Lab 1 – Refill.Me – Product Description

Refill.Me - Team Iron

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1. Introduction

Packaging is all around us and it causes very serious environmental and health problems. The huge amount of packaging waste generated every year as a result of mainstream grocery shopping, and the inefficient recycling system that we currently have are the main culprits of the omnipresent packaging waste problem that is damaging our ecosystems, and our health too. Many are unaware of these issues; however, a growing number of people have realized the importance of cutting back on packaging waste. They are motivated to take actions, and to help the environment, however the lack of available information about package-free shopping, package-free stores, and loose products deters many from switching to this low-waste lifestyle. These shoppers are struggling to find ways to reduce their packaging waste, and at the same time are frustrated by the unnecessary, wasteful packaging that surrounds us. A central hub where information related to package-free shopping is easily accessible, accurate, and up-to-date is missing from the life of novice and experienced package-free shoppers. The mobile phone application, Refill.Me would like to fill this void, and to connect stores that have a bulk section with shoppers who are interested in package-free shopping.

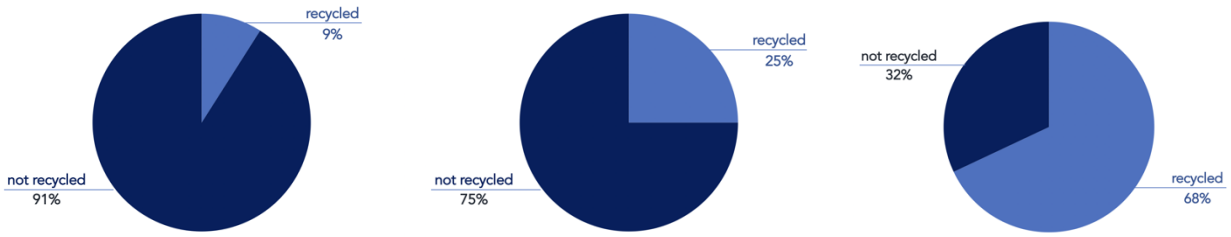
The environmental problems regarding packaging waste are not unique to plastic, even though, it is in fact one of the most problematic packaging materials. During the production of plastic and aluminum packaging, a huge amount of greenhouse gases is released, which directly contributes to global warming (Shen, 2020). Furthermore, microplastics are an enormous problem for our oceans, soil, and increasingly, for our health (Shen, 2020). Also, for the production of plastic, fossil fuel is needed, and for aluminum, bauxite is necessary. These are all nonrenewable resources. Moreover, glass and plastic do not biodegrade, thus, instead of

becoming part of our environment, they just break down into smaller and smaller pieces, further polluting our waters, air, and soil (Carvalho, 2022). Many believe that paper is a great packaging alternative, but this is only partially true, because paper can only be recycled seven times (Sinai, 2017). Lastly, many studies have proven that harmful chemicals leak from plastic, especially when it gets in contact with food (Groh, 2019). To make things worse, many types of paper packaging are lined with a thin layer of plastic in order to prevent liquids from seeping through it (*The Environmental Impact of Food Packaging*, 2018). Thus, while many people believe that they do something good to the environment by choosing paper packaging, unfortunately, in reality, they often get in contact with unwanted plastic packaging.

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 every year. In the USA alone, in 2018, packaging waste added up to 82.2 million tons of waste (EPA, *Containers and packaging: Product-Specific Data*, 2018). This is a staggering amount, especially if we consider that most packaging materials weigh only a few ounces. Also, the 82.2 million tons of packaging waste was 28.1% of the total waste generation, which is almost one third of it (EPA, *Containers and packaging: Product-Specific Data*, 2022). These numbers make approximately 80% of Generation Boomers, Generation X, Millennials, and Generation Z concerned about packaging waste (Denis, 2021). As Figure 1 shows, a huge percentage of plastic and glass is not being recycled. In case of plastic, it is a shocking 91%, while with regard to glass, it is 75% (EPA, *National Overview: Facts and Figures on Materials, Wastes and Recycling*, 2022). The recycling rate of paper is quite high, it is 68%, however, paper can only be recycled a limited number of times (EPA, *National Overview: Facts and Figures on Materials, Wastes and Recycling*, 2022).

