Lab 1 – Refill.Me Description

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12/12/2022

Version 1

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1   Introduction

Every year in the United States, packaging such as glass, paper, aluminum, and plastic produces an enormous amount of packaging waste. In 2018, packaging waste amounted to an astonishing 82.2 million tons, accounting for 28.1 percent of all waste generation that year (EPA, March 2022). The main problem with packaging is that it causes pollution and directly contributes to climate change. Producing plastic and aluminum releases a huge amount of greenhouse gases into the atmosphere. Non-renewable resources are also necessary to make these materials (Shen et al., 2020). For example, creating plastic requires fossil fuels, while making aluminum requires bauxite. (*The Environmental Impact of Food Packaging*, 2018). Another issue is that neither glass nor plastic biodegrades. These materials only break into smaller pieces of plastic and glass rather than eventually returning to nature's cycle (Carvalho et al., 2022). With plastic, this causes yet another issue with microplastics contaminating the environment and our food (Shen et al., 2020). Microplastics are not the only things contaminating food. Dangerous chemicals from plastic packaging are also leaking into food products (Groh et al., 2019). Due to these dangers, many think paper is a better solution to harmful packaging. However, paper packaging is also problematic because it is usually lined with plastic (*The Environmental Impact of Food Packaging*, 2018).

Recycling is increasingly becoming more popular as a way to try to mitigate the damage caused by packaging material building up in our environment. However, it is not the solution to reducing packaging waste. This is because a large amount of packaging is not recycled at all. For example, in 2018 only 9 percent of plastic, 25 percent of glass, and 68 percent of paper ended up recycled (EPA, July 2022). The numbers for paper seem more encouraging, however, a big problem with paper packaging is that it can only be recycled up to seven times (Sinai, 2017).

With more and more people becoming aware of this problem, there is a growing demand for reusable, compostable, and edible goods. Single-use plastics increasingly face bans in favor of reusable alternatives with every year, and the market for better types of packaging is on track to double by 2030 (*Zero Waste Packaging Market Size, Share, Report 2022-2030*). Alongside this trend, up to 80 percent of Generation Z, Millennials, Generation X, and Boomers are very concerned about packaging waste (Denis, 2021). Within this growing movement exists a market for package-free shopping, where shoppers bring their own containers to store products that they buy in order to reduce packaging waste.

These shoppers are concerned about the amount of packaging waste generated by mainstream grocery shopping and how it damages the ecosystem. They face obstacles such as difficulty searching for package-free stores or loose products in their area, and lack of information regarding the kinds of containers necessary for shopping package-free. Even when they do find package-free offerings, the information is often incomplete, such as no clear unit prices for products. Unfortunately, existing apps and websites about package free options are not up to date and have insufficient features for searching.

The solution to these issues is the application Refill.Me. Designed to fill the void in the market for package-free options, it makes package-free shopping more available to more shoppers. Searching for package-free stores and products will be easier than ever. Unit prices for loose products will also be available so that there are no surprises regarding total prices. Refill.Me will also feature information about the necessary containers for package-free shopping. The shopping list feature will give convenient container recommendations as well. Points will also be awarded to shoppers based on completed package-free purchases, which can be redeemed

for benefits such as coupons and discounts. These features will provide a useful information hub

for both novice and experienced package-free shoppers.

2   Product Description

Refill.Me will be a mobile application designed to make package-free shopping more

accessible for eco-conscious shoppers. With Refill.Me, package-free shoppers will be able to

connect with package-free stores near them. It will also aid novice package-free shoppers

transition to package-free shopping, all while helping experienced package-free shoppers keep

up their shopping habits. This will enable shoppers to support local businesses and reduce their

packaging waste. Refill.Me will also provide practical information about package-free shopping,

and present a useful platform for shoppers and store owners. It will also help store owners collect

data from searches in order to provide better offerings for their customers. These goals and

objectives will help keep shoppers engaged and motivated by allowing them to rate stores and

provide feedback, and collect reward points for benefits.

