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Project Title: FOOD MANAGEMENT APP (FEED)

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I.Abstract



Figure 1- I-Abstract -Food donation (clipart library,2022)

A significant problem in the present technological landscape is that food wastage. This serious global issue demands urgent attention. Food wastage occurring at various stages in the food supply chain and it is being a main contributor to economic inefficiency, environmental degradation and social inequality. On the other hand there are millions of people suffering from hunger and malnutrition. To address these issue the “FEED” food donation app was designed using combination of Waterfall and Spiral SDLC which will connect food donors having surplus food to orphanages and charities in need of food, thus creating a more equitable and sustainable food system.

II.Acknowledgment

In the preparation of our group coursework, a few respected individuals helped us to complete the group course work and those individuals deserve our appreciation. We like to convey our exceptional thanks to Ms. Jananie Mayooresan, DOC330 course leader of the Informatics Institute of Technology. She gave us clear guidance which helped us to complete our IFD. Also, we would like to thank charities, restaurants, and people who gave their opinions and inputs through questionnaires and interviews which helped us to enhance the features of our application. The IFD was completed with the efforts of our group members Anusigan, Lithila, Daneesha, Namina, and Senumi who interactively participated and helped each other to complete the IFD on time. We would like to express our gratitude to all those who helped us to accomplish this report.

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VI.List of Acronyms

- SDLC- Software development life cycle
- UN- United Nations
- MSW- Muncipal Solid Wastage
- FAO- Food and Agricultural Organization
- WFP-World Food Programme
- SLILG- Srilanka Institute of Local Governnce

1. Introduction and Description

1.1 Background

Food waste and food insecurity are serious worldwide issues that are deeply rooted in the complex structure of the modern food system. Food waste is a problem that affects every step of the supply chain, from consumer behavior and distribution to management after harvest and crop production. The huge amount of food materials wasted leads to financial losses for producers and businesses. These losses are caused by inefficiencies, inadequate infrastructure for storage and transportation, and market dynamics etc. The improper disposal of food wastage has significant negative effects on the environment as well, since it increases greenhouse gas emissions and exacerbates the depletion of natural resources worldwide. On the other hand, food insecurity remains to be a global problem that affects millions of people worldwide. Having its roots in issues like violence, political unrest, and poverty and unequal distribution of resources, food insecurity leads to insufficient access to safe, nutritious, and culturally appropriate food.

While a significant portion of the globe wastes food , another struggles with inadequate access to food. This contradiction highlights the need to balance the differences in the global food system as well as a distributional injustice. Global development objectives like the UN Sustainable Development Goals' Zero Hunger aim are impacted by the effects of these issues, which are felt on a large scale.

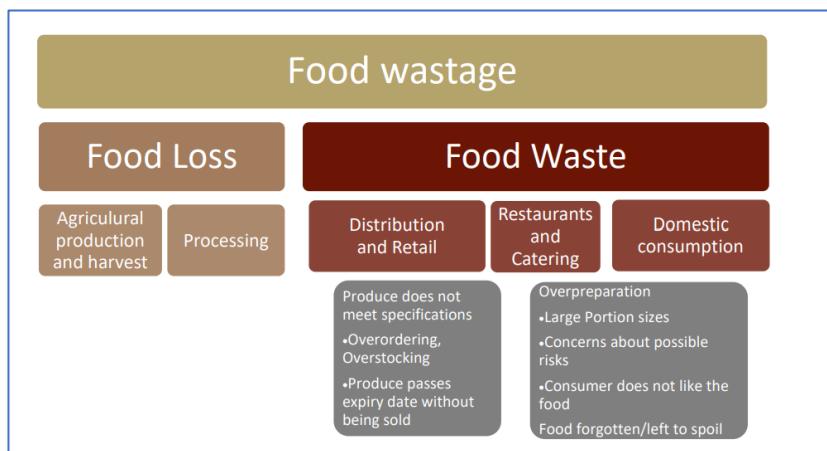


Figure 2-1.1-Classification of food wastage

1.2 Problem Statement

If “Food Waste” were a country it would be the world’s 3rd largest emitter of CO2 after China and the US. - The Food and Agriculture Organization of the United Nations (FAO)

The current situation of food wastage presents a significant global challenge with compelling evidences pointing to its far reaching implications. According to the recent statistics it stated that approximately 1.3 billion tons of food is wasted annually (FAO,2023). Food wastage is occurring at various stages of the supply chain, from production and harvesting to processing, distribution, and consumer consumption. Inefficient farming practices, inadequate storage facilities, overproduction, consumer behaviour are considered as the main cause of Food wastage. Food wastage created another pressing concern Food insecurity which is affecting millions of people worldwide. Reports states that approximately 9.2% of the global population, or around 690 million people went hungry in 2019. The improper disposal of surplus food sent to landfills, undergoing anaerobic decomposition, producing methane, a potent greenhouse gas which is very powerful with a 84 times higher global warming potential than CO2 over a 20 years period (UN Sustainable developments, 2023) contributing to critical environmental climatic changes.

Recent studies also stated that COVID-19 pandemic made the problem even worse by disruptions in transportation of food, changes in consumer behaviours which increased in perishable food losses. The loss of food is also problematic considering the water that went into producing the food. Far most of the water used on this planet is used for food production and wasted food therefore also means wasted water. 250 square kilometres of freshwater is wasted each year to produce food that is lost or wasted. A quarter of the world’s freshwater is used to grow food that will never be eaten. At the same time, the number of people in severe lack of water is growing by the second. It is expected to reach almost 4 billion people by 2050 (FAO,2023). Current food wastage situation of Srilanka states that MSW has a relatively high share of organic and bio-degradable composition. Bandara (2008) found that MSW of Sri Lanka consists of 65-66% of perishable organic material. Biodegradable waste was further analyzed into short-term and long term degradable and reported to have 54.5% and 5.9% respectively. The composition of the waste varies according to the type of LAs, in general, it is assumed that nearly half of the biodegradable part of Municipal Solid Waste (MSW) is food waste (SLILG, 2008).

A study conducted in the Eravur Pradeshiya Sabha area in Batticoloa district shows that every household generates an average of 2.06 kg of food waste per day contributing 79% of the total waste generated in the area (Thirumaran et al, 2015). According to one estimate, about 22% of the total population in Sri Lanka do not have sufficient food to sustain a healthy life (WFP, 2020). Sri Lanka is ranked in 66 th position in the Global hunger index. This is the current situation of world aspect and Sri Lanka's aspect.

1.3 Gap Analysis

Features	Similar Apps & Websites							Proper solution FEED
	Karuna.lk	zamzam.lk	worldvision.lk	ShareTheMeal(Germany)	Olio (UK)	Aahar Daan (India)	mealconnect.org (USA)	
F1-Donor Registration	✓	✓	✓	✓	✓	✓	✓	✓
F2-Recipient Registration	✓	✗	✗	✓	✓	✓	✗	✓
F3-Search option	✓	✗	✓	✗	✓	✗	✓	✓
F4-Automatic suggestion of recipients	✓	✓	✓	✓	✓	✓	✓	✓
F5-social media integration	✓	✓	✓	✗	✗	✗	✗	✓
F6-Multi language support (3 Languages)	✓	✗	✗	✓	✓	✓	✗	✓
F7-Food safety guideline notifications	✗	✗	✓	✗	✗	✗	✓	✓
F8-Review and rating feature	✗	✗	✗	✓	✓	✓	✗	✓
F9-Advertisement free	✓	✓	✓	✓	✓	✓	✓	✓
F10-Donation History	✗	✗	✓	✓	✓	✓	✓	✓
F11-Reports and Analytics	✓	✗	✓	✓	✗	✗	✓	✓
F12-Emergency response	✓	✗	✗	✗	✗	✗	✗	✓
F13-Filter Requirements	✓	✗	✗	✗	✓	✗	✗	✓
F14-View Donor description/ rating	✗	✗	✗	✓	✓	✓	✗	✓
F15-Mobile Application	✗	✗	✗	✓	✓	✓	✓	✓
F16-One to one chat features	✗	✗	✗	✗	✗	✗	✗	✓
F17-Real time tracking	✗	✗	✗	✗	✗	✗	✗	✓
F18-Food/Non food inventory management	✗	✗	✗	✗	✗	✗	✗	✓
F19-Food rescue alerts	✗	✗	✗	✗	✗	✗	✗	✓
F20-Food,grocery,essential items donation feature	✗	✗	✗	✗	✗	✗	✗	✓
F21-Non profit organization validity verifying feature	✗	✗	✗	✗	✗	✗	✗	✓
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2.Methodology

This “FEED” food donation app project is going to be processed through the combination of Spiral SDLC model and Waterfall SDLC model. Spiral SDLC model is used in developing the app because the requirements of the app are complex and significant changes are expected in the app due to research and exploration of the problem. Also, the Waterfall SDLC model is combined with Spiral SDLC model as it’s good for management control and provides structure to inexperienced staff and the technology is understood.

Spiral SDLC model is implemented in the requirement elicitation stage as the “FEED” app have evolving requirements and new features to be added such as non-food items (books, clothes, stationeries, sanitary products) donating feature according to user’s requirements, The Spiral SDLC model allows us to iterate and expand the feature of the app. Waterfall SDLC model is implemented in the designing stage as it enables us to create a comprehensive system design that considers every aspect required for the application, such as user interface design and technical choices. This helped us to create database structures for storing user data, donation contribution records and other relevant information as well as developing the user interface for the donors, recipients and administrators of the “FEED” app. Waterfall SDLC is implemented in the prototype stage as well. It supported to develop a functional prototype of the food donation app with restricted features. Also, it concentrated on the main user interactions, user interface and essential features of the app. Spiral SDLC model is implemented in the Testing stage of the application as it enables us to test and develop the app iteratively. Each section of the application is produced and tested in each iteration. It also helped us to identify and resolve the problems in the app easily. Waterfall SDLC model is implemented in the Installation stage of the app since we had documentation outlines on the functionality, design, and installation requirements of the app. So, it provided a well-organized approach of installation.

3. Solution Outline

3.1 Solution property

The solution “FEED” donation app is designed through the combination of Spiral and Waterfall SDLC models which makes the app more effective. “FEED” app allows donors to donate surplus food and also non-food items such as clothes, toiletries, stationeries to people in need by connecting through non-profit organizations (orphanages, charities). “FEED” app helps the users to find and support the causes they care about and as well as track their donation status.

“FEED” app consists of features that are in common with other food donation app that are present in current market such as Donor registration, Recipient registration, Search and Filter option, social media integration, Multi-language support, Reports and analytics, Filter requirements, Rating and review, guideline notifications, Mobile application feature.

But to enhance the solution and to get market attraction some innovative features are added to the “FEED” app. They are one to one chat features which enables users to communicate with each other and also with the app administrator through text messages, voice calls or video calls, Realtime tracking feature which allows the users to track the location of their donation and deliveries and get update of their donation through photos and videos, Food/ Non-food inventory management feature which enables the users to manage their inventory of surplus items that can be donated, Non-profit organization validity verifying feature which allows users to verify the validity and credibility of the non-profit organizations that are involved in food rescue to ensure the quality and trustworthiness of donations

3.2 Key Benefits

Through the “FEED” app stakeholders of the app and also the society will get maximum benefits.

3.2.1 Stakeholder Benefits

Benefits for Donors

- ✓ Can minimize their food wastage by easily donating their surplus or unsold food items to the orphanages or charities.

- ✓ In some nations donors may be eligible to get tax deductions when they involve in food donations to charities.
- ✓ Businesses can ensure their Corporate Social Responsibility.

Benefits for recipients (Orphanages and Charities)

- ✓ Can get access to nutritious food.
- ✓ Nutritious food donated will help them to be safe from diseases.
- ✓ Can receive not only food items also stationeries, books, toiletries etc.
- ✓ Data and insights generated by the app can help organizations make data-driven decisions and address food insecurity.

Benefits for Local Businesses (Restaurants and grocery shops)

- ✓ Food and non-food items disposal costs is reduced,
- ✓ Increases their reputation in the market for donating surplus food.

Benefits for App administrators

- ✓ Increased Job Opportunities.
- ✓ Platform for innovators to showcase their innovation talents.

Benefits for food safety regulators

- ✓ Food safety advocates can use food donation apps to ensure that donated food is handled safely, and they can contribute to educational initiatives on food safety.

Benefits for corporate sponsors

- ✓ Can gain publicity and reputation.
- ✓ Can obtain tax incentives.
- ✓ Can obtain data and insights which will help for their business developments.

Benefits for Government agencies

- ✓ Government authorities can effectively improve the well-being of their citizens.
- ✓ Government authorities can access the app data to inform policies and interventions for addressing food insecurity more effectively.
- ✓ Government involvement in food donation initiatives can raise public awareness of the issue of food insecurity and encourage civic engagement.

3.2.2 Society Benefits

- ✓ Greenhouse gas emissions and less stress on landfills due to proper management of food.
- ✓ Ensure that surplus, edible food is efficiently distributed to those who need it most, reducing hunger and improving overall well-being within the community.
- ✓ Foster a sense of community and social cohesion by encouraging volunteerism and supporting those in need.
- ✓ Promote sustainable practices by reducing food waste and its associated environmental impact. This aligns with growing concerns about environmental responsibility.
- ✓ Raise awareness about the issues of food insecurity and food waste, educating the public and encouraging people to be more conscious of their food consumption and waste.

3.3 Mind map

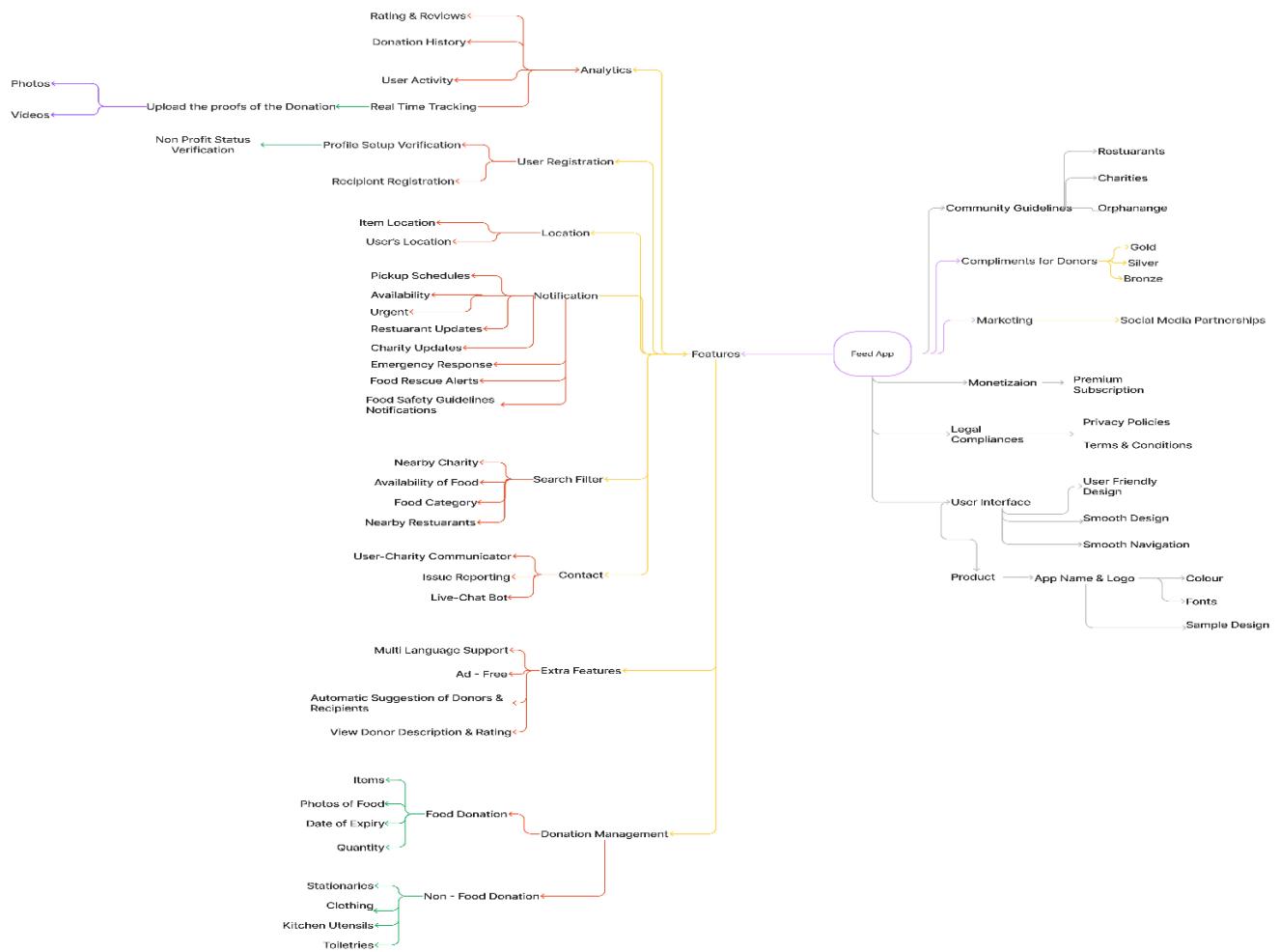


Figure 4-3.3-Mind map for the solution

4. Innovative features incorporated

One to one chat features

This feature allows the users to communicate with each other through text messages, voice calls, or video calls. This feature can help to coordinate the logistics of feed and provide feedback or support.

Real time tracking

This feature allows the users to track the location and status of the donations and deliveries and get update of their donation status through photos and videos.

