Lab 1 – LivelyShelfs Product Description

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1 Introduction

Every day, food waste is created and sent to landfills. Food waste is an ongoing worldwide issue that contributes to economic, societal, and environmental issues. In turn, these issues fuel the fire of the growing problem known as food insecurity, causing a vicious cycle of food waste turning into food insecurity. While large companies can take part of the blame for this, most of the world's food waste comes from the common household. As seen in Figure 1, the U.S. Environmental Protection Agency found that of the 66.2 million tons of food waste generated in 2019, households were responsible for 40 percent of the estimated total (EPA, 2019).

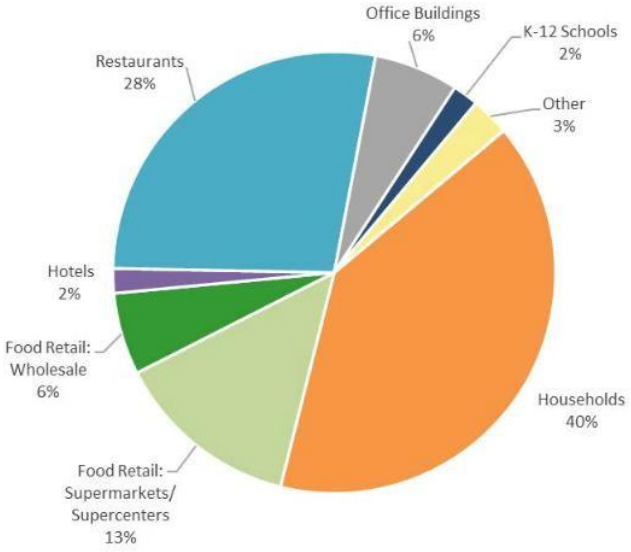

Figure 1: Percentage of Wasted Food from Residential, Retail, and Service Sectors

1.1 Problem Description

It goes without saying that 'money makes the world go round,' and money comes in finite amounts, so the average person cannot afford to continuously burn their hard-earned cash on wasted food without any consequences. According to Figure 2, every year in the United States alone, $144 billion worth of food is wasted by households, and the average American spends

$1300 on food that will be wasted (Shapiro, 2024; Berard, 2020). This wasted money can go towards other expenses such as bills, vacations, or savings. If consumers were more proactive in handling their food waste, they would be able to see significant changes in the amount of money they would save.

Figure 2: Financial Loss Per Sector in the US

As the problem of food waste continues to grow, so does the societal implications that come along with it. Valuable resources squandered on wasted food result in the increase of malnutrition and hunger in the more vulnerable and less fortunate areas of society. The resources that are expended on wasted food could go towards bettering these vulnerable areas through providing water, energy, or even better living conditions. Due to the misuse of resources in 2022, 783 million people were negatively affected by hunger (Nairobi, 2024). A reduction in food waste through the redistribution and sharing of surplus food would alleviate these societal issues.

To properly grow and maintain our daily food ingredients, 70 percent of the world's water is utilized in the agriculture process (Lewis, 2024). When this carefully cultivated food is wasted and thrown away, the water used to develop it is also wasted by extension. Our freshwater is limited, making it so that we cannot afford to waste it so casually. At the end of the day, anything thrown away ends up rotting away in a landfill. These landfills are responsible for eight percent

of greenhouse gas emissions globally (*The Environmental Impact of Food Waste*, 2024). Along with contributing to the problem of global warming, the need for more landfills takes priority over other uses of land, further affecting the surrounding environment.

Combining the economic, societal, and environmental issues posed by food waste, the adverse matter of food insecurity arises. Of the 2.3 billion people who suffered from food insecurity in 2023, almost 38 percent of these people have had the unfortunate experience of going without food for a day or longer due to their lack of food (Berard, 2020). Less healthy and processed foods cost less compared to the attentively grown and nurtured foods, making eating healthy a virtue to those who have less money. Due to this general pricing, 2.8 billion people (mostly from low-income countries) were unable to maintain healthy diets in 2022 (World Health Organization, 2024). From Figure 3, it is evident that over a sixth of U.S. adults in families suffer from food insecurity, along with their children. Food insecurity is a critical issue that must be addressed to loosen the current grasps it has on many lives.