Figure 1

Recycling rates in the United States in 2018 (as a percentage of generation)



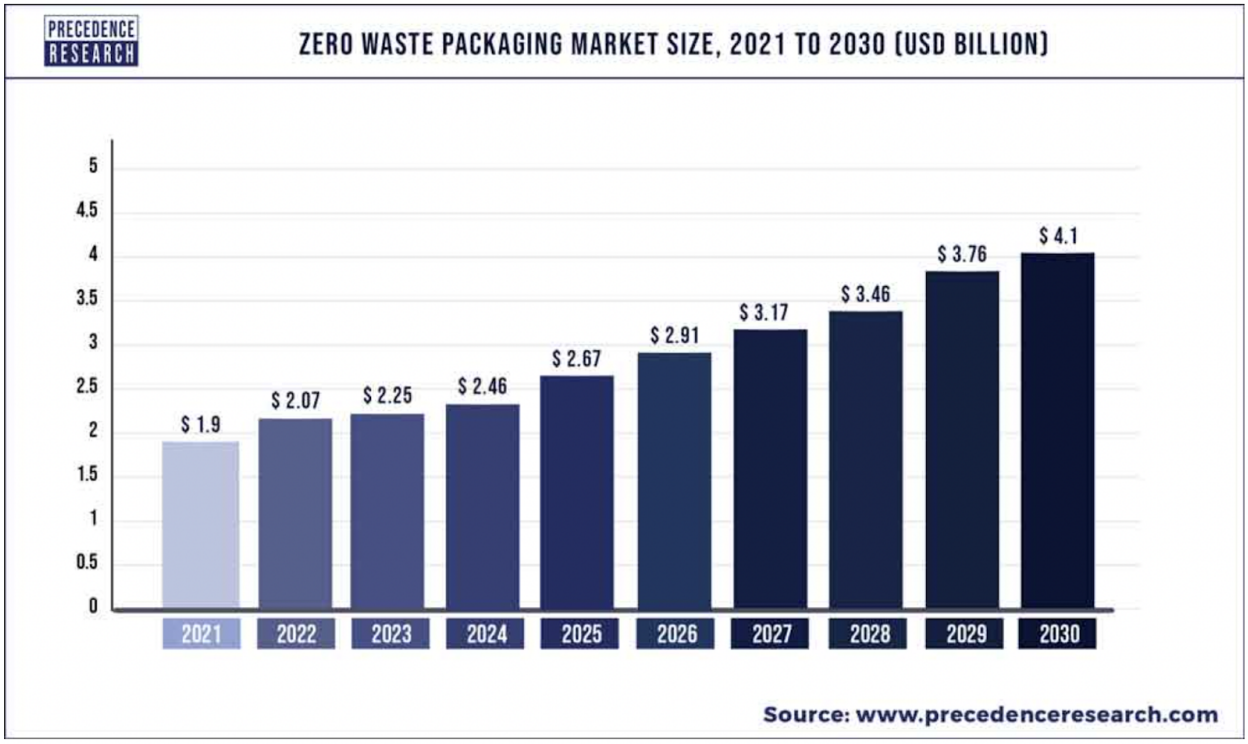
Plastic Glass Paper

The growing concern regarding packaging waste and the manufacturing process of different kinds of packaging materials, have prompted more and more people to express their worries. Some sign petitions, or join peaceful protests, while others take desperate measures to raise awareness about this problem. As a result, several countries have created a strict regulatory environment, and banned single-use plastic items like plastic shopping bags or takeout containers. Moreover, as Figure 2 shows, there is a growing demand for reusable, compostable, or edible alternatives. From 2021 to 2030, the market of these kinds of packaging materials is expected to double. However, even in the light of all this, many believe that these changes are not helpful enough to tackle this immense problem, and they want to opt out of packaging, altogether.

As part of their efforts towards a more eco-conscious lifestyle, a small fraction of the population started to do package-free shopping, which is all about doing grocery shopping with the least amount of packaging possible, mostly by using one's own bags and containers. Thus, package-free shopping promotes sustainable consumption, with a great emphasis on reusability

Figure 2

Zero Waste Packaging Market Size, 2021 to 2030 (USD Billion)



instead of recycling because the latter often gives people the false impression that if something is recyclable, then it is acceptable to discard it. However, with regard to the current recycling rates this is not true. By encouraging people to bring their own containers, package-free shopping pushes for refilling, and reusing bags, jars, boxes, glasses, or any other type of containers. This waste-reduction practice allows eco-friendly shoppers to significantly decrease their environmental footprint.