Food/Non-food inventory management

This feature allows the users to manage their inventory of surplus food or non-food items that can be donated.

Food rescue alerts

This feature allows the users to receive notifications or reminders about feed opportunities or activities.

Food, grocery, essential items donation feature

This feature allows the users to donate or request food, grocery, or essential items through the app.

Non-profit organization validity verifying feature

This feature allows the users to verify the validity and credibility of the non-profit organizations that are involved in food rescue. This feature can help to ensure the quality and trustworthiness of feed.

5. Requirement Analysis

5.1 Requirement elicitation process

We gathered the information regarding the requirements of our project through requirements elicitation techniques such as brainstorming technique which helped us to identify different perspectives and opinions of donors, corporate sponsors, food safety regulators, app administrators and government agencies to promote creativity and innovation and new ideas to solve the issue, Interviews technique which helped us to get a deep understanding of the needs, preferences and pain points of the food donors and donation recipients, clarify doubts and get more detailed information, the interview transcripts used as a supplement for requirement documentation, Questionnaire technique which offered us reviewed and relative quantitative and qualitative data of stakeholders in wide range, Document sampling technique which helped us to examine the documents related to food donation regulations and guidelines to ensure that app's design aligns with legal requirements such as food safety standards and liability considerations which are critical in the context of food donation. Also, document sampling helped to handle feedback, complaints or disputes related to food donation.

5.2 Requirement elicitation survey and Interview Questions

Refer appendix number 10.4

5.3 Requirements of the project

An in-depth understanding of the requirements of the project is necessary to create a successful food donation app. Ensuring that the platform not only satisfies the receivers' and donors' immediate needs but also runs smoothly, safely, and dependably. Requirements of the "FEED" app elicited through surveys is categorized in to functional requirements and non-functional requirements according to the properties of it.

5.3.1 Functional Requirements

User registration to enable users to create accounts, login, logout securely.

Charity verifying feature to assure the non-profit validity of the organization.

Separate interfaces for donors and recipients, where donors will be able to post details about the available food, while recipients wil be able to search for and request food.

Communication portal to enable communication between donors and recipients also communication between users and app administrators.

Geolocation Services to search for nearby food donations and delivery locations.

Scheduling food pickups to specify the availability.

Notification system to remind and alert users about new donations, new requests, messages.

Inventory management to analyse the capacity of surplus food available for donations.

Feedback and Rating mechanism to enhance the performance and future updates.

Integration to social media platforms (Instagram, Whatsapp, Facebook, Twitter) to share users donation progresses.

5.3.2 Non-Functional Requirements

1. Utility: The user experience ought to become the app's first priority, with an interface that is simple to use. The application should be easy for users to engage with, enhancing their experience to be pleasant and successful.
2. Trustworthiness : A high level of reliability demands attention from the application, thereby guaranteeing constant availability for all clients. In order to provide stability, it must minimize system errors or crashes. continuous service and always meet in line with users' expectations.
3. Compatibility and scalability: It is important for the application to be made capable of supporting several users at once. It should be compatible with a range of gadgets, such as cell phones, tablets, and PCs, to ensure usability and a smooth user experience across various platforms.
4. Privacy and security: Strong security methods must be prioritized by the application to safeguard sensitive data of users and respect their privacy. Particular consideration must be made for using encryption, secure authentication, managing financial data securely, and observing industry standards to stop data breaches and illegal access.