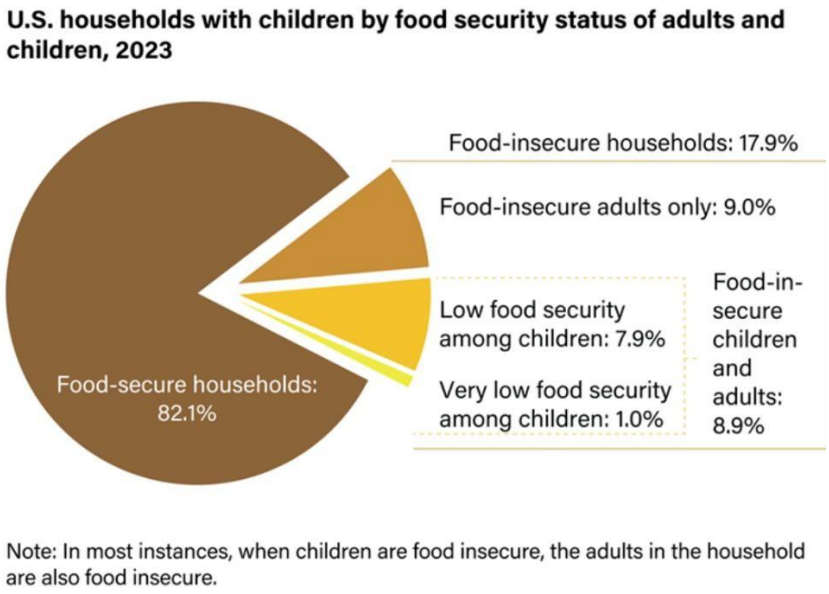

Figure 3: Percentage of Households Facing Food Insecurity in the US

The application, LivelyShelfs, is a proposed solution to overcome the numerous hurdles stemmed from food waste. This solution involves a proactive strategy that entails assistance in managing household food, information analysis, and centralized food redistribution among friends and family.

2 LivelyShelfs Product Description

LivelyShelfs is a mobile and web application with the goals of facilitating the reduction of food waste, promoting financial savings related to food expenses, and amplifying sustainability to combat food insecurity. Rather than being reactive to the accumulation of household food waste worldwide, LivelyShelfs takes a proactive approach that involves eliminating the common actions that lead to the vexing problem of food waste.

2.1 Key Product Features and Capabilities

One of the application key features is the comprehensive inventory provided to every user. The inventory stores any food that the user wishes to supply it with, keeping track of expiration dates and analyzing data based upon what happens to the food. This data can change for multiple reasons such as the food expiring before consumption or being regularly consumed in a timely manner. When food within the inventory becomes close to its day of expiration, the user will be promptly notified and recommended methods to utilize the food such as cooking it as part of a recipe or to make use of another key feature, Shelf Friends. Shelf Friends are mutual friends of the user who also want to reduce their household food waste through sharing their unwanted food with close friends and family. Users can enable a ‘shareable’ status on their food items, making it visible to their Shelf Friends. Through utilization of the chat feature, Shelf Friends are able to coordinate with one another when attempting to share food. Another key feature of the application is the predictive waste analysis. Not only does the application provide

data visualization after the user's food has either been consumed or expired, but this feature also utilizes the recorded data to alert the user of potential waste as soon as the food is entered into the inventory. This gives the user a sense of urgency when it comes to the proper utilization of their food.

2.2 Major Components (Hardware/Software)

LivelyShelfs makes use of a three-tiered architecture to appropriately manage the relationships between the hardware and software aspects. In Figure 4, the Major Functional Components Diagram displays the contents of the presentation, web, and database layers.

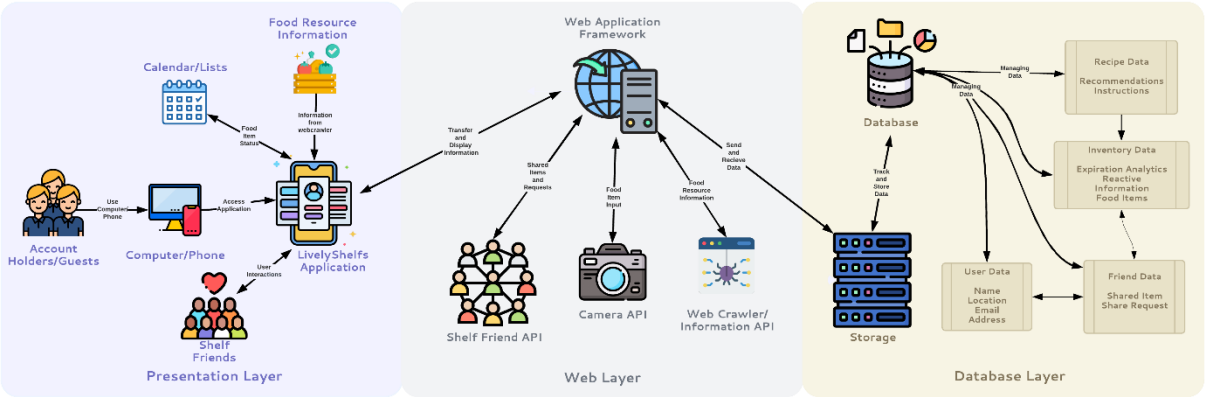

Figure 4: Major Functional Components Diagram

The presentation layer involves users accessing the LivelyShelfs application to utilize its many features. Data from sources such as Shelf Friends and the calendar have a bidirectional flow, allowing the data to stay up to date. The database layer stores the data related to the user, external recipes, shelf friends, and inventory data in an organized manner. The stored data also has some bidirectional relationships, as certain portions of each data structure depend upon each other. The web layer bridges the presentation and database layers through providing a web

application framework that encompasses the selected APIs while utilizing the information from the two adjacent layers.

