CS 410 Lab 1

Template and Formatting

Team Bronze

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1 Introduction

Food waste is a growing problem worldwide. In the US alone 66.2 million tons of food waste were generated (EPA). This can be food that simply isn't eaten after it is served or food that is left to spoil. In addition, there can be mishaps in the production process that also result in food waste.

1.1 Problem Description

The food waste problem is more than just the fact that food is not being used for its intended purpose. The waste of food in households and across the world has cascading economic, societal, and environmental costs. In addition to this, food insecurity is another issue that is closely related to the food waste problem.

1.1.1 Economic Cost of Food Waste

Food waste is responsible for a shocking amount of economic loss. Around the world monetary loss due to food waste is equivalent to $940 billion, the US alone is responsible for $218 billion of this total (Shapiro). This loss is an almost unimaginable amount for the average person. If we take a closer look at the average American, they spend $1300 a year of wasted food, which is more than they spend on many other needs like gas, clothing, and home maintenance (Berard, A). This economic loss could be reduced greatly if a proactive approach was taken and people worked to reduce food waste.

1.1.2 Societal Cost of Food Waste

The societal impacts of food waste are a little harder to see at first glance. Food waste can worsen other issues that are already present such as hunger and malnutrition. Even though such a large amount of food is wasted annually, 783 million people were affected by chronic hunger in 2022 (Move For Hunger). Food waste is not the only wasted

resource in the process of food waste. Other resources like water and energy that are used in the process of producing and transporting food also end up wasted when food is wasted. If these resources were put to good use instead of being wasted perhaps issues like hunger and the environmental impacts of this waste could be lessened.

1.1.3 Environmental Cost of Food Waste

As mentioned previously, food waste also results in wasted resources like water and energy in the process of producing and storing food. Agriculture, the process of growing crops and food production, accounts for 70% of water usage worldwide (Lewis, J). This massive amount of water usage is wasted when the food it is used to produce is also wasted. When food is wasted, it is often sent to a landfill. Of the food waste generated by food retail, food service, and residential sectors in the US 60% of it is sent to a landfill (EPA). Landfills have direct negative impacts on the environment, they are directly responsible for 8% of global greenhouse gas emissions (Move For Hunger). Wasted food in landfills not only contributes to an already worsening climate crisis but also uses land that could be put to more productive use.

1.1.4 Food Insecurity

Food insecurity is a problem parallel to food waste. Food waste can worsen hunger and while food waste continues to grow food insecurity grows as well. In 2023 2.3 billion people suffered from food insecurity and in 2022 2.8 billion people were unable to afford healthy diets (World Health Organization). It is equally important to note that a larger portion of people in lower income areas and countries are affected by food insecurity and unable to afford healthy diets than those in countries with higher average incomes. While

food waste continues to grow so does food insecurity despite the fact that no one should have to go without food, a basic human need.

1.2 Solution Description

Our solution to the problems of food waste and food insecurity is LivelyShelfs, an application designed for busy households and individuals with the goal to provide proactive approaches and tools to minimizing food waste while helping save money and implement more sustainable practices.

1.2.1 LivelyShelfs Application

LivelyShelfs plans to help reduce household food waste through grocery spoilage tracking via a Calendar and List that shows groceries an individual purchased and their estimated spoilage date. The plan is to make use of cameras present in phones/computers to allow for easy input but the option to log food items manually is also present. Based on what food items users have and when they spoil, we plan to provide informational resources on how to help keep their food fresh for longer and what to do with groceries to prevent the creation of waste. One method of spoilage prevention is through recommended recipes. When the LivelyShelfs application notices that certain food items are nearing expiration, it will search through popular online recipe sources to find uses for food that may spoil soon. In addition to this we plan to unite a close community of "Shelf Friends" to allow for sharing of food that may spoil soon instead of letting it go to waste. Finally, LivelyShelfs will also visualize user data to help users better understand how they are wasting food or reducing their own food waste. By showing users infographics of their of food use we hope to keep them motivated to continue to reduce waste.

1.2.2 Solution Benefits

LivelyShelfs provides many benefits to not only the user but also society. Through the reduction of food waste less food will end up in landfills resulting in lower emissions worldwide. When less food is wasted, less money is wasted as well. Users will put a large majority of their groceries to use before they spoil, which will lead to less money wasted on food. In addition to this, by fostering a close community of people who are working to reduce food waste and share food within their community we hope to also lessen the problem of food insecurity.

1.3 Risks

The goals of the LivelyShelfs team do not come without risks. We would need to gain a large enough consistent user base to have an impact. This itself introduces its own risks where we need to adapt to the market in order to retain users. Additionally, we also must be technically skilled enough to implement the solution in a manner that is comfortably useable.