2.1   Key Product Features and Capabilities

Refill.Me provides many features for registered shoppers, such as searching for package-

free stores. This will produce a list of all package free stores in the shopper's area. The shoppers

can use this feature in two ways, either by entering in their zip code, or by enabling location

services on their phone. They will also be able to search for loose products in three ways. They

can search through icons and click on the one representing the product that they want to buy,

such as nuts. Shoppers can also scan an item's barcode to find package-free alternatives near

them. The last option is to type in the product's name in the search bar. These search features

allow shoppers to find package-free stores and loose products easily, and it includes unit prices

so that shoppers know exactly what their total will amount to. The Container Guide provides

knowledge to novice package-free shoppers about containers such as jars, tote bags, produce

bags, or other container types that are necessary. Shoppers will be able to create a shopping list

of all the loose products they want to buy, after which the Container Recommendation feature

will provide customized container recommendations based on the items in the list so that

shoppers will know exactly what containers they need to bring. Then, the reward system, called

Reward.Me, will award points to shoppers who complete package-free purchases. They can

redeem these points for coupons or discounts offered by the stores partnered with Refill.Me.

Refill.Me also provides useful features for store owners. The Product and Price

dashboard allows store owners to add or remove products from their listings, and update unit

prices as well. Stores can also check that the information they entered displays correctly by

searching for products. Store owners can search for products in the same manner of ways that

shoppers can, by icon, scanning a barcode, or searching by name. Similarly, owners have access

to the store search feature as well to ensure that their store information is correct. The Reward

Point Conversion dashboard allows store owners to add or remove awards that shoppers can

redeem their points for. For example, owners can specify that 100 points can be redeemed for a

10% off coupon. The Coupon dashboard shows the owner what coupons have been used by their

customers. Store Analytics provides useful information such as products that shoppers are

searching for and whether they were able to find it in the owner's store. Store Owners also have

access to their Store Rating, where they can read feedback from users and see how their

customers rate their services.

All of Refill.Me's features solve many of the current issues surrounding package-free

shopping. The search features make finding package-free stores and loose products with unit

prices much easier than before. Unit prices are included in the product search so that no one is surprised at the total price. The Container Guide and the Container Recommendation features ensure that shoppers are familiar with the containers necessary for package-free shopping and will know what needs to be brought with them when they shop. Store owners will be able to attract more shoppers because knowledge of their stores and how to shop package-free is more accessible with Refill.Me.

2.2 Major Components (Hardware/Software)

Refill.Me's structure is three-tiered, as shown in Figure 1 below. These tiers are the presentation layer, the application layer, and the data layer.

Figure 1

Refill.Me Major Functional Component Diagram
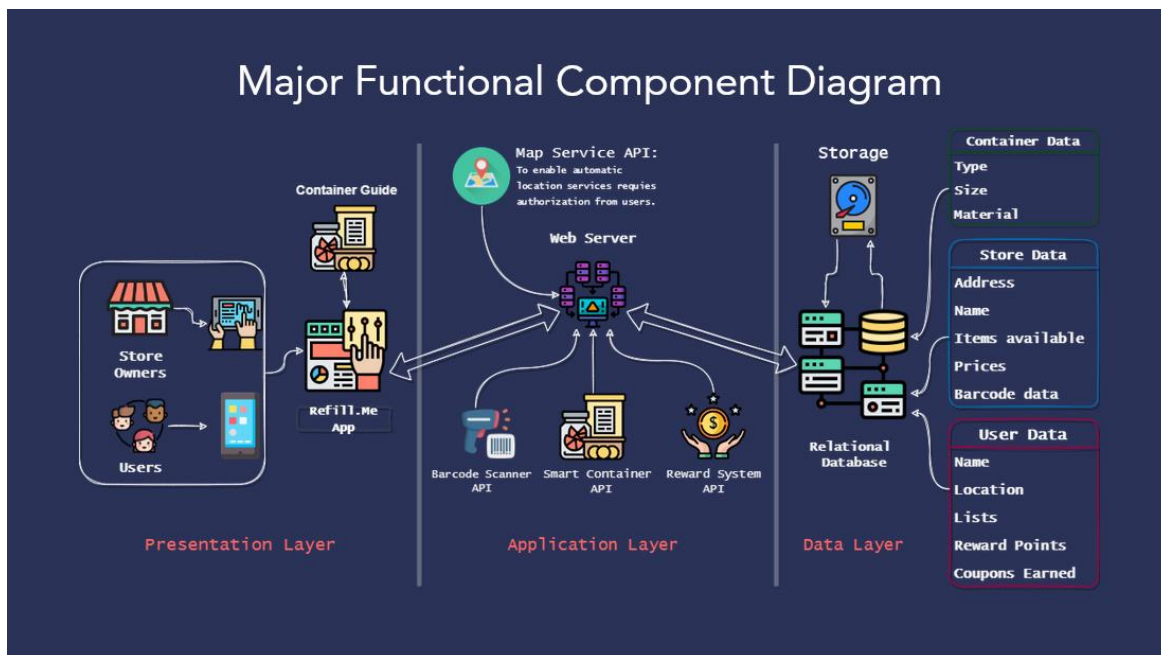
The presentation layer is where users will interact with the application. For this, Refill.Me will be optimized for different hardware depending on the type of user. For store