5.4 Context Diagram

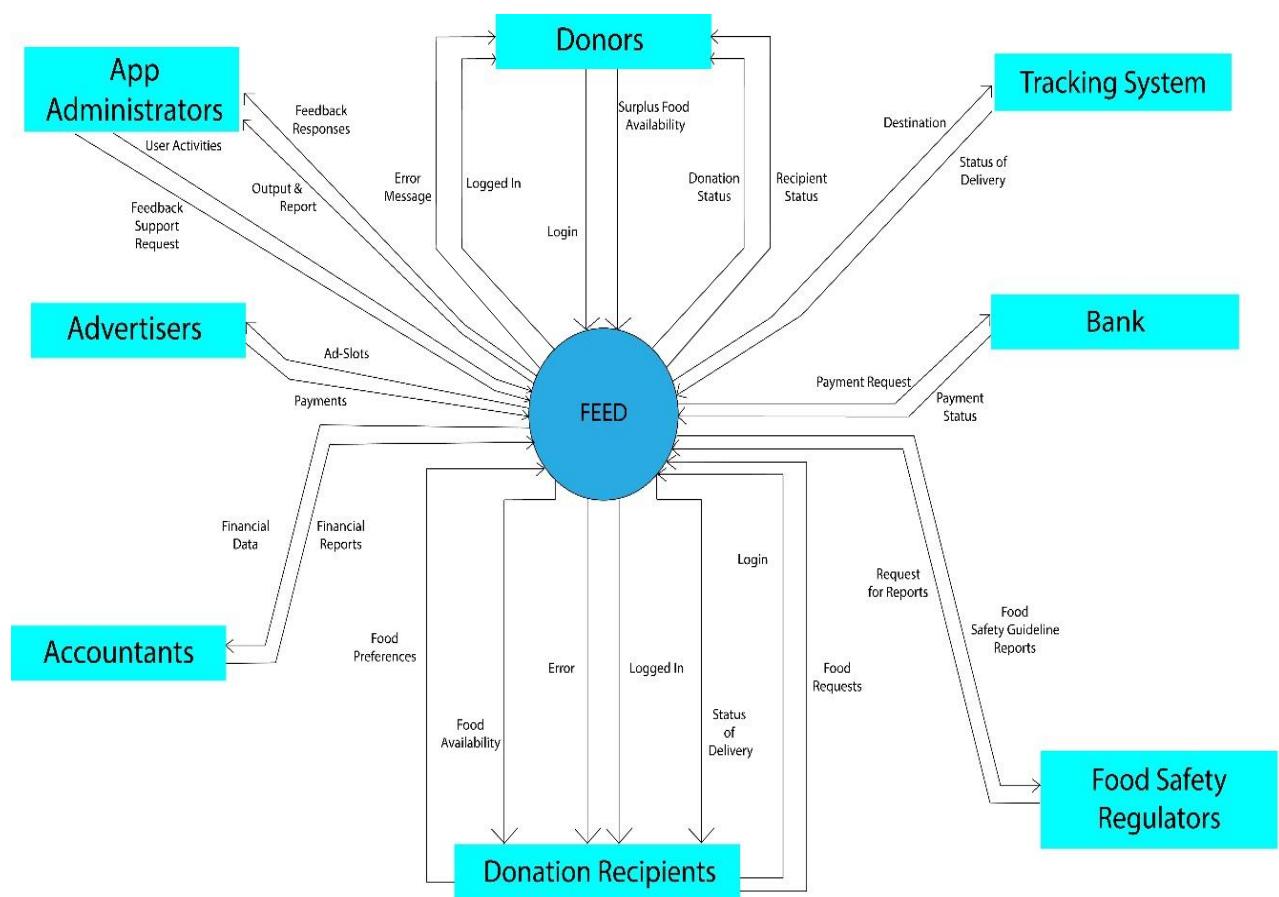


Figure 5-5.4-Context diagram

6.Screenshots of the Prototype



Figure 8- 6-Startup page 2 screenshot

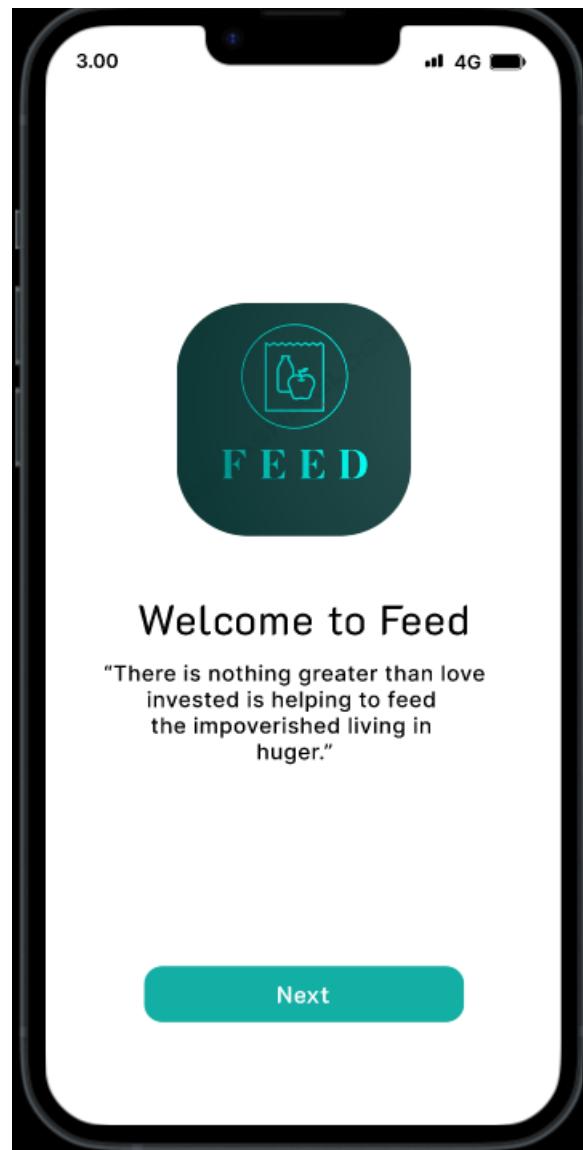


Figure 6-6-Startup page 1 screenshot

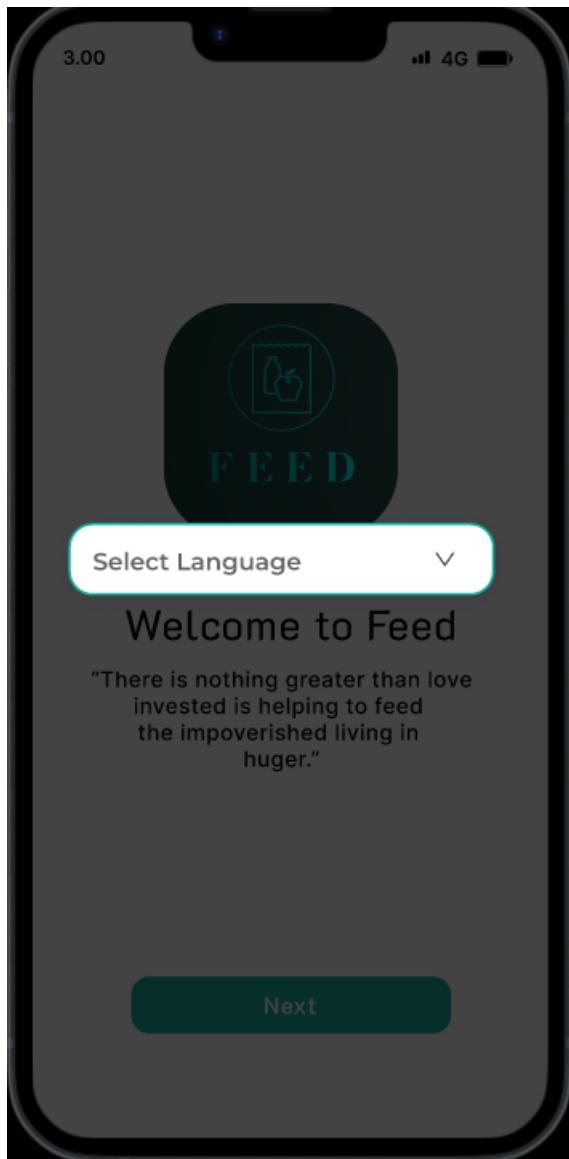


Figure 10-6-Select language feature screenshot

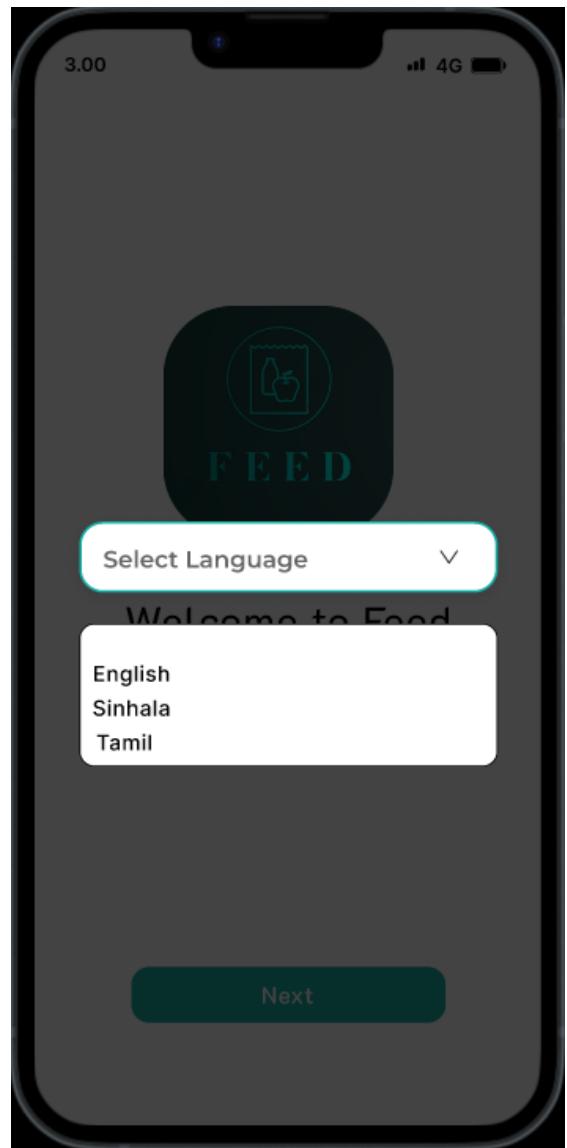


Figure 9-6-Languages page screenshot

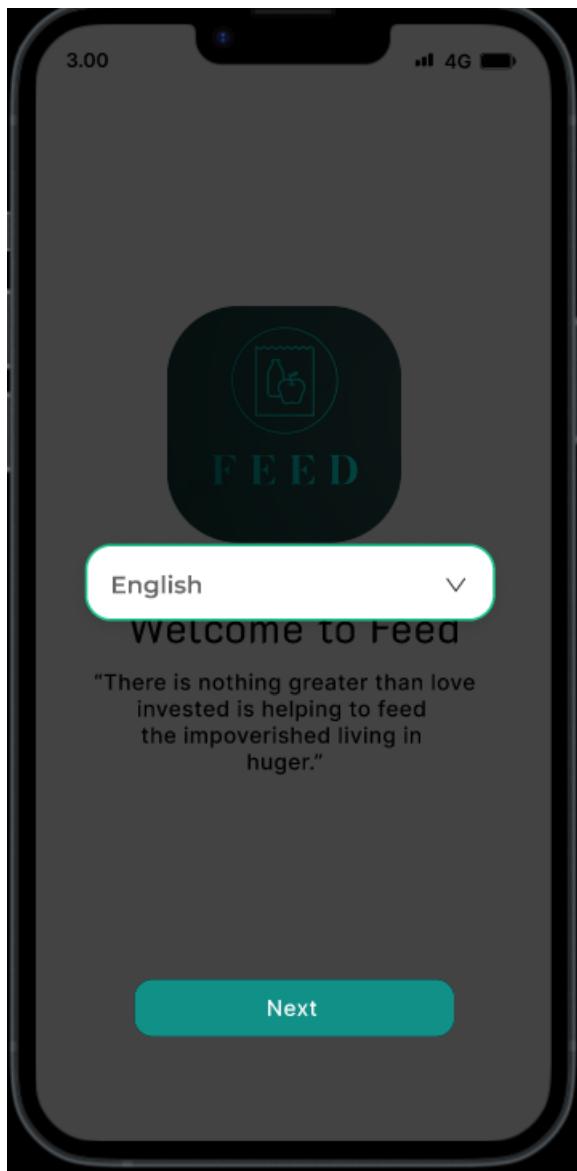


Figure 12-6-English language page selection screenshot

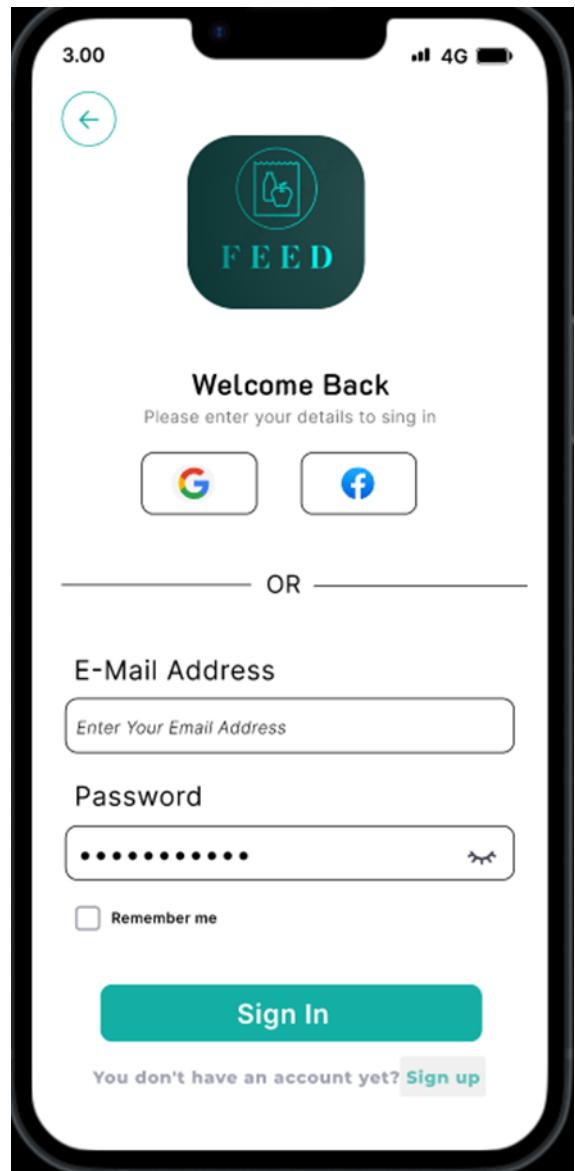


Figure 11-6-Sign in page screenshot

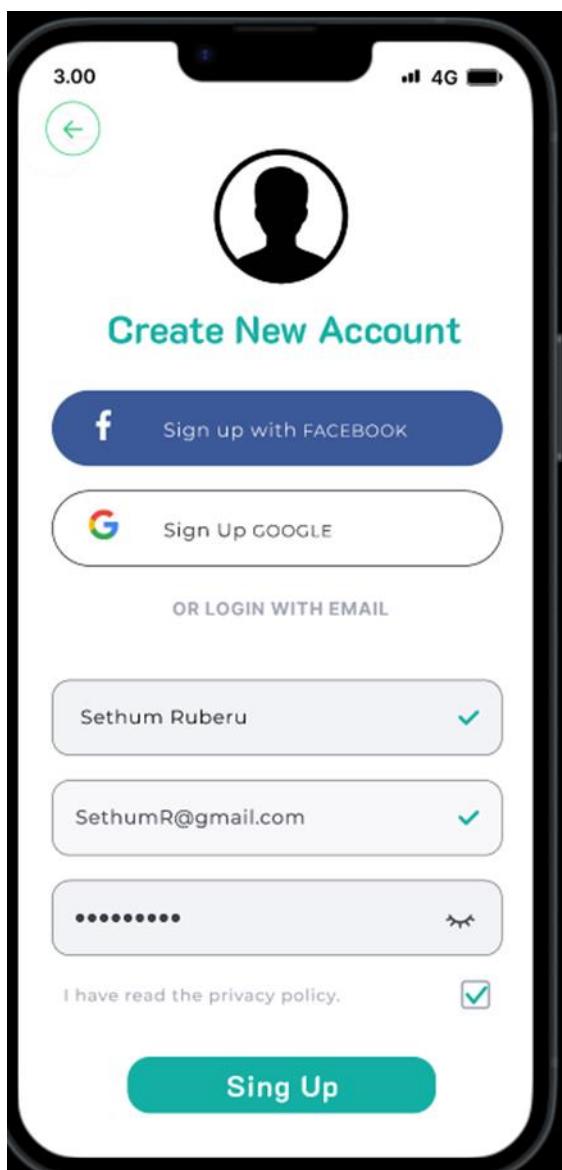


Figure 14-6-Create new account page screenshot

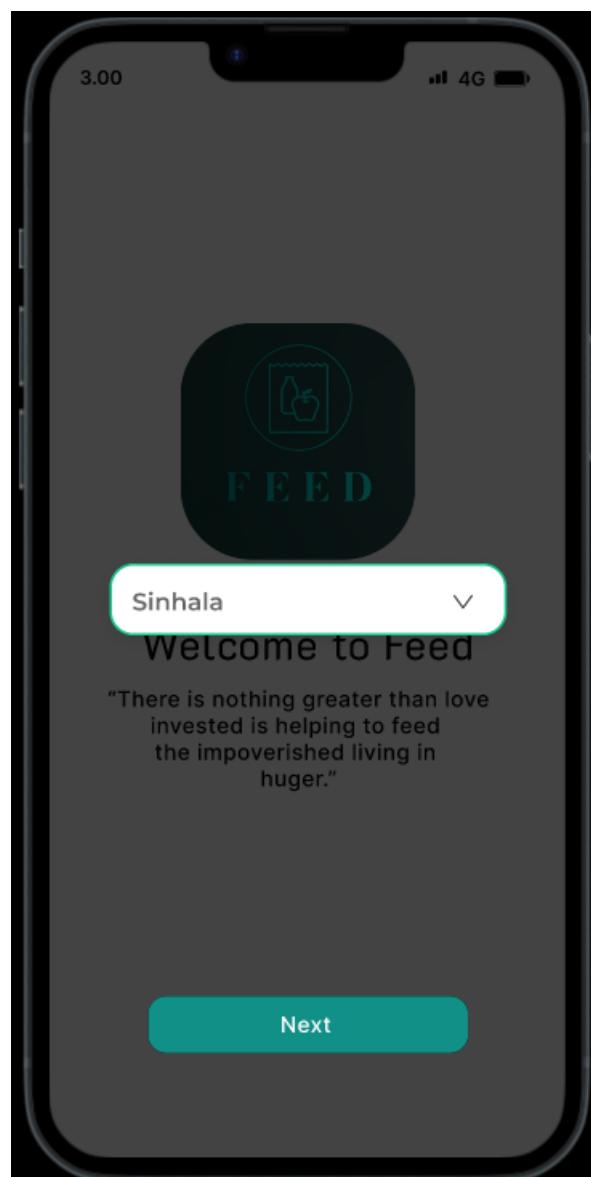


Figure 13-6-Sinhala language selection screenshot



Figure 16-6-Sinhala language sign in page 1 screenshot



Figure 15-6-Sinhala language sign in page 2 screenshot

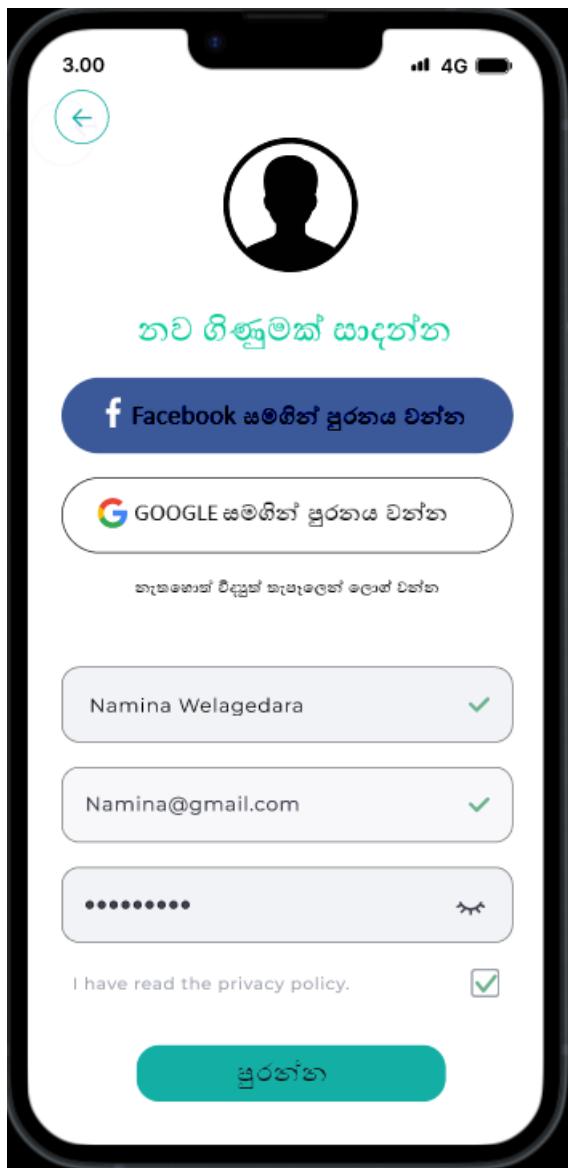


Figure 18-6-Sinhala language sign in page 3 screenshot

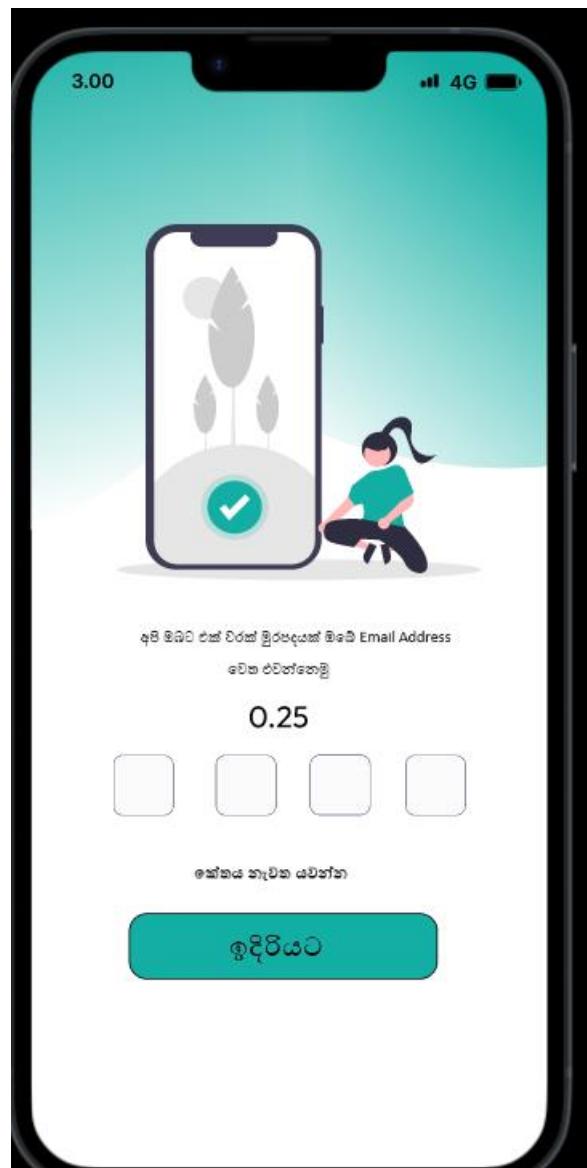


