

Lab 1

Refill.Me – Team Iron

Michael Colombini

Old Dominion University

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Professor Sarah Hosni

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1. Introduction

Walk into any grocery store or supermarket and most of the products on the shelves will be in self-contained packaging systems. Packaged items usually come in the form of plastic, cardboard, cans, and glass jars. Much of these packaging sources end up in landfills and are left to decompose in the span of decades or centuries. Even products that end up in recycling centers are sometimes not eligible to be recycled or can cost astronomical amounts of money to be reused. To reduce the burden of recycling, much of the United States' recycling was sold to other countries. The current system does not begin to solve the problem of an overabundance of packing materials that end up in landfills. As of right now, Society needs the ability to conduct package free shopping that is both environmentally friendly and promotes positive consumer interaction.

The problem with packaging waste, specifically in the United States, accounts for approximately 82.2 million tons a year (EPA, 2022). "Modern food packaging is made from a variety of manufactured and synthetic materials, including ceramics, glass, metal, paper, paperboard, cardboard, wax, wood and, more and more plastics and, more and more, plastics" (FoodPrint, 2018). Much of this packing waste ends up in landfills where it sits until it decomposes, which can take hundreds of years to carry out. "Approximately 50 per cent of plastics are used for single use, such as packaging, agricultural films and disposable consumer items..." (Hopewell et al., 2009). This is not the right approach when it comes to being environmentally friendly.

Microplastics pollution is a significant problem. Most of the plastic and glass packing are not biodegradable and will just sit in the landfills for eternity or get eroded until they become microplastic or micro glass, which then end up in the oceans, the soil, and have negative impacts towards the environment (Shen et al, 2020). The best way to prevent microplastics is to "control and prevent plastics from entering the environment (Pinjing He et al., 2019). Paper packaging is no better as it can only be

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reused a max of seven times before it is no longer recyclable (Sinai, 2017). This is since paper is made up of fibers and after each reuse of these fibers, they become shorter and shorter making it effectively useless after the seventh time.

The creation of packaging materials can be a nasty business. Each type of packaging material uses resources such as “energy, water, chemicals, petroleum, minerals, wood, and fibers to produce. Its manufacture often generates air emissions including greenhouse gasses, heavy metals, and particulates, as well as wastewater and/or sludge containing toxic contaminants” (FoodPrint, 2018). For example, to make plastic, fossil fuels are used and to make aluminum, bauxite (a naturally occurring mineral) is used. There are many chemicals that are involved in creating plastic packaging that encounters food. These chemicals can include different types of polymers, additives, adhesives, and coatings (Groh et al., 2019). Many of these chemicals are recognized by the Environmental Protection Agency (EPA) and through multiple international agencies as being hazardous to human health, can accumulate in the body and can disrupt the body’s natural processes (Groh et al, 2019).

Recycling can be an answer to help alleviate the burden from packing waste. We don’t have to look far to find a recycling bin to throw our reusable packaging products into, but the issue starts after those products are tossed in. There are several reasons why there are not enough people choosing to recycle. As shown in figure 1, the current rate of recycling is not working. The rate of recycling for glass is only 25%, paper is 68% and plastic is an abysmal 9% (EPA, 2022). According to the Environmental Protection Agency, the current challenges facing recycling are that most Americans want to recycle but do not know what is recyclable and this often leads to confusion. The current recycling infrastructure has not progressed enough to keep up with the current waste stream. And the current domestic market for recycling has historically been exported internationally to other countries, but the international policies have changed to prevent this from happening (EPA, 2022).