1.3.1 Customer

The customer risks we have identified so far include users being too far from each other to form sufficient communities, food information being entered incorrectly, and Users ignoring the spoilage information they receive from the application.

1.3.2 Business

The business risks we have identified include a lack of community engagement, not adapting to competing applications, and complying with privacy laws for sensitve user data. The most threating risk of these three is a lack of community engagement which we hope to mitigate by partnering with companies with green initiatives like Kroger and their

Zero Hunger | Zero Waste program to get our application out there more. Secondly, we plan to mitigate the lack of adaptability of our application by allowing community to feedback for new features or changes to make sure the LivelyShelfs community is content. Finally, the easiest risk to mitigate is complying with privacy laws. Privacy law is well documented, and we will follow it closely to avoid any complications and update the application as needed.

1.3.3 Technical

The last section of risk we are concerned with is technical risks. These include our web crawler providing incorrect data, a possible data breach due to buffer overflow through API, and the integration of API's becomming overly intricate. The most threating of these risks is the API integration. We plan to mitigate this by researching APIs and familiarizing ourselves with the ones we plan to use via documentation. For the second most likely risk, the web crawler returning incorrect information, we plan to have all the information reviewed before it is uploaded to the app and seen by users. Finally for the least likely technical risk, Data breach through buffer overflow, we plan to mitigate this using traditional methods like input validation.

2 LivelyShelfs Product Description

LivelyShelfs is a web/mobile application with the goal of helping households reduce their food waste in order to save money and have a positive impact on the environment. We hope to help green minded individuals reduce their food waste through grocery tracking and food sharing.

2.1 Key Product Features and Capabilities

LivelyShelfs key features are grocery inventory tracking, recommendations based on user inventory, providing informational resources based on user inventory, and shelf friends. Through

self-friends we plan to provide food sharing and messaging capabilities. The informational resources and recipe recommendations are provided through LivelyShelfs web crawling capabilities.

2.1.1 Grocery Spoilage Tracking

Grocery Spoilage tracking through LivelyShelfs is done through a visual calendar and list. Both the calendar and list show spoilage dates and have a color-coded system based on how soon the item will expire. LivelyShelfs offers two input methods for grocery tracking; manual input from the keyboard and barcode scanner input via camera.

2.1.2 Informational Resources

LivleyShelfs plans to provide informational resources through web crawling. The goal is to crawl the web for information specific to user needs such how to store certain foods they may have or green methods they can take to reduce food waste. This will also encompass things like freezing items so that they can be stored for longer or donating packaged food that might not be used to local food pantries or food drives. If the unfortunate event does occur that some food goes to waste LivelyShelfs will also crawl the web to provide users with information on the least harmful ways to dispose of the waste such as composting.

2.1.3 Recommendations

LivelyShefls plans to provide recommendations for recipes and food sharing. The recipe recommendations will require web crawling for recipes that include the ingredients users have that will spoil soon. If the user has the required ingredients or their shelf friends have the

required ingredients available to share the recipe will be recommended to them. Food sharing recommendations generally follow the same process as recipe recommendations. If a user has a food item that may spoil soon and there is no suitable recipe that uses the item they will be recommended to share the item with their shelf friends.

2.1.4 Shelf Friends

Shelf Friend are close friends or family members that you would feel comfortable sharing food you might not use with. LivelyShelfs plans to bring this group of people together to reduce food waste in communities. Users will be able to request food items that their friends wish to share and share items they may not use before they spoil with their friends. In addition to this we intend to implement friend to friend messaging to add a level of communication for users who may wish to share food or anything else with each other.

2.2 Major Components (Hardware/Software)

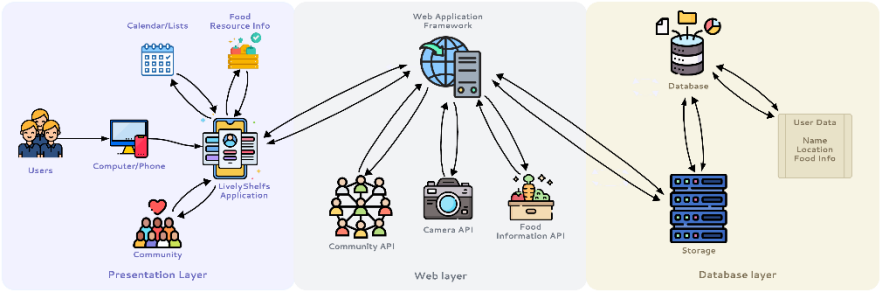

Figure 1: Major Functional Components Diagram

2.2.1 Presentation Layer

The presentation layer consists of the UI/UX of LivelyShefls. This is the layer where users will interact with the application and use features like the calendar and list for grocery tracking. In addition to this this layer is where shelf friends will be able to interact with each other. The presentation layer and web layer interact through the transfer and display of information.