Figure 17-6-OTP verification page screenshot



Figure 20-6-Sign in completed screenshot

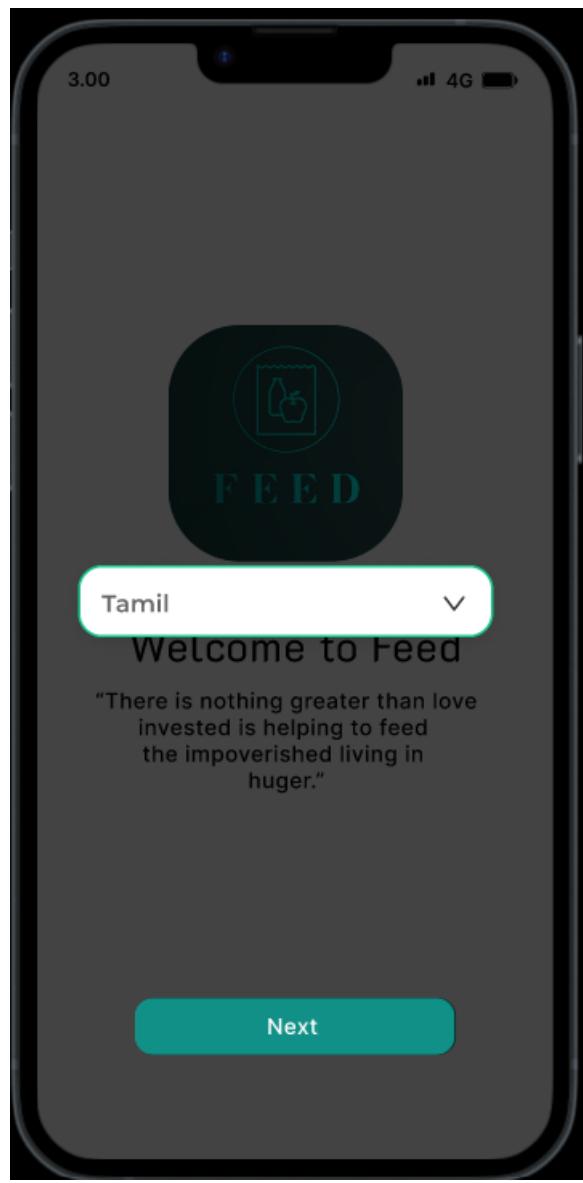


Figure 19-6-Tamil language selection screenshot

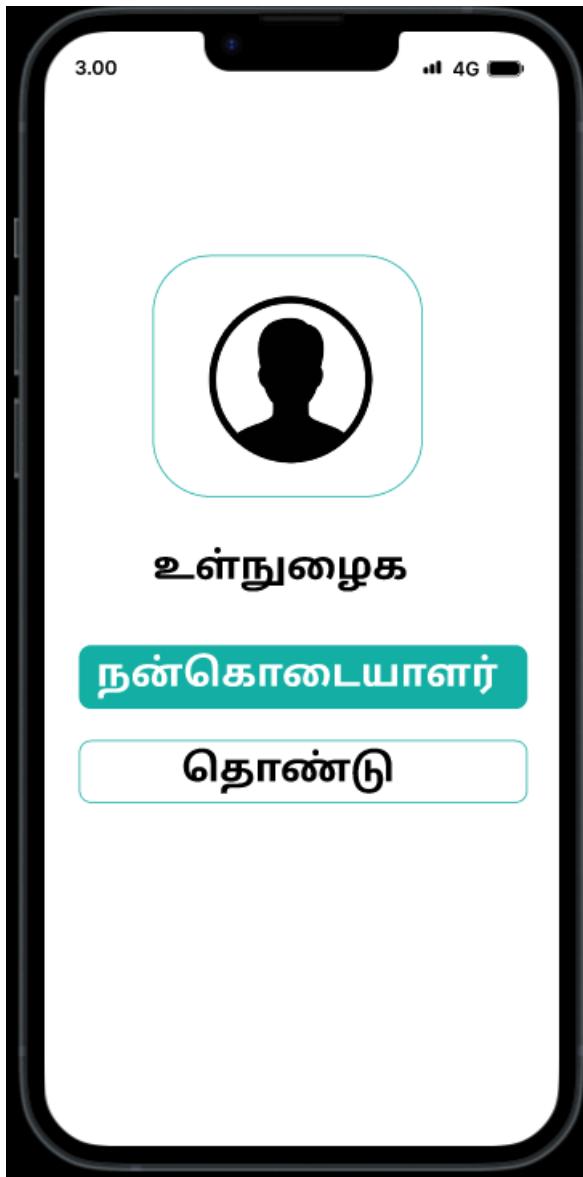


Figure 22-6-Tamil language sign in page 1



Figure 21-6-Tamil language sign in page 2

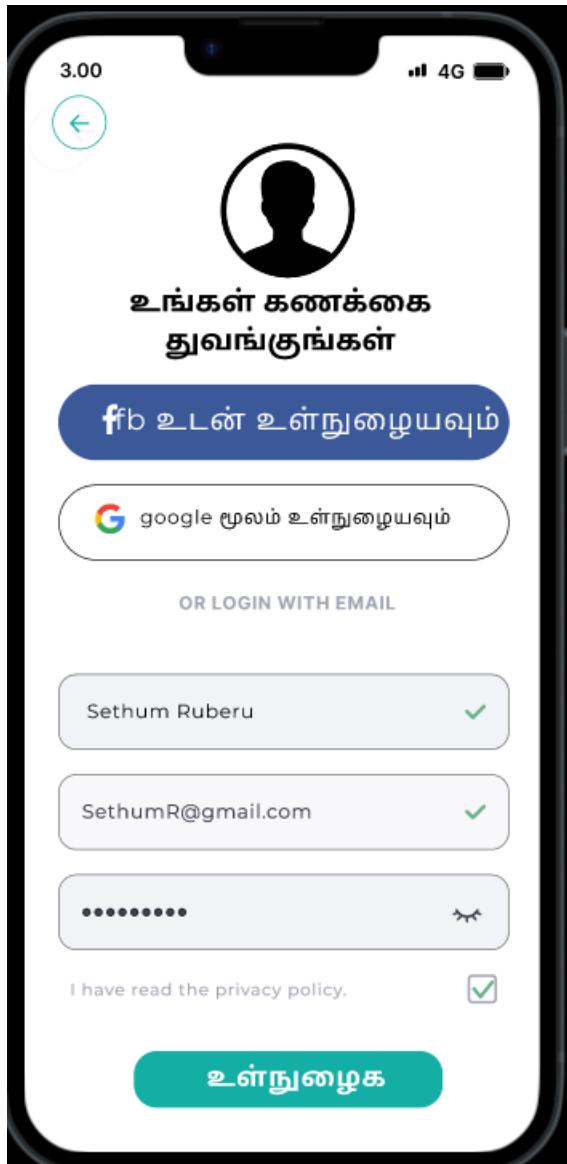


Figure 24-6-Tamil language sign in page 3

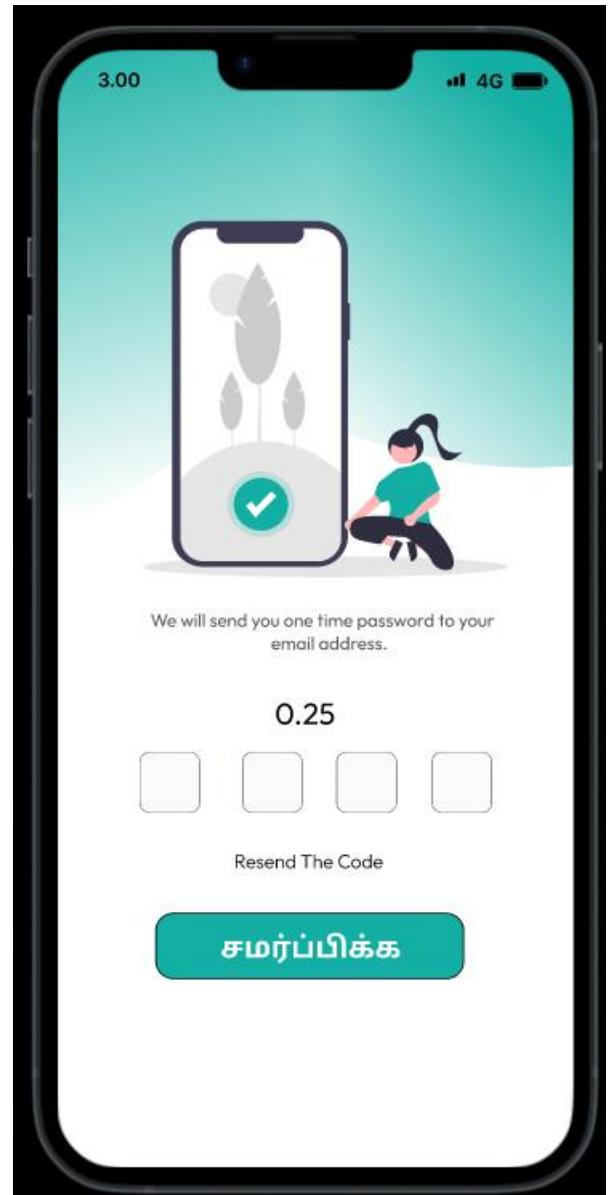


Figure 23-6-Tamil language OTP verification page screenshot

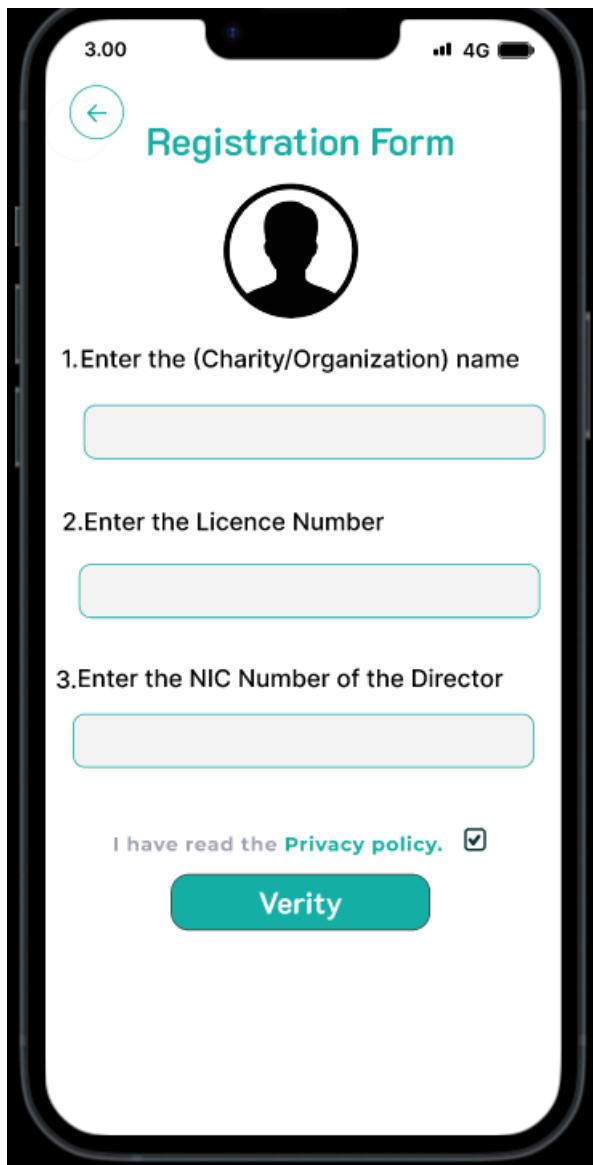


Figure 26-6-Charity verification feature page screenshot

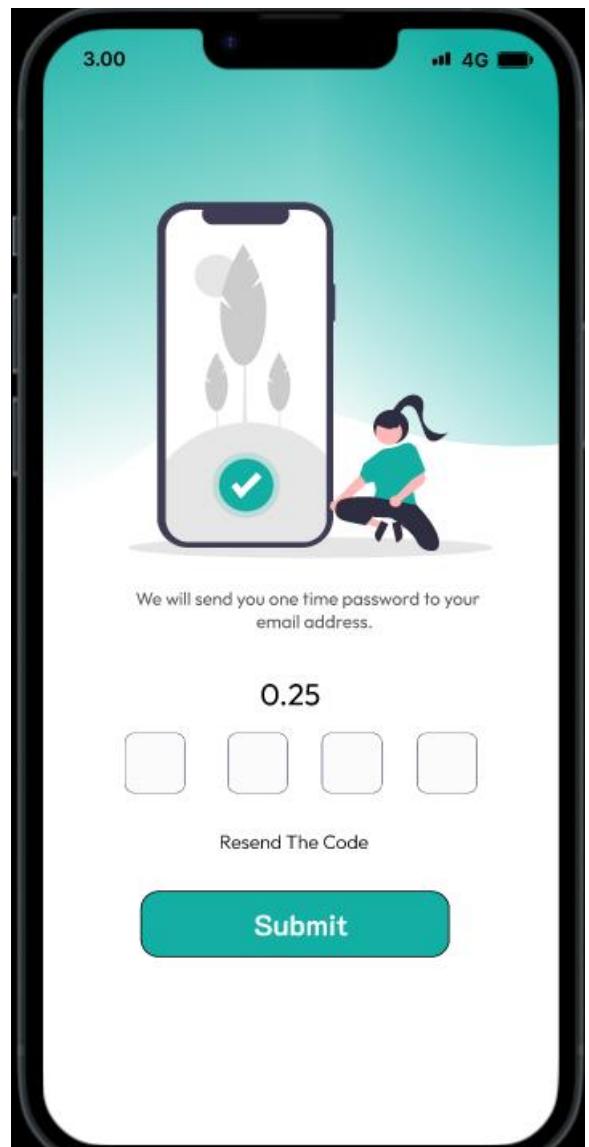


Figure 25-6-Charity OTP verification page screenshot

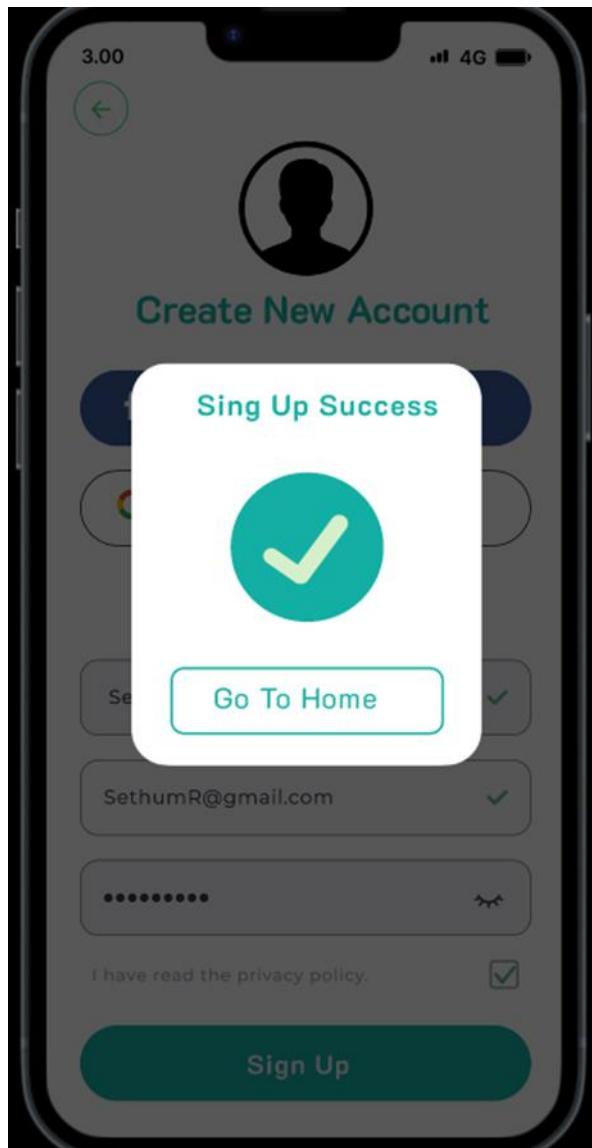


Figure 28-6-Successful sign in page screenshot

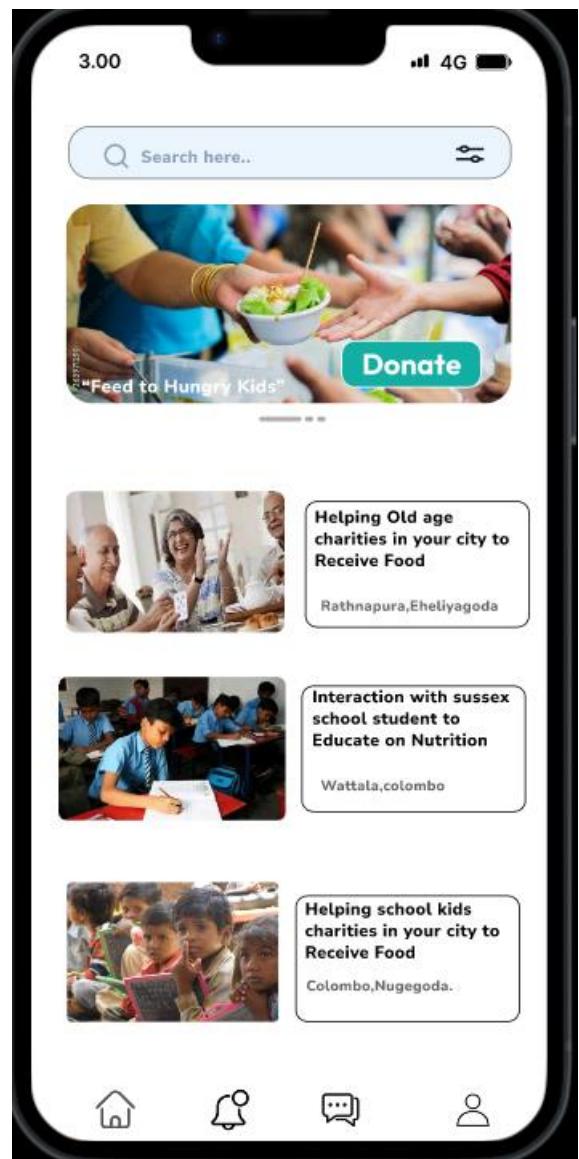


Figure 27-6-Donor homepage screenshot

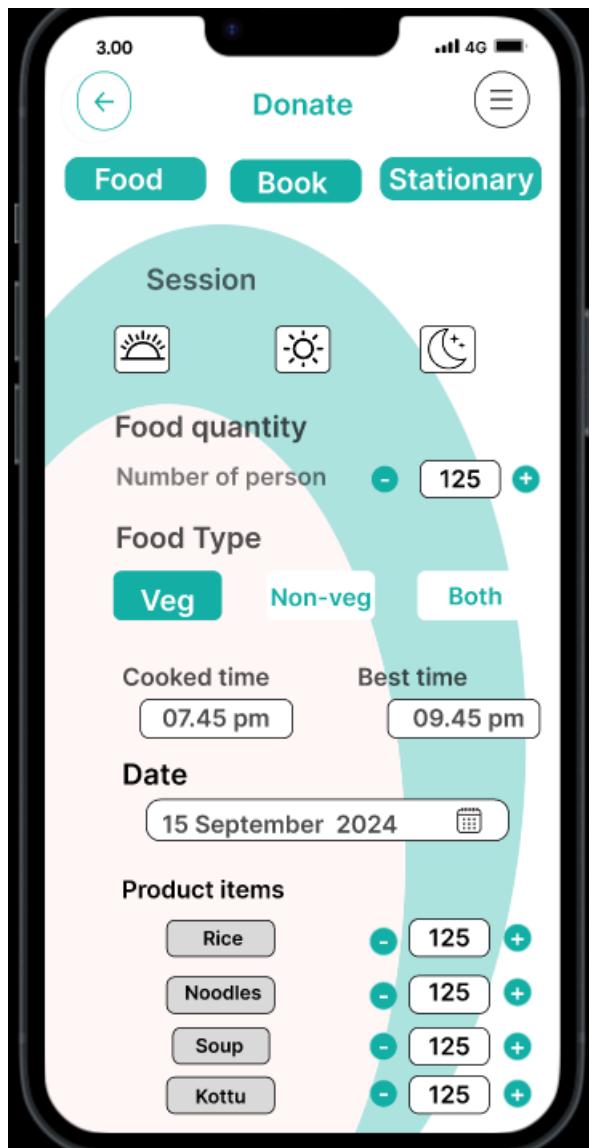


Figure 30-6-Donor inventory feature page screenshot

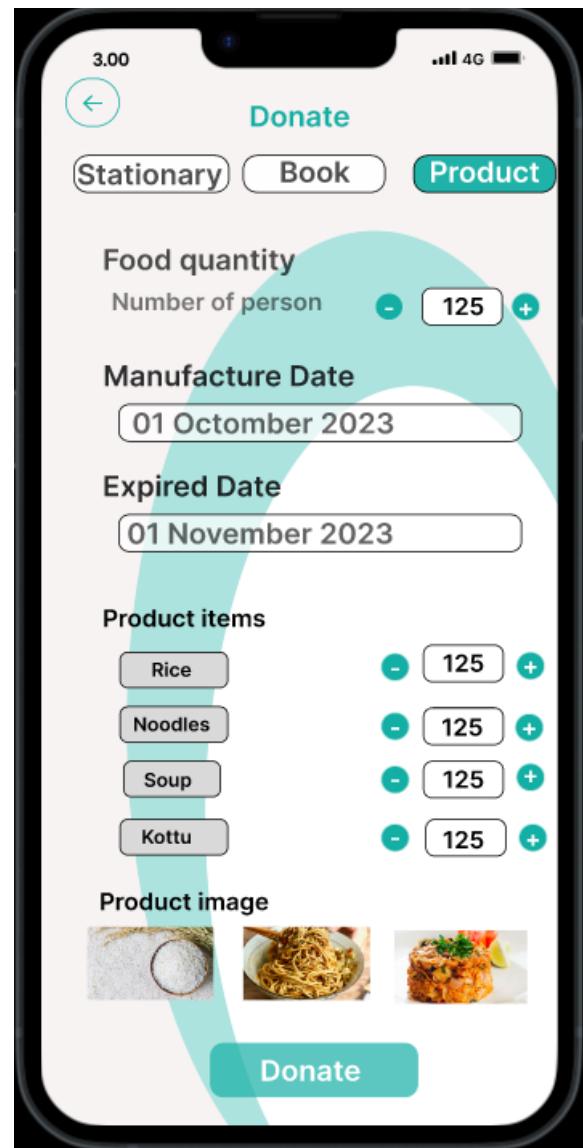


Figure 29-6-Donor inventory feature page details entering screenshot.

