototype demo. The ‘reward point conversion’ allows farmers markets, store owners, and the maintenance team to set/update parameters on how the points are converted to discounts. Again, the points that shoppers accumulate have no expiration date, but the discount has an expiration date. All roles except for guests and shoppers will have access to personal ‘store ratings’ where they can review and track the rating for the store. In ‘store analytics’, store owners can generate data for desired store/inventory analyses –for example, based on search product searches found the item that the shoppers was searching for, product availability in the store. Store owners can contact administrative staff for a specific report, but it will require admin assistance.

Features that team is expecting to release in the next year, the milestone-release crowdsourcing information, would keep shoppers motivated with the app, from store’ ratings to advertisements of hot items is also with assist with shopper’ networking. For shopper input and support, Refill.Me is going to have Reward.Me options, where shoppers could upload their receipt for points. Once a lump sum of points is accumulated, the shoppers can exchange it to a discount based on the vendor. The app is going to provide limited analytical records that would assist store owners in the long run by reducing waste more in-depth analysis can still be gathered upon request using the Support/Contact Us page.

2.3 External Interface

The Refill.Me prototype will rely on specific hardware, software. Hardware interfaces include requirements regarding operating systems; the software interfaces will be used to develop the functionalities of the user interface. The software will act as a communication link between the database and the frontends for the prototype.