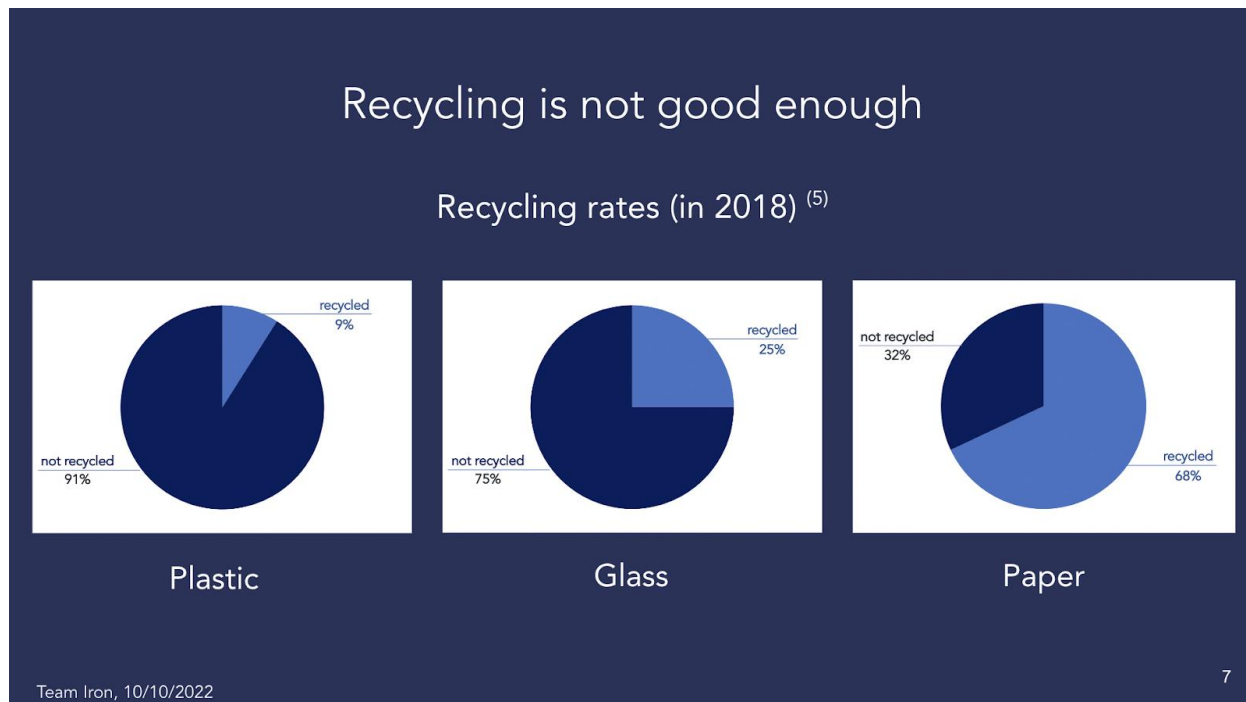


FIGURE 1

Instead of trying to convince people to recycle their packaging products, there is an emerging market for reusable, compostable, and edible goods (Hoover, 2022). Citizens around the world are demanding that their countries and states act against the packaging waste problem. This has resulted in new regulations that are shaping the market. Many countries and states are in the process or have already banned the use of single use packing materials. Along the same lines, there is a demand to replace the single use packaging with materials that are reusable, compostable, or edible alternatives. This trend is ticking upwards each year (Carvalho et al., 2022). Also, according the Consumer Brands Association, “the majority of Americans believe that the federal government should tackle plastic and packaging waste as its next “moon shot,” and “If given the option to buy products with recyclable or compostable packaging, 47% of Americans opt for recyclable products as their first choice and 20% prefer compostable products”. (Denis, 2021).

1.1. Problem Description

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Package-free shopping is a way of reducing the negative environmental impact through purchasing products that avoid unsustainable packaging materials. Currently there are some obstacles when trying to undertake package free shopping. These include lack of information about where to go and to what is available package free. There is also the issue of understanding what to bring with you to conduct package free shopping and the previously discussed issues with the current packaging waste.

Packaging waste from mainstream grocery shopping damages the ecosystem. The current process of grocery shopping involves buying products that are prepackaged in plastic or glass containers, plastic shrink wrap, in cardboard paper containers, or in metal canisters. These packages end up in landfills or are sometimes recycled. As said previously, the amount of waste produced is unsustainable and can be devastating to the environment.

There is little information on the market today that allows grocery shoppers to find package free or bulk stores that do not use packaged products. The current application market that deals with package free shopping is not robust or offers limited services. As said previously, there is a growing demand for replacing single use plastic materials with reusable, compostable, or edible alternatives. Shoppers wish to reduce their environmental footprint and make a conscious choice in fighting climate change. Shoppers also lack knowledge about where or what are package free stores. Shoppers may find it difficult to conduct package free shopping and could become discouraged. Shoppers may not know which types of containers to bring with them.

The current application market for package free shopping lacks essential information on package free shopping. There are no robust search options for finding package free stores in shoppers' areas. There is no way to search for specific package free items or figure out prices of package free items. There are many applications for regular grocery shopping, but with someone wanting to go package free or reduce the amount of waste, this is a huge issue.

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The current package free stores, bulk items stores, or farmers markets don't have the ability to reach their target audiences. They are smaller mom and pop shops that don't have robust marketing abilities to reach shoppers. These stores also may be lacking a proper point of sales system to track their current inventory levels. Finally, these types of stores could benefit from having data analytics about what their shoppers/ community wants or needs.