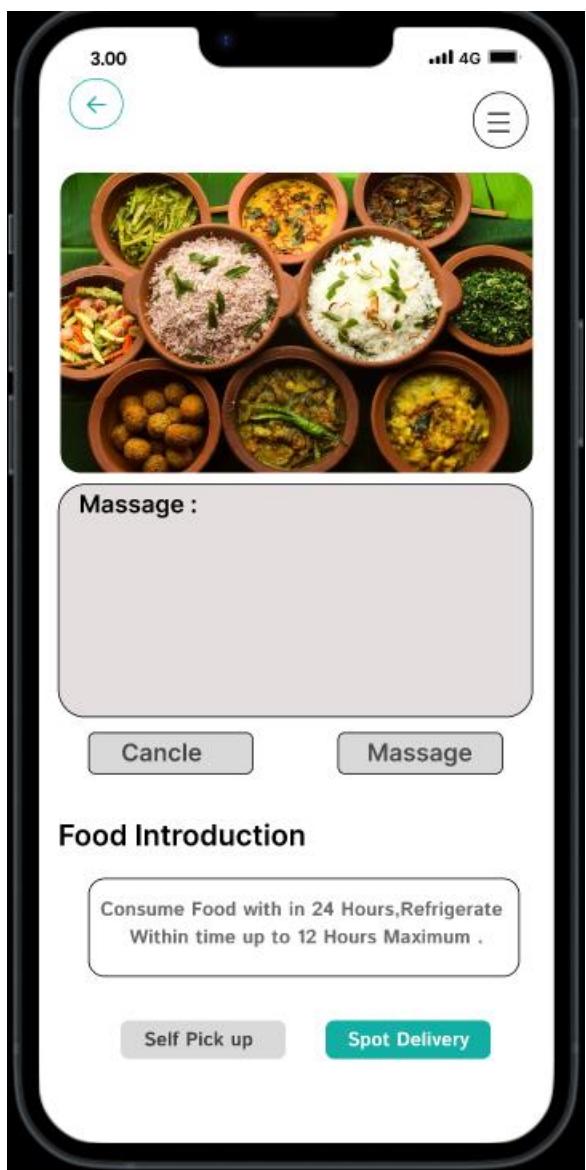


Figure 32-6-Entering information about donation item screenshot

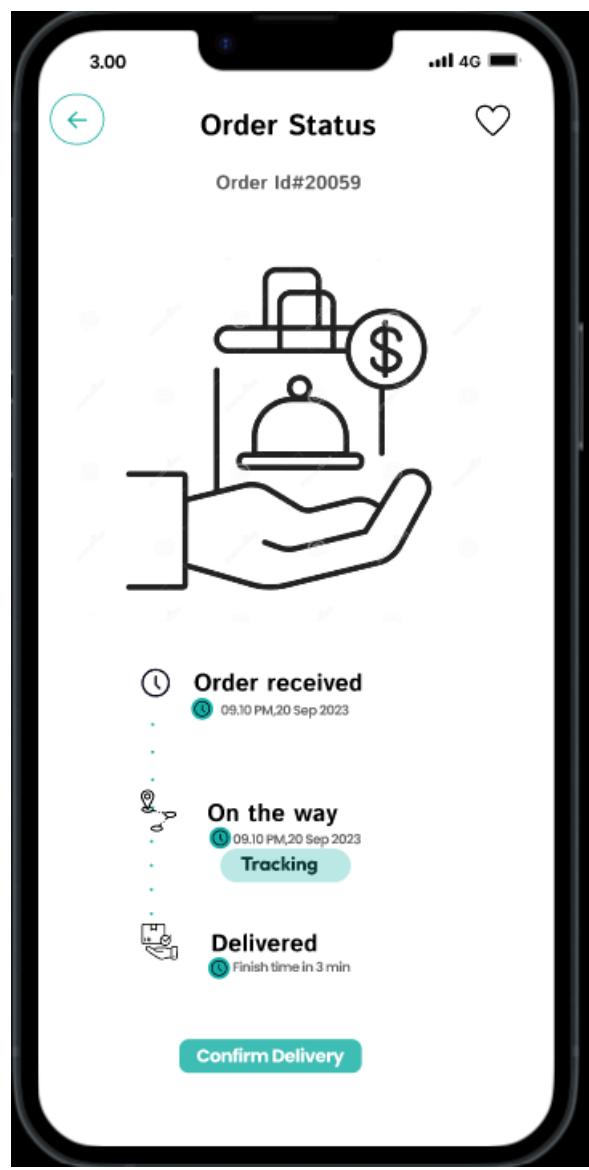


Figure 31-6-Food donation status screenshot

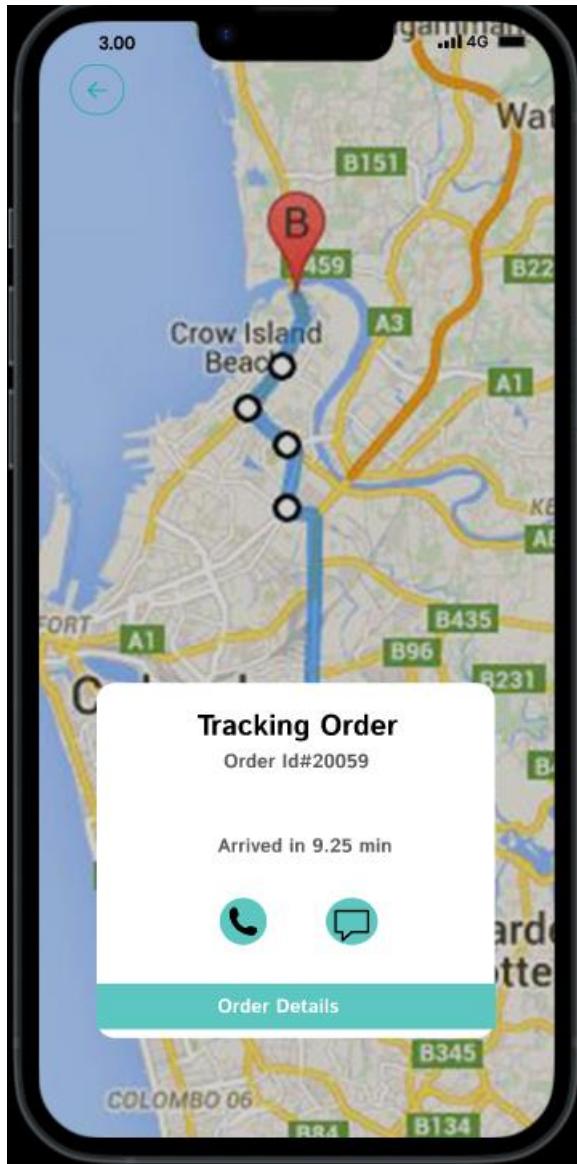


Figure 34-6-Donation tracking feature screenshot

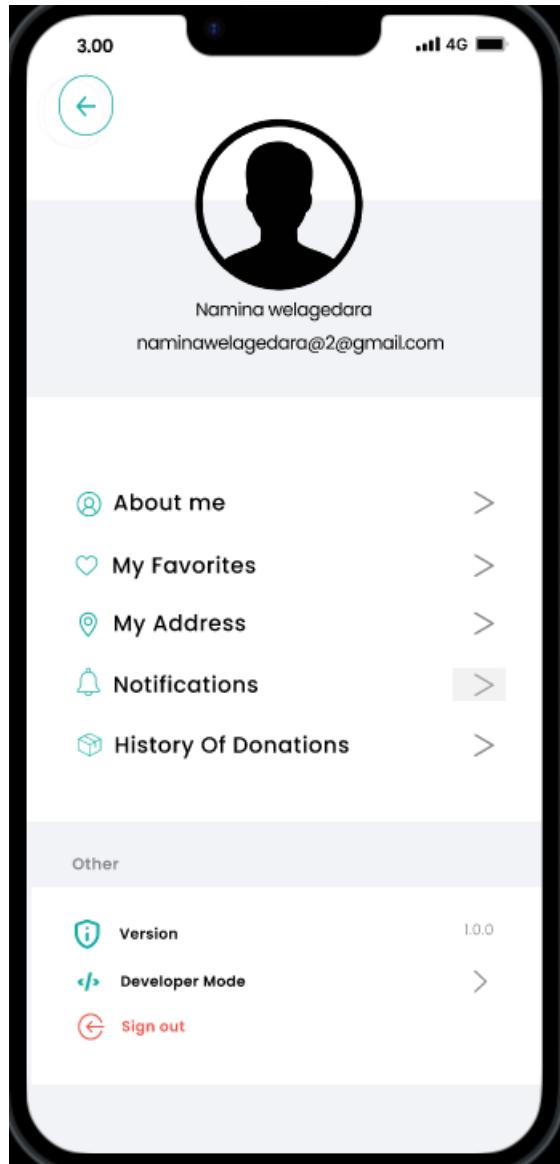


Figure 33-6-Donor profile page screenshot

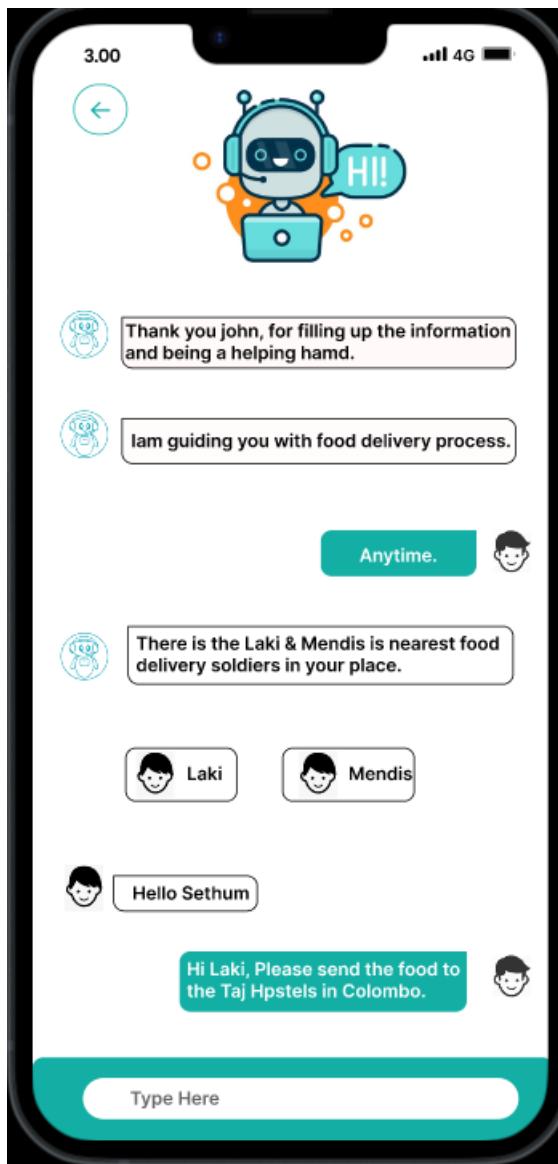


Figure 36-6-One to one chat feature of donor interface screenshot

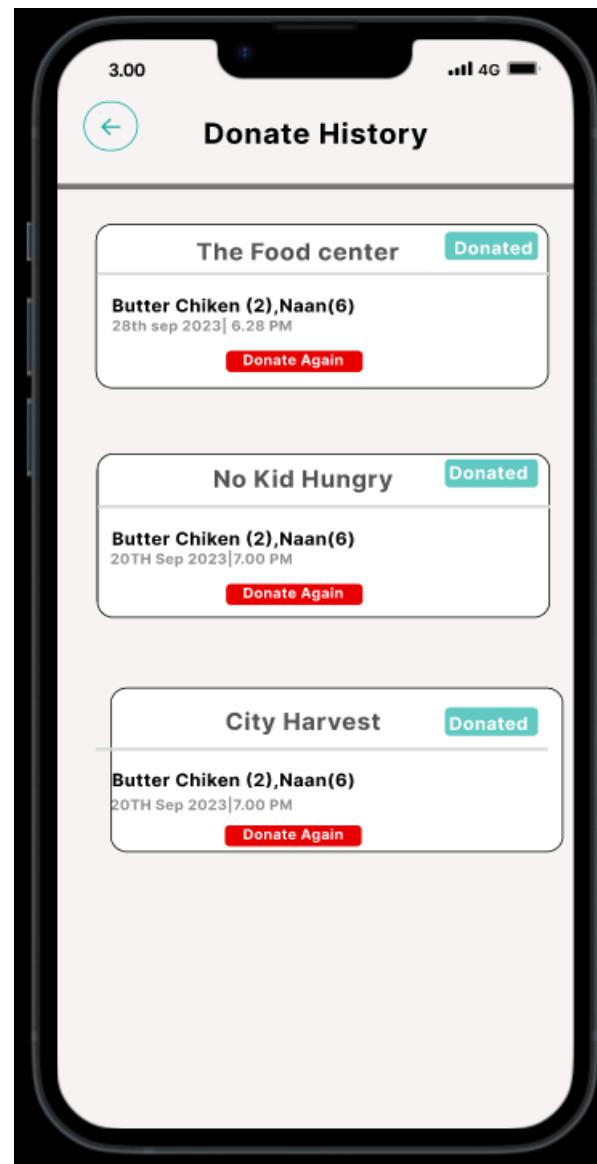


Figure 35-6-Donation History page of donors screenshot

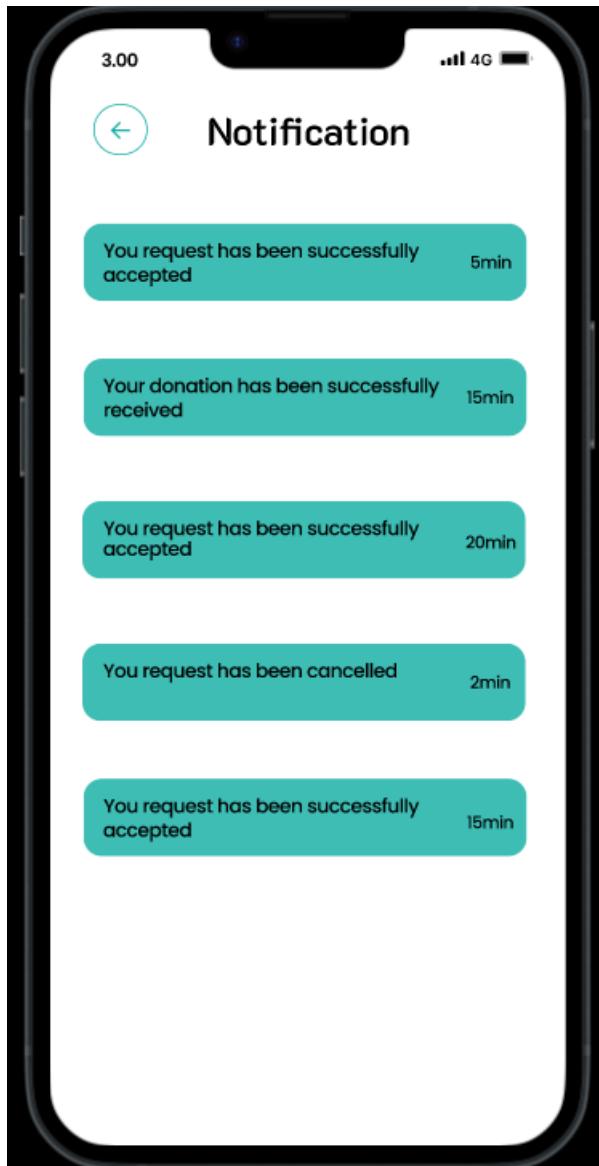


Figure 38-6-Notification page of donor interface screenshot

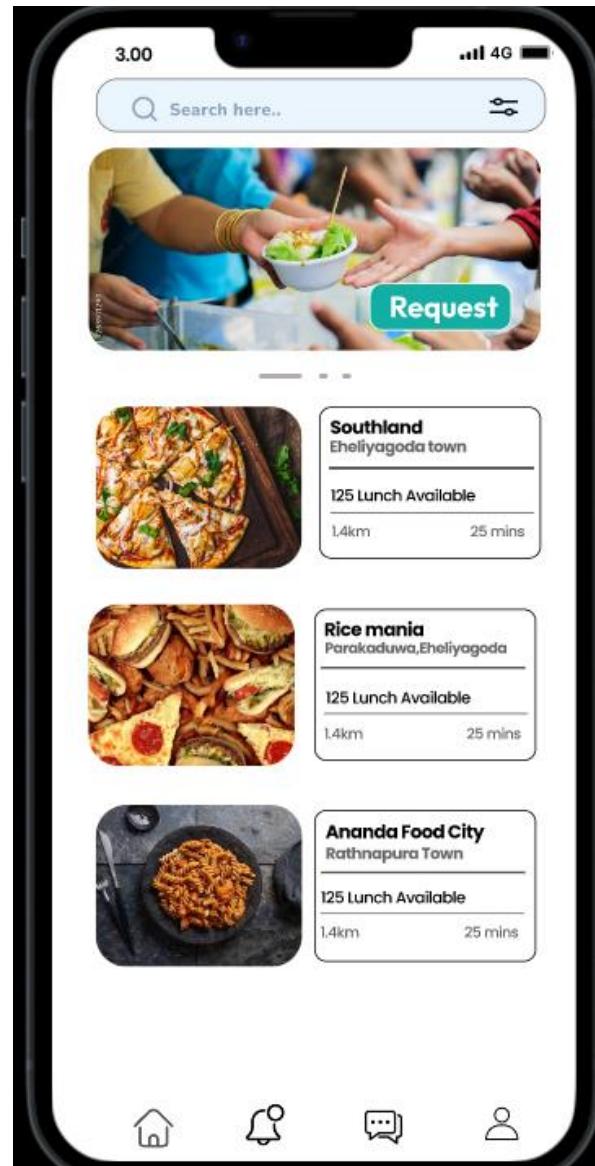


Figure 37-6-Home page of charity screenshot

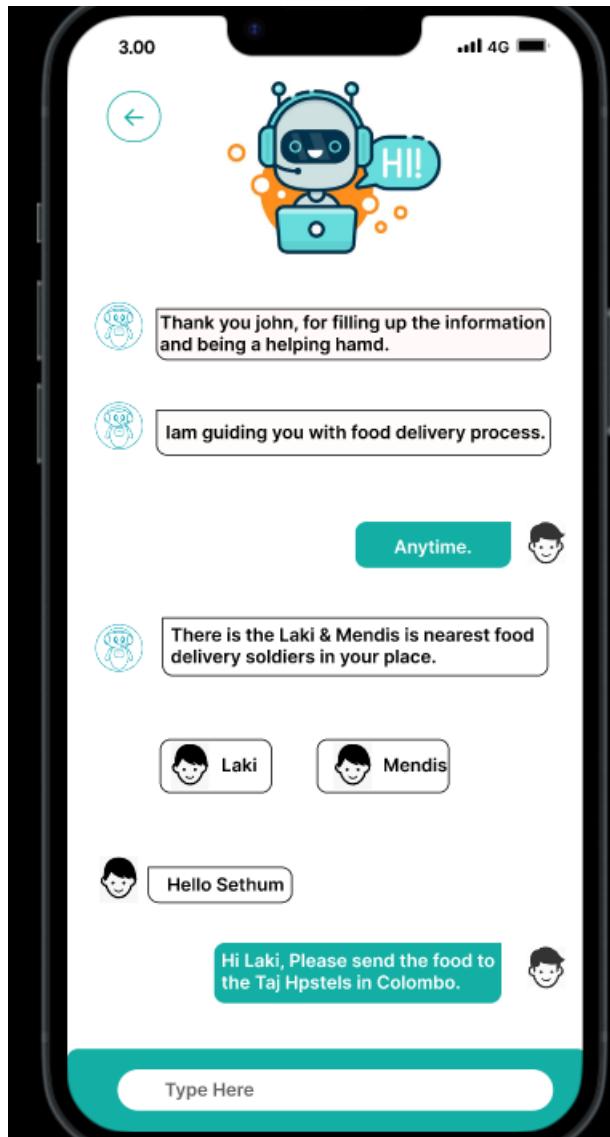


Figure 40-6-One to one chat feature of charity interface screenshot

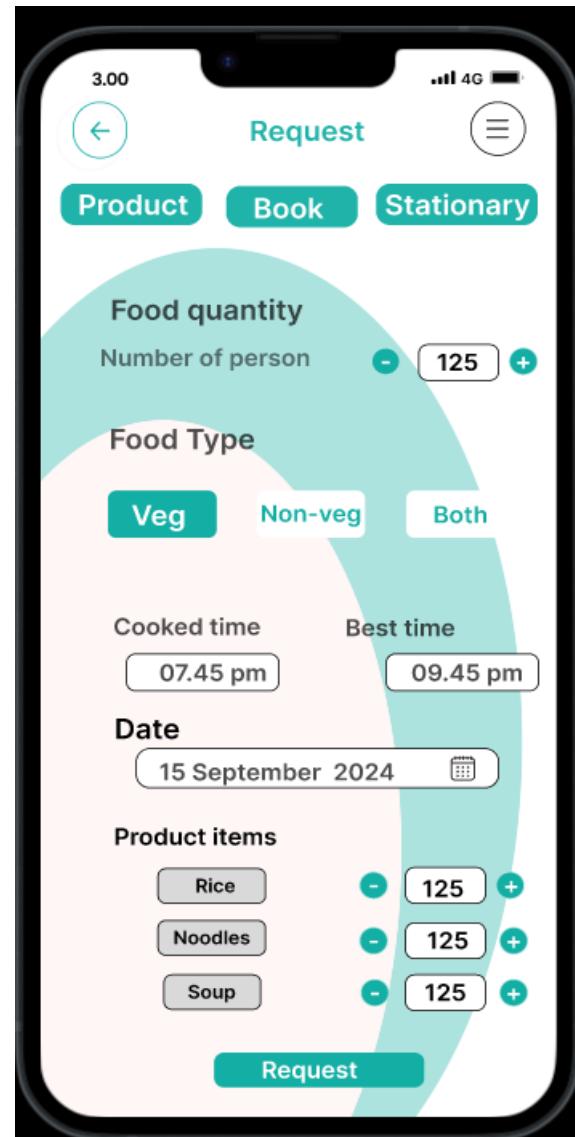


Figure 39-6-Charity food request page screenshot

7.Evaluation

7.1 Detailed Analysis of the solution

“FEED” application was created to connect donors with surplus food to the charities searching for food. A variety of features are available on “FEED” app to improve the user experience and to make the donation processes more easier and convineant. Donors will be able to create account in the application by using their google account or email and Charities need to go under a verification process as well to verify them as non-profit organizations. “FEED” app offers a comprehensive list of charities nearby for the donors to donate food and also it offers a comprehensive list of food items available for donation in nearby places along with the location, Food Type, Quantity, Special notes. Users will also provide insightful criticism through reviews and ratings and feedback.

“FEED” application offers real-time availability updates of donations, requests for donations, capabilities for maintenance requests and issue reporting, ensuring smooth communication between donors and charities. Donors and Charities are informed through notifications of donation requests and donation status and sensible reminders. “FEED” places a high priority on security and privacy to protect the data and information of the users. “FEED” looking to be a dependable platform for both donors and charities to engage in smooth outstanding donation progress.

7.2Internal Testing

The internal testing of the Food Donation App revealed positive findings across key areas. The user interface was found to be intuitive, aesthetically pleasing, and well-organized, contributing to a positive user experience. Functionality testing confirmed that essential features, such as registration, donation posting, donation requesting, delivery status, location services, inventory, rating and retrieval, worked smoothly without glitches. The app demonstrated prompt and accurate notifications for successful transactions and maintained a seamless in-app messaging system between donors and recipients. In terms of performance, the app displayed

optimal speed, responsiveness, and resource utilization, ensuring an efficient user experience. Security measures were robust, with encrypted data transmission and strong authentication mechanisms in place, aligning with industry standards.

7.3 External Testing

External testing involved collecting user feedback through issuing questionnaires, which largely reflected positive sentiments regarding the app's ease of use, intuitive design, and real-time notifications. Users expressed appreciation for the app's compatibility across different devices and operating systems, noting a consistent and responsive experience. Performance under load testing indicated the app's resilience during peak usage times, with no reported crashes or slowdowns. While a few minor bugs were reported, such as occasional delays in message delivery, the development team demonstrated responsiveness by actively addressing these issues through regular updates.

7.4 Lessons Learned

Developing a food donation app that allows users to donate surplus food has been a wonderful learning experience. Understanding the diverse requirements and capabilities of donors and charities has emphasized the need of developing a platform that is not only effective and technically solid but also truly human-centered. Dealing with regional communities and organizations has shown us just how essential it is to adapt the app to certain logistical and social circumstances in order to ensure its applicability and efficiency. Furthermore, managing the regulatory framework has highlighted the need for strong compliance procedures, especially with regard to food safety and data privacy. These lessons are still crucial as we develop and enhance the app, serving as a reminder that the effectiveness of technology in resolving social issues depends on its capacity to connect with and empower users.

7.5 Recommendations for future works

Based on the evaluation works and lessons learned, various recommendations for future work can be proposed. expanding the app's reach to new regions and communities. This involves collaborating with local organizations and understanding specific needs and preferences in different areas. Also, gamification elements into the app to incentivize and reward users for consistent contributions. This could include badges, leaderboards, or recognition for users who make significant impacts in terms of the quantity or quality of donated food, fostering a sense of community and friendly competition. By incorporating these recommendations, the food donation app can evolve into a more comprehensive, user-friendly, and impactful platform, addressing not only immediate needs but also contributing to broader societal and environmental goals.

8.Conclusion

“FEED” application has successfully achieved its basic goals and objectives by providing a solution for the donors and charities to connect with each other and engage in donation activities. Through a human centred approach “FEED” app was tailored to meet the food and other donation needs of charities and also for the restaurants, donor individuals, business organizations to donate surplus items they have, resulting in an effective and aligned solution.

“FEED” app has some limitations that require attention for continuous improvement and long-term success. Expanding the app’s reach to several other regions enabling charities in other regions also get benefits by the app also enabling donors to manage their inventory with surplus items available for donation and gamification elements included in the app with badges, leaderboards, or recognition for users who make significant impacts in terms of the quantity or quality of donated food, fostering a sense of community and friendly competition. The project team needed to be remained committed to iteration evaluation and improvement of the “FEED” app according to user feedback and emerging future technologies.

In conclusion, “FEED” app has proven to be successful platform in addressing the problems such as food wastage and food insecurity through innovative solutions. Its achievement in obtaining the expected outcomes and goals showcases its potential to make a significant change in the society. By addressing the identified weaknesses and limitations, carrying out the future work with a focus on continuous improvement of the solution will undoubtedly attract the audience and gives a recognition to the product in the market.

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10.Appendices

10.1 Workload Matrix

	Anusigan Sivananthan (20230297)	Lithila Mahagedara (20230176)	N.T Welagadara (20222090)	M.H.A Daneesha Hansaka (20230229)	Senumi Dahanayake (20230148)
Abstract	✓				
Acknowledgement			✓		
Introduction and Description	✓				
Problem Specification					✓
Gap Analysis	✓	✓	✓	✓	✓
Methodology	✓	✓		✓	✓
Solution outline				✓	
Mind map	✓	✓	✓	✓	✓
Innovative features incorporated		✓	✓		✓
Requirements Analysis	✓			✓	
Context Diagram	✓	✓		✓	✓
Prototype			✓		
Evaluation		✓			
Conclusion	✓				✓
References		✓		✓	
Appendices	✓			✓	

Report Formatting	✓				
Proof Reading	✓	✓	✓	✓	✓

Table 1-10.1-Workload matrix

10.2 Meeting Agenda

Location	Common room
Date	09/10/2023
Time	50 minutes

Table 2-10.2-Meeting agenda 01

Agenda Goals

- Deciding the complex problem.
- Introduction of the members of the team.
- Appointing a Leader for the project.

Location	Lab 5
Date	11/10/2023
Time	40 minutes

Table 3-10.2-Meeting agenda 02

Agenda Goals

- Coming up with a solution to the problem
- Problem Justification

Location	Lab-03
Date	13/10/2023
Time	60 minutes

Table 4-10.2-Meeting agenda 03

Agenda Goals

- Finding the innovative features, we can come up with for the solution.
- Designing the mind map

Location	Lab 7
Date	17/10/2023
Time	1 hour and 30 minutes

Table 5-10.2-Meeting agenda 04

Agenda Goals

- Gap analysis table

Location	Online Meeting (zoom)
Date	29/10/2023
Time	1 hour and 30 minutes

Table 6-10.2-Meeting agenda 05

Agenda Goals

- Deciding of the software development life cycle model
- Justification of chosen model

Location	Online Meeting (zoom)
Date	15/11/2023
Time	1 hour and 30 minutes

Table 7-10.2-Meeting agenda 06

Agenda Goals