2. Refill.Me Product Description

Refill.Me is a mobile phone application that has a mobile phone view optimized for shoppers. Scanning the barcode of products for which shoppers would like to find package-free alternatives, taking and then uploading the photos of receipts in order to collect reward points, and the efficient use of the shopping list are the easiest when the app is used on a mobile phone. For store owners, the app is customized for tablet usage, since they are often on-the-go, but still need to manage their business while traveling or simply being away from the store. This can be conveniently done on a tablet using the different views and the tables that Refill.Me provides.

The main goal of Refill.Me is to connect package-free shoppers with package-free stores, and to provide them with information about the practicalities of package-free shopping. It aims to help novice shoppers who are about to transition into package-free shopping, and also to experienced package-free shoppers who would like to maintain their shopping habits. Refill.Me's mission is to support local businesses, and help build communities, while reducing packaging waste.

2.1. Key Product Features and Capabilities

One of the primary features for shoppers is the store search. To use this, shoppers either need to enable location services, or provide a ZIP code so that the app can suggest nearby stores. If there are any supermarkets with a bulk section, package-free stores, or farmers' markets nearby, they will be shown on the map. By clicking on a store, users can get more information, like opening hours, link to the store's website, etc. The second most important feature is the product search that can happen in three different ways. First, the search by icons option lists products represented by icons that are available package-free. Second, shoppers will also be able

to scan a product's barcode for which they would like to find a package-free alternative. Lastly, users can also enter a product's name, and then search. These three options will give shoppers a thorough product listings with unit prices so that they will be able to make an informed decision. Information regarding the containers that can be used for package-free shopping is also not easy to come by. To remedy this, one of the main innovations of Refill.Me is to provide information about containers in the form of a simple listing, the Container Guide, and to give container recommendations for every product, and also based on the user's shopping list, for a specific grocery shopping that the shopper would like to do. With the reward program called Reward.Me shoppers can collect points and enjoy discounts or other benefits offered by the stores.

The most important feature for store owners is the Product and Price dashboard, where they can add, edit, delete, sort, or filter products. The Reward Point Conversion dashboard is essential in communicating to the shoppers the amount of reward points needed for getting certain discounts or benefits. The Coupon dashboard helps to create and manage coupons that are provided to the shoppers in exchange to reward points. The Store Rating dashboard gives a good overview of ratings that were submitted by shoppers, and an opportunity to store owners to answer any questions or concerns that were addressed. Store owners will also have access to Store search and Product search so that they can validate whether the modifications they made will be displayed to the shoppers the way they wanted to.

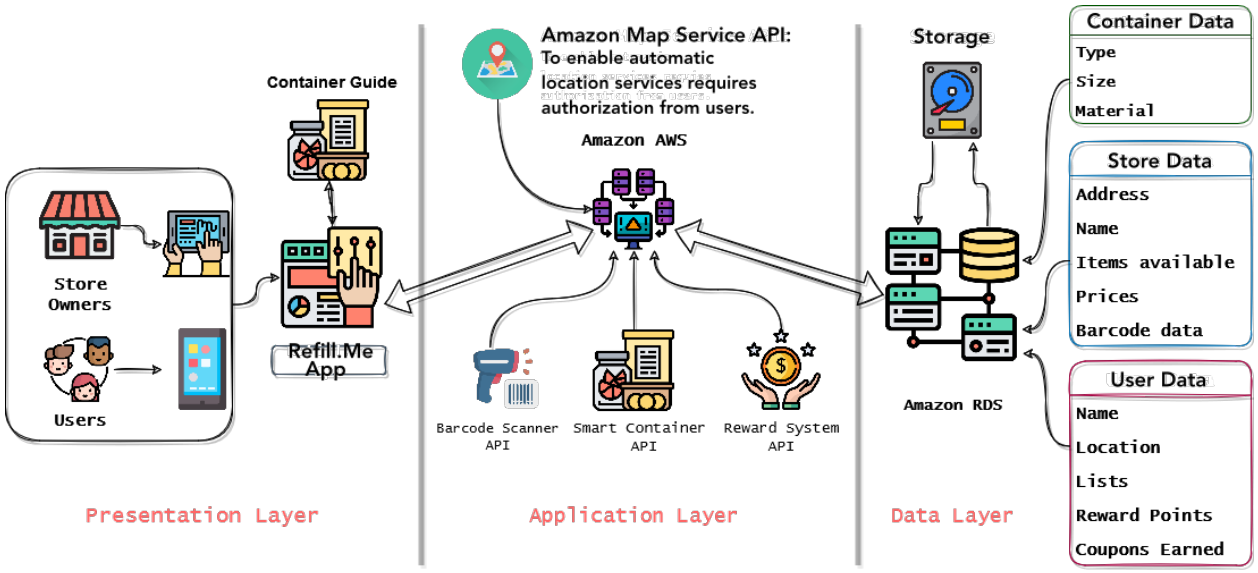
2.2. Major Components (Hardware/Software)