3 Identification of Case Study

The target audience of LivelyShelfs who will purchase the app are the heads of households who want to reduce their food waste. These people are those who generally cook or handle the food within the household. Managing food for one person is already a lot, so managing the food for an entire household may require some form of assistance. The application will simplify their daily tasks related to food, allowing them to divert their attention to other responsibilities.

Those who will utilize the app will be people who tend to struggle when attempting to monitor their food waste and want assistance in doing so. They would also like to minimize the amount of excess food that they purchase along with being recommended recipes to maximize the returns on their food. Reducing food waste does not have to be an independent task, so LivelyShelfs gives that push that its users may need to motivate and guide them in their food preservation endeavors.

Stakeholders who desire to witness a decrease in food waste and the accompanying environmental impact include community groups who wish to increase their quality of life through the reduction of household food waste, businesses and retailers who are pursuing strategies in minimizing their own food waste, and political organizations that are concerned with the climate crisis and want to make a difference. Investing into the app will allow the stakeholders to leave a positive mark on their surrounding community and those who potentially work under them.

4 LivelyShelfs Product Prototype Description

The goal of the prototype will be to introduce partial functionality from our proposed structure. To reduce anticipated workload burdens, functionality will be prioritized over aesthetics and multiple aspects of the application will be simulated. At a minimum, the prototype will include the previously stated key features, either simulated or fully implemented.

4.1 Prototype Architecture (Hardware/Software)

The simulated features of the prototype were chosen based upon the available hardware and software components of the application. As full functionality is not a goal of the prototype, the application will be designed to function with only one operating system. The prototype will be able to work on Android smartphones with release dates no older than January 1, 2020. Given that specific data components will be simulated, a network connection will not be necessary.

By leveraging VS Code and its many extensions, the backend framework will be coded in Java, utilizing assets such as the Apache and Time libraries. As we are utilizing Java, the popular testing framework, JUnit, will be our method for implementing tests. The tests associated with the prototype will also be specialized for their prototype counterparts, while the final product will have similar but updated versions. While the aesthetics will not be our primary focus, we plan to utilize JavaScript, HTML, and CSS for the user interface elements. The team's version control will be done through GitHub, a developer platform that the team is familiar with. Minimal quantities of simulated data will be utilized, so an extensive database will not be required.

4.2 Prototype Features and Capabilities

Compared to the final product, the planned prototype will be at least 40 percent simulated. The simulated aspects include information that will be provided by the web crawler in the final product, user data to imitate real Shelf Friends, and the previously mentioned tests.

Simulating these aspects of the prototype will allow the team to demonstrate the key features of the application without the potential complications that can come with the development of the final product. A more detailed visualization of the features in the prototype can be found below in Table 1.

Feature	Real World Product	Prototype(planned)
Food Handling Advice	✓	Simulated
Access to External Partners	✓	✓
Shelf Friends	✓	✓
Spoilage/ Green Information	✓	Simulated
Ease of Input	✓	✓
Spoil Calendar	✓	✓
Spoil List	✓	✓
Data Visualization	✓	✓
iOS/Android	✓	Simulated
Testing	✓	Simulated

Table 1: Real World Product vs Prototype Features

4.3 Prototype Development Challenges

Difficulties that may arise within the development of the prototype will pertain to the implementation of the user interface elements. These difficulties will be mainly due to the time restraints of developing the prototype, as the team will have to learn the necessary information to complete this task within the allocated time. Another difficulty that may arise is implementing the method of camera input to scan user barcodes. This is not an area that the team has

experience in, requiring us to experiment with one of our external APIs, ML Kit. The prototype will not be on the same scale as the final product, but the team will still exert ourselves to produce a product that is more than satisfactory.

5 Glossary

API: Also known as "Application Programming Interface" it is a protocol that allows for different software applications to communicate with one another.

Community Hub: A part of LivelyShelfs that helps bring the community together and allows user interaction to share sustainable habits and tips.

Database: An organized collection of information stored electronically.

Food Insecurity: Not having access to enough food to meet ones needs or not being able to access quality food to meet ones needs.

Food Waste: Food that isn't used for it's intended purpose or is not used before spoiling.

GitHub: A service that allows developers to collaborate on the development of projects and provides version control.

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JUnit: A testing framework for Java.

Landfills: A site where waste is disposed of, typically the waste is covered by soil. **Spoilage Calendar:** An efficient and intuitive calendar provide by LivelyShelfs that notifies users of when their food is going bad

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Sustainability: A goal to avoid actions that harm the environment or deplete natural resources while still meeting ones needs.

Trello: A service that helps with project management and planning.
VS Code: Also known as "Visual Studio Code" it is a development environment used by the team that is compatible with many different languages.

Web Application Framework: Software platform intended to help developers in building web applications, providing access to pre-built tools and libraries.

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