- Prototype sketching

Location	Lab3
Date	28/11/2023
Time	1 hour and 30 minutes

Table 8-10.2-Meeting agenda 07

Agenda Goals

- Carrying out test cases for the prototype.

Location	Lab3
Date	01/12/2023
Time	1 hour and 30 minutes

Table 9-10.2-Meeting agenda 08

Agenda Goals

- Proof reading of the draft report.

10.3 Meeting Minutes

No	Date	Time duration	Participants	Minutes
1	09/10/2023	50 minutes	20230297 20230176 20222090 20230229 20230148	Got introduced in the team and appointed Student Id:20230297 as the leader of the group. Decided the complex problem that we are going to comeup with the solution
2	11/10/2023	40 minutes	20230297 20230176 20222090 20230229 20230148	Analysed the justification of the problem. Decided about the solution.

3	13/10/2023	60 minutes	20230297 20230176 20222090 20230229 20230148	Found out the innovative features to add in the app. Designed a mind map for the application(solution)
4	17/10/2023	1 hour 30 minutes	20230297 20230176 20222090 20230229 20230148	Designed gap analysis table.
5	29/10/2023	1 hour and 30 minutes	20230297 20230176 20222090 20230229 20230148	Finalized the SDLC models to implement in the project.
6	15/11/2023	1 hour and 30 minutes	20230297 20230176 20222090 20230229 20230148	Sketched and planned the prototype.

7	28/11/2023	1 hour and 30 minutes	20230297 20230176 20222090 20230229 20230148	Tested the app prototype.
8	01/12/2023	1 hour and 30 minutes	20230297 20230176 20222090 20230229 20230148	Proof reading of IFD

Table 10-10.3-Meeting minutes

10.4 Requirement Elicitation Interview Questions

10.4.1 For Donors

1. What motivates you to provide food donations to people in need?
2. What is the average number of times and quantity of food that you donate?
3. What difficulties did you face when attempting to donate food?
4. What features would be beneficial in an app to make food donation easier?
5. How would you want to be notified when there are opportunities for food donations?
6. What types of food do you like to contribute, and is there any rules or limitations that you stick to?

7. To what extent does receiving information about the impact of your donations matter to you?
8. If you have any concerns about using a food donation app, what are they?
9. How might you find the procedure more convenient using a food donation app?
10. Are there any charities or food banks you prefer to donate to, and why?

10.4.2 For Donation Recipients (Charities)

1. Could you briefly describe your organization and the ways that food contributions support it?
2. What kinds of meals do you often need to provide for the individuals you look after, and are there any dietary restrictions?
3. What are the non-food items required as donation?
4. What issues do you currently have and how do you currently get food donations?
5. Currently, how do you collect and distribute food donations?
6. Would you be interested in learning about possible food donations? For this, do you utilize any apps?
7. Which features would be most beneficial for your organization in a food donation app?
8. What details are crucial to you while thinking about donating food?
9. How crucial is it that your organization provide contributors with feedback?
10. Do you have any concerns regarding utilizing an app that donates food?

10.4.3 Responses of the interview questions for donors

Responses we got through interviewing Mr.R.Rishaanth who is engaging in donation activites for past 5 years.

1. What motivates you to provide food donations to people in need?

The fact that we are all humans and all of us deserve to be fed properly.

2. What is the average number of times and quantity of food that you donate?

Once a month,30 servings of rice.

3. What difficulties did you face when attempting to donate food?

Making sure the food actually goes to the people in need.

4. What features would be beneficial in an app to make food donation easier?

Tracking and being able to communicate what is exactly required.

5. How would you want to be notified when there are opportunities for food donations?

Via whatsapp

6. What types of food do you like to contribute, and is there any rules or limitations that you stick to?

Rice and mains.

7. To what extent does receiving information about the impact of your donations matter to you?

I would like to know if my donations have been beneficial to someone.

8. If you have any concerns about using a food donation app, what are they?

The verisimilitude of the app to be assured.

9. How might you find the procedure more convenient using a food donation app?

With tracking it will be more efficient and satisfactory

10. Are there any charities or food banks you prefer to donate to, and why?

No

10.4.4 Responses of the interview questions for donation recipients

These are the responses we got through interviewing the officials of the non-profit organization “The Foundation of Goodness”.

1. Could you briefly describe your organization and the ways that food contributions support it?

Launched in 2022, the Foundation of Goodness' 'Feed a Child' School Meals Programme is a vital initiative that provides much-needed support to the children of Sri Lanka who struggle with limited access to nutritious meals through mid-day meals and so far 102,000+ meals have been provided to 103 schools from all 25 districts.

2. What kind of meals do you often need to provide for the individuals you look after and are there any dietary restrictions?

The Feed a Child programme provides nutritious midday meals at school while the Feed the Hungry Programme (which has concluded for the year now) provides grocery packs consisting of rice, lentils and soya meat for families struggling to afford meals.

3. What are the non-food items required as a donation?

This programme can feed 24 children with USD 10 (one meal is Rs. 150) and we only accept monetary donations for these programmes. (Please note that no administrative cost is charged for any of our programmes and all donations go solely to the respective programmes)

4. What issues do you currently have and how do you currently get food donations?

The donations are currently donor based and we promote on social media to obtain donations.

5. Currently how do you collect and distribute food donations?

Through our 18 Village Heartbeat Empowerment Centers island wide, we are able to make and distribute midday meals to the respective schools. We obtain permission from the schools beforehand as well.

6. Would you be interested in learning about possible food donations? For this, do you utilize any apps?

Yes, and currently we do not use any app.

7. Which features would be most beneficial for your organisation in a food donation app?

A feature that could facilitate updating the donor.

8. What details are crucial to you while thinking about donating food?

Cleanliness and nutritional value

9. How crucial is it that your organization provide contributors with feedback?

As we are entirely donor based, feedback and project updates are most important and currently we send a receipt when the donation is received along with an acknowledgement and once the distribution is completed, we update the donor on how and where their donation was utilized and what sort of impact their contribution had.

10. Do you have any concerns regarding utilizing an app that donates food?

The streamlining of the donation process is a concern.

10.5 Requirement Elicitation Questionnaires

10.5.1 Questionnaires for Donors

FEED Food Donation App : Tackling Hunger

We appreciate your participation in this poll. Your feedback is important to us as we develop the FEED Food donation app because it helps us better understand the wants and expectations of donors like you. Please take some time to respond to the following survey. Your responses won't be shared with anyone.

Figure 41-10.5.1-Questionnaire for Donors

Age?*

- 16 - 30
- 31 - 50
- 50 and above

Individual or Business ?*

- Individual
- Business

Gender?*

- Male
- Female
- Other

How often do you typically have surplus food available for donation?

- Daily
- Weekly
- Monthly

What types of food do you usually have available for donation? (e.g., non-perishable, perishable, cooked meals)

- Non-perishable
- Perishable
- Cooked meals
- Non-Food Items (Clothes, Books)

If the above answer is Non-Food Items please describe

-

Your answer

What times are most convenient for you to arrange for food pickups?

- Breakfast
- Lunch
- Dinner

How much food do you typically have available for donation? (e.g., number of items, weight)

- Your answer

Do you have any specific requirements or concerns related to food safety when donating?

- Choose

How do you typically package and store the food you donate? (e.g., sealed containers, refrigerated)

- Refrigerated
- Sealed containers

Do you have any preferences for the type of organizations ?

*

- Orphanages
- Charities
- Food Banks

How would you prefer to be notified about available donation opportunities?

- App notifications
- Email
- SMS

Would you like the option to provide feedback on your donation experiences? If so, how would you prefer to do so?

- Your answer

Is there anything else you would like to share or suggest regarding the food donation process?