2.2.2 Web Layer

The web layer is the backend of the livelyshelfs application. This is where functionality like the web crawler for finding recipes and helpful information to users will be. In addition to this the functionality for interacting with shelf friends will be a part of this layer as well as functionality for all other features like grocery input with the camera or manually and recommendations.

2.2.3 Database Layer

The database layer is where all of the application and user data will be stored and managed. This includes things like user inventory data such as the groceries they have and when they will expire, recipes we plan to recommend to users, and friend data. The database layer and web layer interact through data operations such as the storage and retrieval of data.

3 Identification of Case Study

3.1 Customer

The main customer of LivleyShefls is the heads of households. Ideally our customers will be those who manage the food in their household and cook most of the food as these people will be the most mindful of what food they have and when they need to use it by. Our main customers will also likely be environmentally conscious individuals who are looking to reduce their waste.

3.2 User

LivelyShelfs Users share a similar profile to the customers: environmentally conscious people who are looking to reduce food waste. However, our users also extend a bit further than this. We are hoping to attract users who struggle to keep track of their food and would like an easier way to stay on top of things. LivelyShelfs also caters to people who are hoping to save money by spending less on excess food they end up not using. Users also include extensions of the customers, who are the head of their households, via account guests. Account guests would be anyone else who also lives in the house so that they may track extra things they buy or use.

3.3 Stakeholder

LivelyShelfs stakeholders include multiple different groups such as community groups, businesses or retailers, and potentially political organizations. Community groups that may be interested in reducing food waste across their community and enriching their community to be more environmentally friendly are potential investors in LivelyShelfs as it could help them reach their own goals. We have a similar perspective towards businesses like restaurants or food retailers who wish to reduce their own food waste. Chains could potentially add each other as shelf friends and transfer unused goods to another chain in need, reducing cost while continuing to provide their service. Political organizations have the same interest as local communities to become stakeholders in LivelyShelfs. They may wish to help their members/constituents to reduce food waste and create greener habits with the goal of creating a better society for everyone.

4 LivelyShelfs Product Prototype Description

4.1 Prototype Architecture

One of the goals of LivelyShelfs is to be widely available to anyone who likes the message of reducing food waste for a greener community. To support this, we plan on implementing a cross-platform architecture so that our solution is widely available. In addition to this we have something like microservices in mind. LivelyShelfs will be built from multiple small parts such as the web crawler, inventory management system, and friend management system that come together to make the full experience.

4.1.1 Hardware

The LivelyShelfs prototype should be available on mobile hardware including iOS and android devices. In addition to this we plan to also have LivelyShelfs available as a web application. The

goal of having LivelyShelfs available on many different hardware platforms is to have the app be as accessible as possible to make the biggest impact.

4.1.2 Software

The LivelyShelfs application will likely be built off of multiple different software components. Off course we will be using version control software like GitHub to manage the project and VS code as our IDE. The language of the software as of now is planned to be a combination of java and python for backend with html, CSS, and JavaScript for the frontend. Of course, this may change down the line during 411 these are just the technologies our group is most familiar with as of now. In addition to this we plan to make use of some third-party API software such as ML kit for barcode scanning, Scrapy for web scraping, and google analytics for any analysis we may need.

4.2 Prototype Features and Capabilities

The prototype of LivelyShelfs will have a majority of the planned features for the application, however, some features will be simulated. The team plans for the all-inventory tracking features to be present such as the spoil list, calendar, and input functionality. In addition to this the prototype will also have data visualization features so that users can visibly see how much food they are wasting or have saved. The shelf friends feature such as sharing food and messaging will also be implemented in the prototype. The iOS and android environments will be simulated as LivelyShelfs will not actually be published to any app stores. In addition to this the food handling and advice will be simulated as during the prototyping stages we will not be using actual groceries so recommendations/advice will be made off of simulated data.

4.3 Prototype Development Challenges

There are a few potential challenges the team could face during the development of the prototype. The most notable is the development of our own “shelf friends” API. We could not find an already present API that fit exactly what we wanted so we could face some difficulty building our own from the ground up. In addition to this, I am not sure many members of the team have much experience implementing APIs so implementing third party APIs could pose a challenge for us as well. Finally, the ideas we have proposed are quite complicated. I am sure we can implement them, but we may run into time constraints and only end up being able to implement certain features.

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 one's needs or not being able to access quality food to meet one's needs.

Food Waste: Food that isn't used for its 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 one's needs.

Trello: A service that helps with project management and planning.

VSCode: 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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