1.2. Solution

The Refill.Me application is the proposed solution to reducing and eliminating package waste. By supplying relevant and timely information to package free shoppers and helping shoppers to conduct package free shopping through an innovative application. Refill.Me is designed to help consumers to reduce or eliminate the amount of packaging material they buy. When shoppers use the application, they will be able to shop in local stores, know what products are available in their area, know what to bring with them to make the experience more enjoyable, and lastly supply up to date pricing information.

Our application will provide users with information on different kinds of containers to bring with them on their shopping experience. Users will also be supplied the opportunity to search for items in their area, obtain the products prices, and find nearby package free stores. Refill.Me will help novice package free shoppers ease into the process. It will enable the shoppers to learn about the different types of containers they will need to bring with them to conduct package free shopping and where these containers are available for purchase, or they may already have in their homes. Refill.Me will provide users with an intuitive user interface. Refill.Me will provide shoppers with a list feature, information on stores, hours, their location, products available, and prices. Stores will gain valuable information on consumers who shop at their stores or neighboring package free stores in the

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community. Shops will have the ability to reach out to their target audience, and to track their current inventories.

2. Key Product Features and Capabilities

The main features for the shoppers will include a robust search function of local package free stores in the user's area. It will also include a product search that will allow users to search for products by a general icon. This means that users can search for nuts by clicking on a peanut icon and will display the variety of nuts available in their area, their locations, and pricing. Refill.Me will allow users to open the Refill.Me application, click on the search by barcode button, which will open the user's camera. The user can then scan the bar code of the product they are looking at and will display other products in their area that match that item and the prices. This will help the user to make a choice on what is available to them and for the best price. Refill.Me will allow users to search for products by name. The application will display the products that relate to the searched item in the user's area and the prices.

Refill.Me will also feature a guide on containers. This is useful for novice package free shoppers who may not know what to bring with them when conducting packager free shopping. The guide will encompass the variety of containers available, the best types of containers, and where these containers can be bought. Refill.Me will also provide shoppers with the ability to create shopping lists. Based on the shopper's in-app list, Refill.Me will also provide a list of containers they will need to bring with them on their shopping trip. This will help to remove any confusion or ambiguity on the shopper's part.

Another feature that will hopefully enhance the applications repeated use is Reward.Me. Shoppers will receive reward points based on the amount of money spent on package free items at participating stores. Shoppers can then redeem the points in the form of cash back or coupons on their purchases. This system will be tracked through receipt uploading after purchases are made. The items that are considered package free will be counted and the correct amount of reward points will be issued to the user.

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The main features for the store's owners will include the ability to add products and pricing to their store on the application. Refill.Me will allow shoppers to rate package free stores based on their shopping experience, the store's cleanliness, the amount of package free items available, and the cost of the items. This in turn will help other users avoid or go to stores. It will also help store owners be aware of any potential issues and correct deficiencies. Refill.Me will be tracking data across multiple vectors to include most popular search items, the amount of people searching for items in the stores area, how many shoppers are creating lists, what are being added to lists, if the shoppers conduct package free shopping, how many of the shoppers that do shopping are also a part of the reward system, the pricing of products from others stores, the store ratings and reviews.

2.1. Major Components (Hardware/Software)

The Major Functional Component Diagram below in Figure 2 gives a high-level overview of the feature architecture and how the data will be transferred. The Refill.Me application will be available on Android, iOS, and any PC or other device with an internet connection. We expect users to be using the application while on the go and will be expecting them to shop with a smartphone or tablet. While store owners will be able to access the application through a smartphone, tablet, or a device with an internet connection. This is since store owners will be inputting data and may find it easier to complete the tasks with a keyboard.