- Your answer

10.5.2 Responses for the questionnaires for Donors

Age?
31 responses

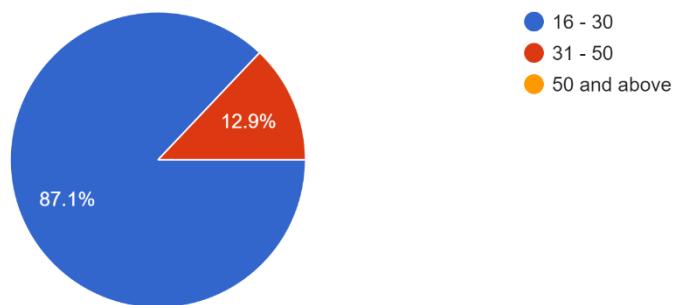


Figure 42-10.5.2-Response 1

Individual or Business ?
30 responses

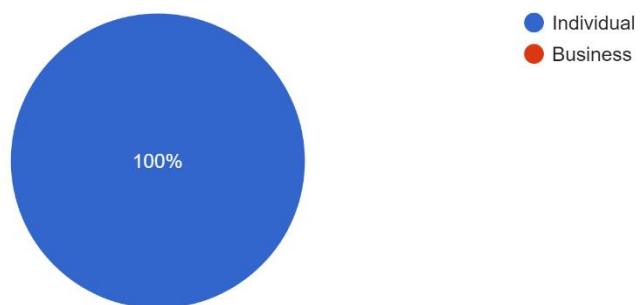


Figure 43-10.5.2-Response 2

Gender?

31 responses

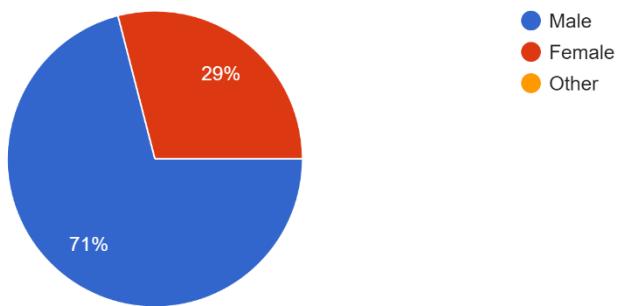


Figure 44-10.5.2-Response 3

How often do you typically have surplus food available for donation?

31 responses

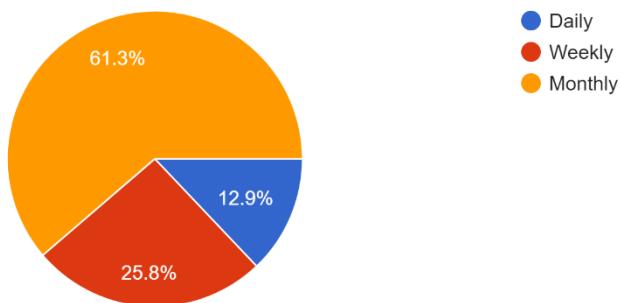


Figure 45-10.5.2-Response 4

What types of food do you usually have available for donation? (e.g., non-perishable, perishable, cooked meals)

31 responses

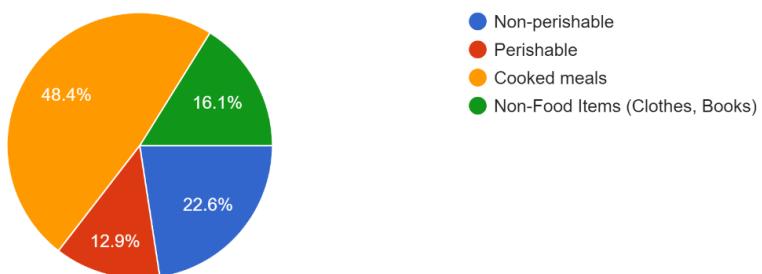


Figure 46-10.5.2-Response 5

If the above answer is Non-Food Items please describe
3 responses

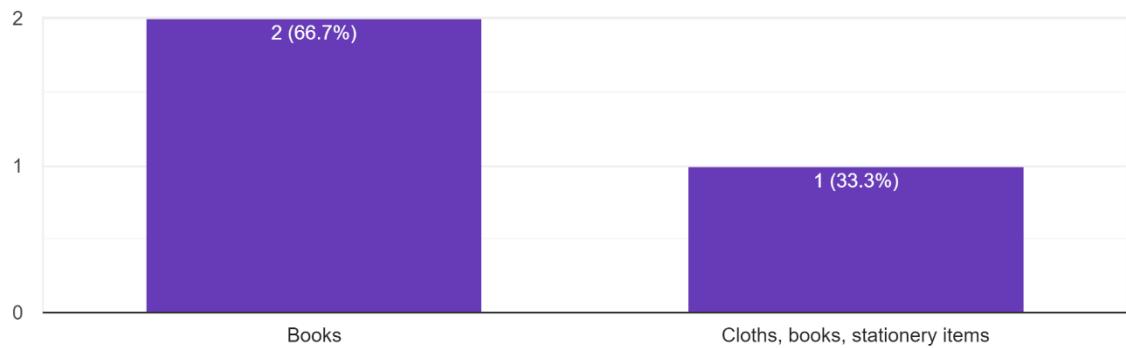


Figure 47-10.5.2-Response 6

What times are most convenient for you to arrange for food pickups?
30 responses

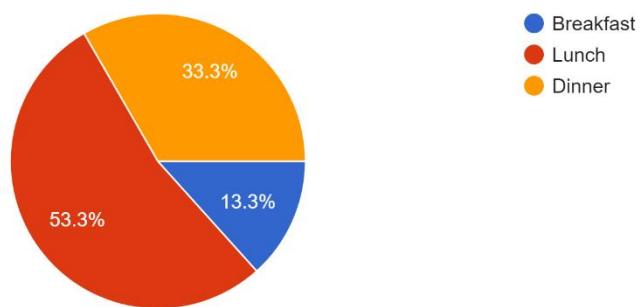


Figure 48-10.5.2-Response 7

How much food do you typically have available for donation? (e.g., number of items, weight)
14 responses

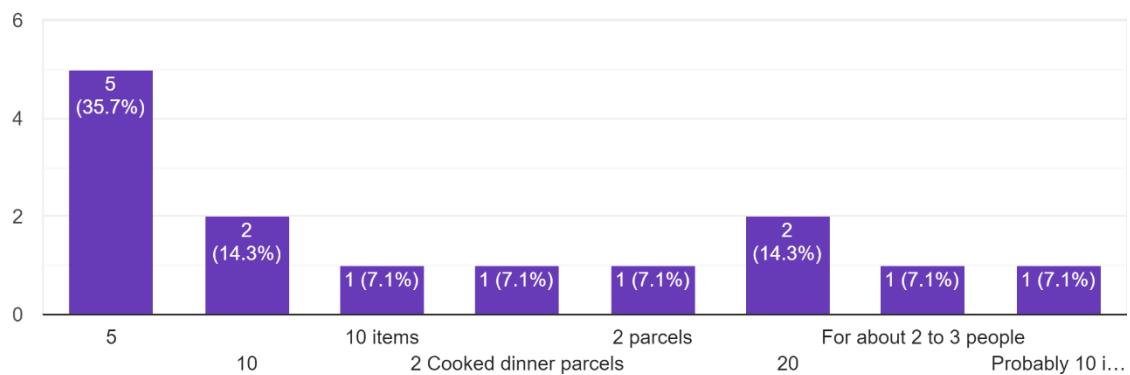


Figure 49-10.5.2-Response 8

Do you have any specific requirements or concerns related to food safety when donating?
29 responses

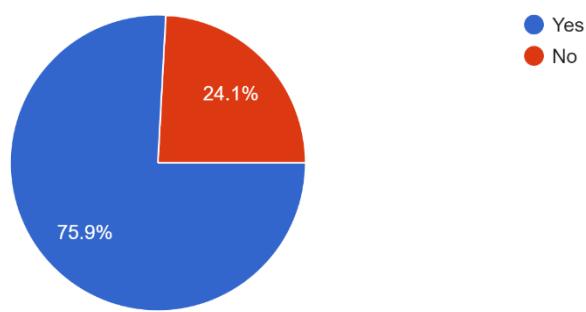


Figure 50-10.5.2-Response 9

How do you typically package and store the food you donate? (e.g., sealed containers, refrigerated)
28 responses

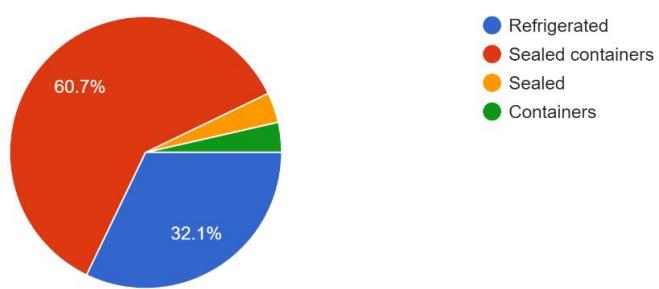


Figure 51-10.5.2-Response 10

Do you have any preferences for the type of organizations ?

29 responses

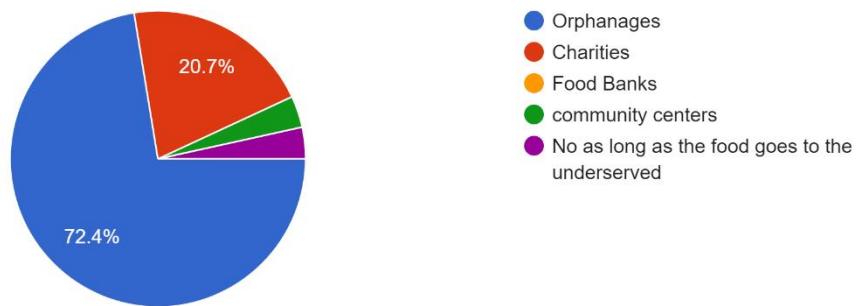


Figure 52-10.5.2-Response 11

How would you prefer to be notified about available donation opportunities?

30 responses

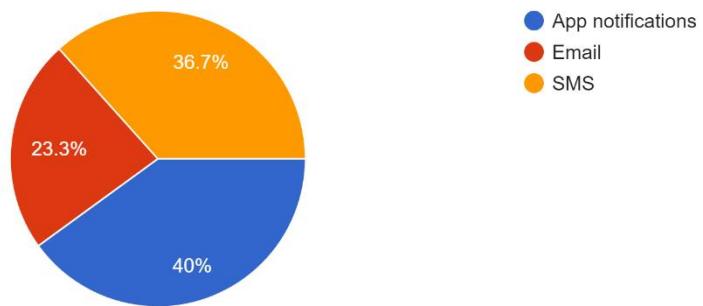


Figure 53-10.5.2-Response 12

Would you like the option to provide feedback on your donation experiences? If so, how would you prefer to do so?

7 responses

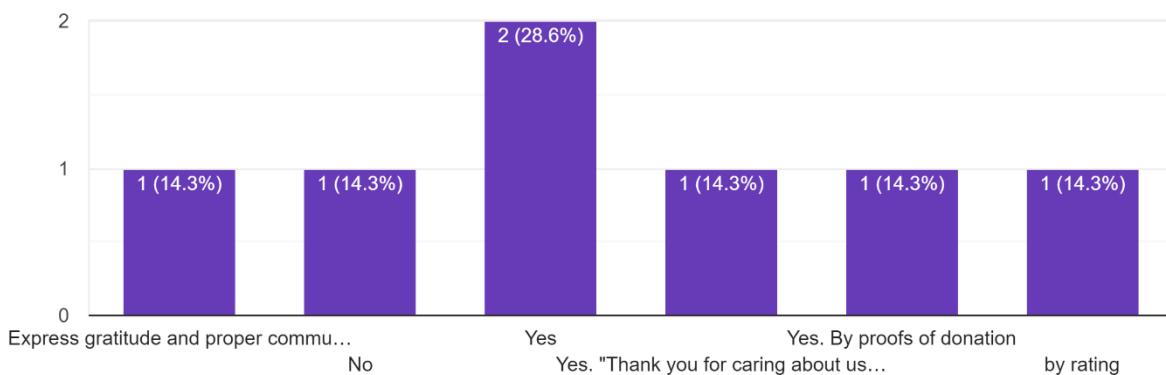


Figure 54-10.5.2-Response 13

Is there anything else you would like to share or suggest regarding the food donation process?

9 responses

Best of luck

No

Nothing more

That's great that you're interested in donating food!

Good Idea💡

Specific areas where the people who lack of food live

Categorise the food based on the age. Not all food can be consumed by everyone

10.5.3 Questionnaire for Donation recipients (Charities/Organizations)

FEED Food Donation App - Survey for donation recipients

We appreciate your participation in this poll. Your feedback is important to us as we develop the FEED Food donation app because it helps us better understand the wants and expectations of recipients like you. Please take some time to respond to the following survey. Your responses won't be shared with anyone.

Figure 55-10.5.3-Questionnaire for recipients

How do you currently receive food donations?

- Through Individuals
- Through Clubs and Societies
- Through Business organizations
- Other:

Are there any challenges or pain points in the current process?

- Your answer

A rectangular text input field with a scroll bar on the right side. At the bottom of the scroll bar are four small square buttons: a double-left arrow, a single-left arrow, a single-right arrow, and a double-right arrow.

How often do you receive food donations? *

- Daily
- Weekly
- Monthly

What is the typical volume of food you receive in a donation?

- 10-20 packs
- 20-40 packs
- 40-60 packs
- Above 60 packs
-

How do you currently handle and distribute donated food?

- Your answer

Are there any common allergies or dietary restrictions you need to consider when receiving food donations?

Your answer

◀▶

▲▼

Do you prefer to pick up donations or have them delivered? *

- Pick-up
- Delivery

Which specific time frames that work best for you?

- 7 AM - 10 AM
- 12 PM- 3 PM
- 5 PM- 7 PM

How would you like to be notified and communicate about potential food donations? *

- App notification
- E-mail
- SMS

Would you like the ability to track and report on received donations? *

- Choose

Are there any specific requests or preferences you have for donated food (e.g., non-perishable items, fresh product, etc.)?

Your answer

◀▶

▲▼

Would you like the ability to provide feedback on the quality or suitability of received donations?

- Choose

Is there any specific functionality or feature you would like to see in the app that has not been covered in current apps?

Your answer

◀▶

▲▼

10.5.4 Responses for the questionnaires for Donation recipients (Charities/Organizations)

How do you currently receive food donations?

4 responses

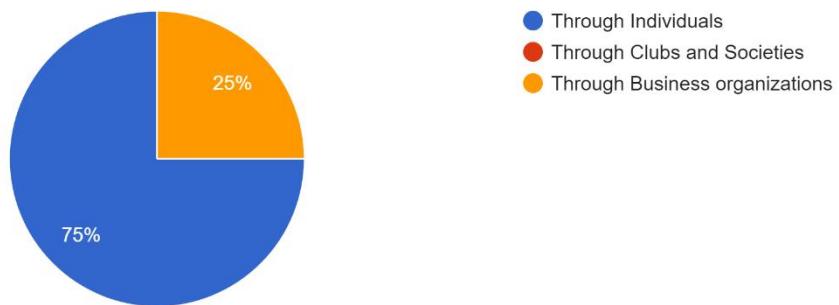


Figure 56-10.5.4-Response 14

Are there any challenges or pain points in the current process?

4 responses

the donation process is not continuous

Yes. We are not having assurity for food everyday

No

Yes

How often do you receive food donations?

4 responses

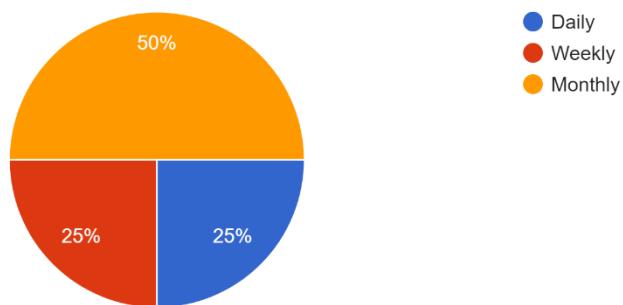


Figure 57-10.5.4-Response 15

What is the typical volume of food you receive in a donation?

4 responses

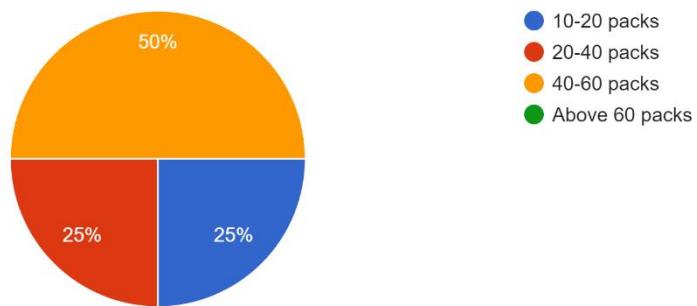


Figure 58-10.5.4-Response 16

How do you currently handle and distribute donated food?

2 responses

Using proper schedules

Through proper management

Are there any common allergies or dietary restrictions you need to consider when receiving food donations?

3 responses

No

Sea food allergies

Do you prefer to pick up donations or have them delivered?

4 responses

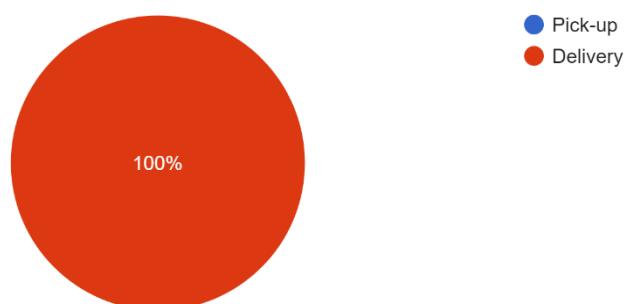


Figure 59-10.5.4-Response 17

Which specific time frames that work best for you?