Refill.Me uses a three-tier architecture to organize the application into logical and physical computing tiers. Figure 3 illustrates the major functional component diagram of Refill.Me. There are three layers: the presentation layer, the application layer, and the data layer.

The application layer is all about the user interface that will be optimized for mobile phones for the shoppers, and for tablets for the store owners – both for Android and iOS. The data flow is from the store owners who will provide the product and price, the reward point conversion, and coupon information to the users who can access it via Refill.Me.

Figure 3

Refill.Me Major Functional Component Diagram



The brain of the application, the web server, and the APIs reside in the application layer. It will enable the integration of various APIs. For mapping Amazon Maps API is used, for barcode scanning the Barcode Detection API, and for receipt uploading the open-source OCR (Optical Character Recognition) API, Tessaract. Furthermore, to create and deliver coupons, the Tremendous Gift API will be integrated, while for web scraping, the open source Scrapy will be used.

The data layer is where data that is associated with the application is stored and managed using a relational database. Amazon RDS for MySQL will provide the database that can be used to store data tables related to store, product, user, and reward information. Data analysis will be performed by Amazon Kinesis Data Analytics.

The React Native and Expo framework will provide the basis for developing a cross-platform solution. An Android, iOS, and a web application will be deployed based on the program written in HTML, CSS, and JavaScript. For database programming, MySQL is used. The testing framework Jest provides the testing tools needed for our unit, integration, and system testing. The build is handled by Webpack and Node Package Manager.

The chosen IDE for development is Visual Studio Code. For version control and for continuous integration, GitLab will be used. For project management and group collaboration, Trello, Discord, and Zoom will be the main tools.

3. Identification of Case Study

Refill.Me's mobile phone version is designed for eco-conscious shoppers in the USA. This target group consists of mostly women between the ages of 18 and 65, who have diverse income levels, and are highly educated (Hoover, 2022; Kim, 2018; VanRemoortel, 2018). The user interface appeals to this market segment with a simple, easy-to-follow navigation bar, a quick menu, and a well-chosen color palette. On the other hand, the tablet version is laid out for store owners or vendors at farmer's markets who sell loose products, package-free.

The prototype case study will revolve around a Caucasian woman who is in her 30s, has a master's degree, high income, one child, and is passionate about the environment. Package-free shopping in general is targeted at consumers like the one in our case study, thus, Refill.Me has a high potential to become a major platform for these users to get practical information about

package-free shopping, to search for stores and products, or to get familiar with containers that could be used for package-free shopping. Also, these shoppers will make use of the built-in shopping list, and will be excited to collect reward points in their favorite stores to get further benefits.

Regarding package-free stores, the case study will include the store owner of a small package-free store that offers a moderate number of package-free items (approx. 100-120), and a few accessories like bags, kitchen towels, kitchen utensils, etc. Above all, they will use the app in order to communicate their products and prices to package-free shoppers, and to get search information in their area, which they can use for future planning like diversifying their store offerings.

In the future, once package-free shopping became more widespread, Refill.Me might be integrated into well-established grocery shopping apps. Currently, such an integration would not be beneficial because package-free shoppers' special needs cannot be addressed by just one or two filtering options, especially if the container features of Refill.Me are considered. Also, Refill.Me could be used by trucks selling package-free products for reporting their current location, and the products they have in stock to the users of the app.

4. Refill.Me 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.

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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