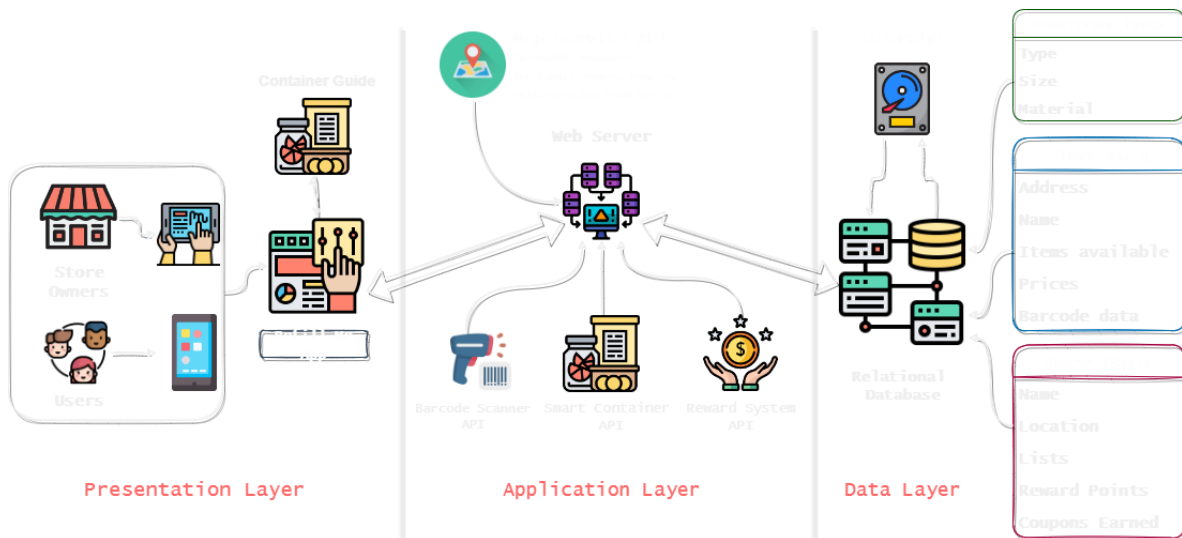


FIGURE 2

The application layer will include the web server, which will house the business logic, several Application Programming Interfaces (API), and will communicate between the user interface and the database. The server will be hosted by Amazon Web Services. The APIs that will be used are a barcode scanner, receiving scanning, rewards systems, mapping services, web scrapping, and data analytics. There are also several algorithms that will include the searching features, container recommendations, shopping lists, rewards systems, and data recordings. The data layer will be a relational database for storing the store owner's and user's data. The database will be hosted and supported by MySQL on Amazon Relational Database Services.

3. Identification of Case Study

The main users of Refill.Me are intended for eco-conscious grocery shoppers who want to reduce their packaging waste consumption. They may be novice or expert package-free shoppers, but would like a way to find new stores, to search for products in their area, or to join a group of similar like-minded shoppers. They are shoppers who want to slow down, meet up with friends, take the time to fill containers, and connect with the community. Our research indicates that eco conscious shoppers are

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mostly women (Kim, 2018). They also include age groups from Gen Z to Baby Boomers. In a 2021, Consumer Brands IPSOS poll surveyed a group of adults in the USA and found that approximately 80% of Generation Boomers, X, Millennials, and Z are concerned about packaging waste (IPSOS, 2021).

Eco conscious shoppers come from diverse income levels. A package free lifestyle does not mean it will cost more to achieve. As mentioned above, there are different generations of people that want to do something that helps the environment and combat climate change. The average income that bought ethical products was between \$50,000 and \$59,000, with a bigger jump when income hit the range of \$125,000 and above (Kim, 2018). They are also highly educated. According to Laura Kim, there is an increase in ethical consumption when there are more years spent in education (Kim, 2018). People who are more educated are more likely to be concerned about the environment and take steps to help. “Information about the negative effects of consumerism on the environment have prompted environmentally minded consumers to take matters into their own hands by changing the ways they consume (VanRemoortel, 2018).

Another user of Refill.Me includes stores that sell bulk items and packaged free products. These small business shops lack the ability to reach a larger target audience. Refill.Me will allow shops to keep track of their inventories, keep track of their competitor pricing, and gain useful data analytics of shoppers and real-time trends. Stores will be able to see what the most popular search items are and based on the current season and can better prepare their future inventories. Store owners want to connect with like-minded shoppers, but don’t have a platform that directly supports this like Refill.Me does.

These shops can be large grocery stores that have a bulk items section. The store will have both packaged items and package free items available for purchase. These stores are more prevalent than just package free stores and this is an easier transition for novice package free shoppers. Another type of “store” are Farmers’ markets. These markets are a collection of farms and agricultural communities.

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They are a community gathering place where local artisans, bakers, and other crafts display their goods or wares. Shoppers will need to bring their own containers to bring home their purchases. And then there are package free stores. These stores have only bulk items and shoppers will need to bring their own containers.

As more shoppers see the benefits of shopping package free, the demand will quickly culminate in more packaged free products becoming available. This will in turn encourage more shops to open with the goal of promoting package-free products.

4. Refill.Me Prototype Description

4.1. Prototype Architecture (Hardware/Software)

4.1.1. Hardware

4.1.2. Software

4.2. Prototype Features and Capabilities

4.3. Prototype Development Challenges

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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 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

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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 break 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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