owners, Refill.Me will be optimized for tablets so that owners will have access to larger screens

while maintaining portability. For shoppers, Refill.Me will be optimized for smartphones. The

application layer will handle the web server as well as algorithms such as barcoding scanning

and container recommendations. This layer will also handle API integration as well as linking

APIs with the database. Lastly, the data layer will manage all of the data associated with

Refill.Me in a relational database. This will include tables for stores, products, users, and

rewards, while also including tables for data analytics such as the kinds of products that shoppers

are searching for.

The design of Refill.Me will be utilizing many software applications for the front end,

back end, and testing purposes. For the front end, the React Native and Expo framework will be

used with the languages CSS, HTML and JS. The back end will be using MySQL for the

database, alongside AWS data management services. For testing, the Jest framework and Gitlab

CI/CD tools will be used. To provide many of the services Refill.Me promises, third-party

software will be utilized and integrated, such as Amazon Maps and other APIs. Executing the

project will also require third-party software. For example, Trello will be used for project

management while the code repository will be handled through Gitlab, and Zoom and Discord

will provide the grounds for group collaboration. Visual Studio Code will be the IDE of choice

and Gitlab CI/CD will be used for continuous integration.

3   Identification of Case Study

Refill.Me is designed with eco-conscious shoppers in mind. These shoppers tend to be

predominantly women who are very passionate and invested in climate change and mitigating

the damage associated with it (Hoover, 2022). They come in wide variety of ages, from eighteen

to sixty-five, and live mainly on the east or west coasts of the US. They also have diverse

economic backgrounds, from low to high income levels, and are usually very educated (Kim, 2018). Refill.Me is also designed to benefit store owners who have stores offering loose products, such as supermarkets with bulk sections, package-free stores, and farmer's markets.

A small group of package-free shoppers and package-free store owners will act as the case study. The search features, container features, shopping list, and Reward.Me all benefit shoppers' efforts to shop package-free. These enthusiastic shoppers will be a valuable source for feedback about the usefulness of Refill.Me's features. Store owners will be another important source for feedback. These owners that are part of the study will be able to communicate their products and prices to their customers, allowing them to increase their digital presence. They will also be able to access data about the products their customers are searching for, which provides useful feedback about the popularity of certain items.

In the future, Refill.Me could be used like a regular grocery shopping app. The reason that shoppers can not buy online with Refill.Me is that there would be no way to store those products for the shopper to pick up, since they need to bring their own containers. For shoppers to be able to buy through the app, trucks would need to be able to deliver the products straight to their door, where the shopper would be waiting with their containers. For now, there is not enough demand to warrant these trucks. However, this movement is growing and could become big enough to compete with mainstream grocery shopping enough to demand this kind of service.

4   Product Prototype Description

4.1   Prototype Architecture (Hardware/Software)

4.2   Prototype Features and Capabilities

4.3   Prototype Development Challenges

5   Glossary

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

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

Compostable: breaks down into organic matter and does not produce any chemicals during that process

Container: tote bags, produce bags, glass or plastic jars, glass or plastic boxes, glass or plastic bottles 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.

Experienced package-free shopper: a shopper who has experience, and thus, knowledge of package-free shopping

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

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

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, not considering environmental aspects

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

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

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

Package-free store (in the context of our application): supermarkets with a bulk section, stores exclusively selling loose products, and vendors 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

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

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

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

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

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