4 responses

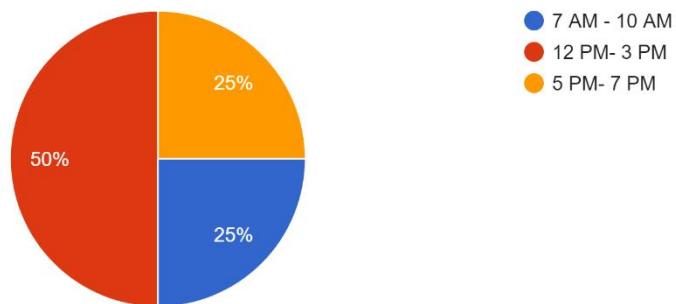


Figure 60-10.5.4-Response 18

How would you like to be notified and communicate about potential food donations?

4 responses



Figure 61-10.5.4-Response 19

Would you like the ability to track and report on received donations?

4 responses

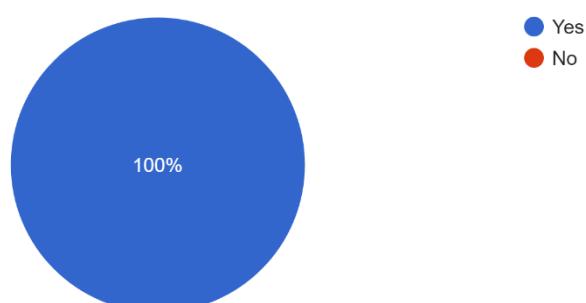


Figure 62-10.5.4-Response 20

Are there any specific requests or preferences you have for donated food (e.g., non-perishable items, fresh product, etc.)?

2 responses

No

Biscuits, Fresh products

Would you like the ability to provide feedback on the quality or suitability of received donations?

4 responses

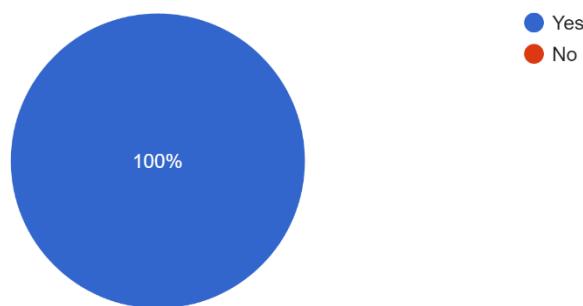


Figure 63-10.5.4-Response 21

Is there any specific functionality or feature you would like to see in the app that has not been covered in current apps?

3 responses

No

10.6 Test Cases

Test Case ID	Test Description	Test Steps	Test Data	Expected Results	Actual Results	Pass/Fail
1	Select Language	1.Open app	1.Selecting English 2.Selecting Tamil	Successfully giving interface in	As expected	Pass

		2.Select one of the languages	3.Selecting Sinhala	selected language		
2	Signing in to “FEED” app as Donors	1.Open app 2.click get started 3.Create new account	1.Create account by entering details 2.Enter and confirm password	Successfully Signed up Access to donor homepage	As expected	Pass
3	Signing in to “FEED” app as Charity	1.Open app 2.Click get started 3.Create new account 4.Verify the organization	1.Enter e-mail 2.Enter password 3.Enter organization licence number 4. Enter director details	Successfully Signed up Access to charity homepage	As expected	Pass
4	Donor Homepage	1.Open app 2.Login as donor	1.Donate 2.Charity Suggestions	Show main categories and relevant ads of “FEED”	As expected	Pass
5	Search option in donor page	1.Open app 2.Login as donor 3.Search nearby charities	1. Filtering locations near	Show nearby charities	As expected	Pass
6	Donate Option	1.Open app 2.Login as donor 3.Select donate	1. Donation item (Food,Books,Stationery) 2.Product quantity 3.Manufacture date 4.Expire date 5.Capacity	Show relevant options to enter the properties of the donation item	As expected	Pass

			6.Any message 7.Select spot delivery/ Pickup			
7	Donation Status	1.Open app 2.Login as donor 3.Complete Donation process 4.Select Order Status	1.Confirm Delivery 2.Delivery Date 3. Delivery Time 4.Order ID	Status of Delivery	As expected	Pass
8	Live location Tracking	1.Open app 2.Login 3.Complete Donation process 4.Select Order details	1.Order Id 2.Location	Live location of Donated item	As expected	Pass
10	Notifications	1.Open App 2.Login 3.Select Notifications	1.Food Urgents 2.Delivery Time 3.Delivery Date	Alerts and notifications of donations Donation Reminders	As expected	Pass
11	Chat Feature	1.Open app 2.Login 3.Select Chats	1.Chat messages	Chats between donors and charity	As expected	Pass
12	Charity Homepage	1.Open app 2.Login as charity	1.Request 2.Donation Suggestions	Show main categories and relevant ads of “FEED	As expected	Pass
13	Search option in charity page	1.Open app 2.Login as charity	1.Filtering locations near	Show nearby donors	As expected	Pass

		3.Search nearby donors				
14	Request Option	1.Open app 2.Login as charity 3.Select Request	1. Select needed item (Food,Books,Stationery) 2.Enter product quantity 3.Enter any message	Show relevant options to enter the properties of the requested item	As expected	Pass
15	Donation History	1.Open app 2.Login 3.Go to Profile 4.Select History of donations	1.Previous donation informations 2.Photos and proofs of previous donations	Show old donation informations and photos and proofs	As expected	Pass
16	Inventory	1.Open app 2.Login as Donor 3.Select Inventory	1. Surplus Item Details	Show surplus items available for donation	As expected	Pass
17	Rating	1.Open app 2.Login 3.Complete Donation process 4.Rate the donation	1.Rating (1-5 stars)	Show rating option	As expected	Pass

Table 11-10.6-Test cases

10.7 User Validation Questionnaire

FEED Food Donation App : User validation questionnaire

We appreciate your participation in this poll. Your feedback is important to us to evaluate as we develop the FEED Food donation app because it helps us better understand the wants and expectations of users like you. Please take some time to respond to the following survey. Your responses won't be shared with anyone.

Figure 64-10.7-User validation questionnaire

Was the registration process easy to complete?

- Yes
- No

If the above answer is "No" please describe

- Your answer

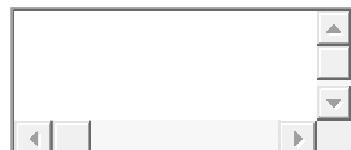


Did you encounter any issues while creating your account?

- Yes
- No

If the above answer is "Yes" please describe

- Your answer



How easy was it to navigate through the app?

- 1
- 2
- 3
- 4
- 5

Were you able to find the key features easily?

- Yes
- No
- Moderate

Did you face any challenges in moving between different sections of the app?

- Yes
- No

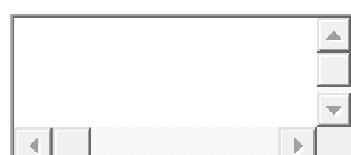
If the above answer is "Yes" please describe

- Your answer



How would you describe the process of donating food items through the app?

- Your answer

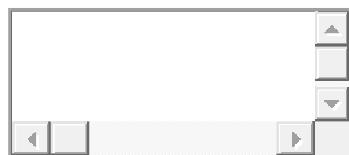


Were there any features or options you found confusing during the donation process?

- Yes
- No

If the above answer is "Yes" please describe

- Your answer



How satisfied are you with the app's notifications and tracking system regarding your donations?

- 1
- 2
- 3
- 4
- 5

Did you find it easy to search for nearby organizations or recipients in need?

- Yes
- No
- Moderate

Were the search filters helpful in narrowing down your options?

- Yes
- No
- Moderate

How do you feel about the feedback and ratings system for both donors and recipients?

- 1
- 2
- 3
- 4
- 5

How convenient was it to schedule and coordinate the pickup or delivery of food donations?

- 1
- 2
- 3
- 4
- 5

How satisfied were you with the responsiveness and helpfulness of the support team?

- 1
- 2
- 3
- 4
- 5

Did you experience any lag, crashes, or other performance issues while using the app?

- Yes
- No

If the above answer is "Yes" please describe

- Your answer

How would you rate the overall speed and reliability of the app?

- 1
- 2
- 3
- 4
- 5

How confident are you in the security and privacy measures of the app, especially regarding personal information and donation details?

- Your answer

Is there anything specific about the app's security that concerns you?

- Your answer



A large rectangular text input field with a thin black border. On the right side, there is a vertical scroll bar with up and down arrows. At the bottom of the field, there is a horizontal scroll bar with left and right arrows.

10.8 User validation questionnaire responses

Was the registration process easy to complete?

5 responses

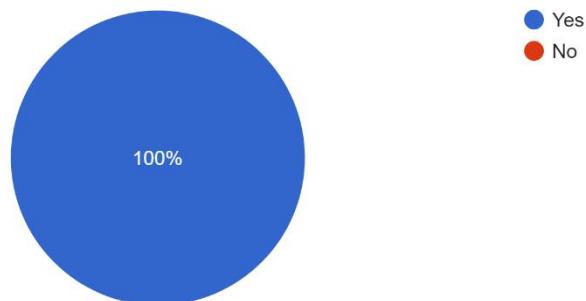


Figure 65-10.8-Response 22

Did you encounter any issues while creating your account?

5 responses

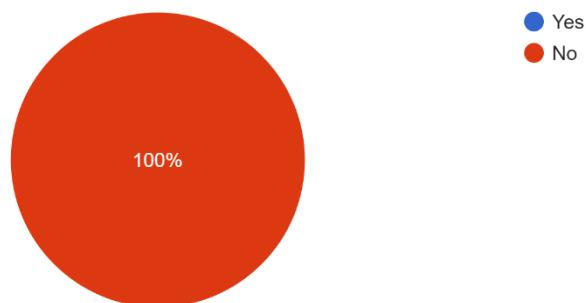


Figure 66-10.8-Response 23

How easy was it to navigate through the app?

5 responses

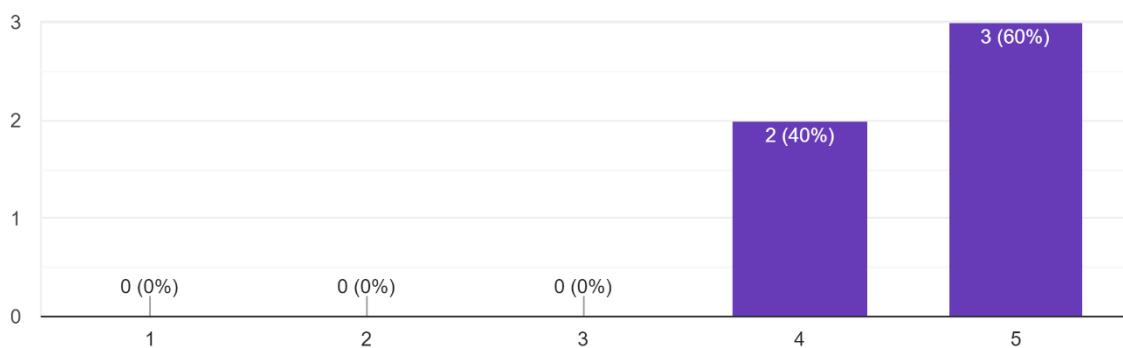


Figure 67-10.8-Response 24

Were you able to find the key features easily?

5 responses

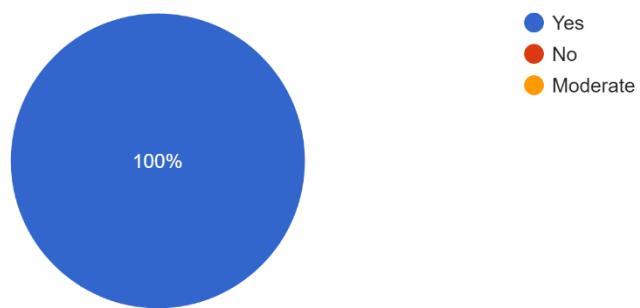


Figure 68-10.8-Response 25

Did you face any challenges in moving between different sections of the app?

5 responses

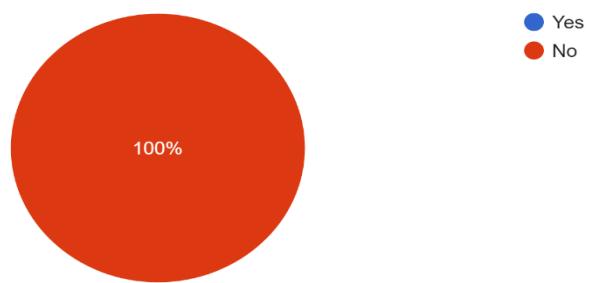


Figure 69-10.8-Response 26

How would you describe the process of donating food items through the app?

2 responses

It was easy

Easy

Were there any features or options you found confusing during the donation process?

5 responses

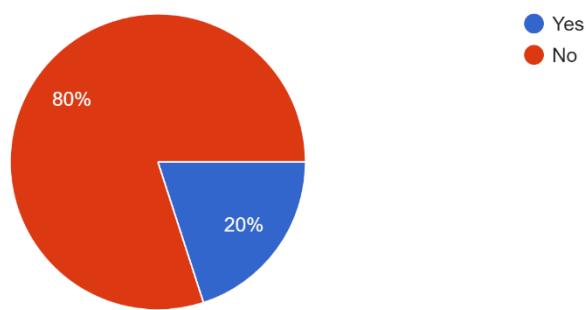


Figure 70-10.8-Response 27

How satisfied are you with the app's notifications and tracking system regarding your donations?

5 responses

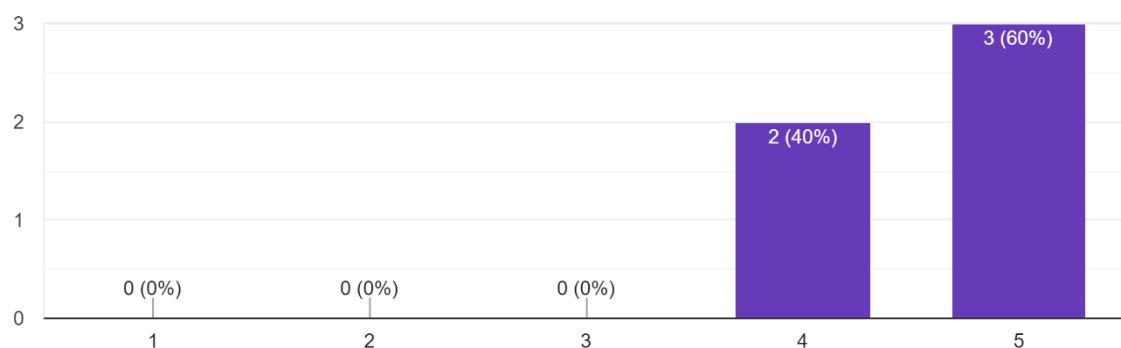


Figure 71-10.8-Response 28

Did you find it easy to search for nearby organizations or recipients in need?
5 responses

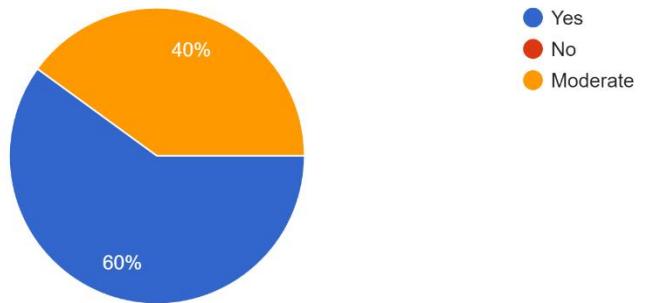


Figure 72-10.8-Response 29

Were the search filters helpful in narrowing down your options?
5 responses

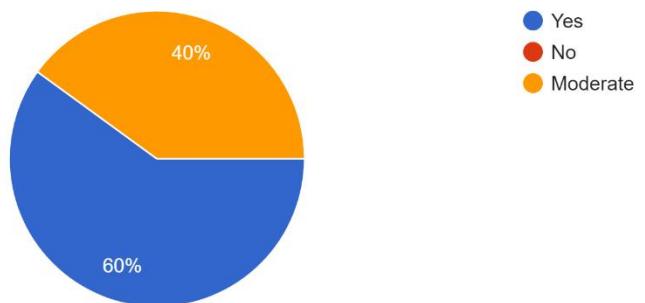


Figure 73-10.8-Response 30

How do you feel about the feedback and ratings system for both donors and recipients?

5 responses

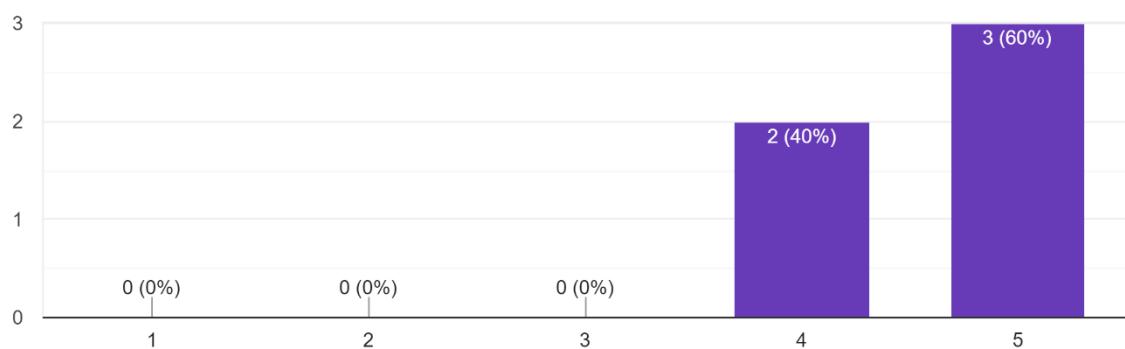


Figure 74-10.8-Response 31

How convenient was it to schedule and coordinate the pickup or delivery of food donations?

5 responses

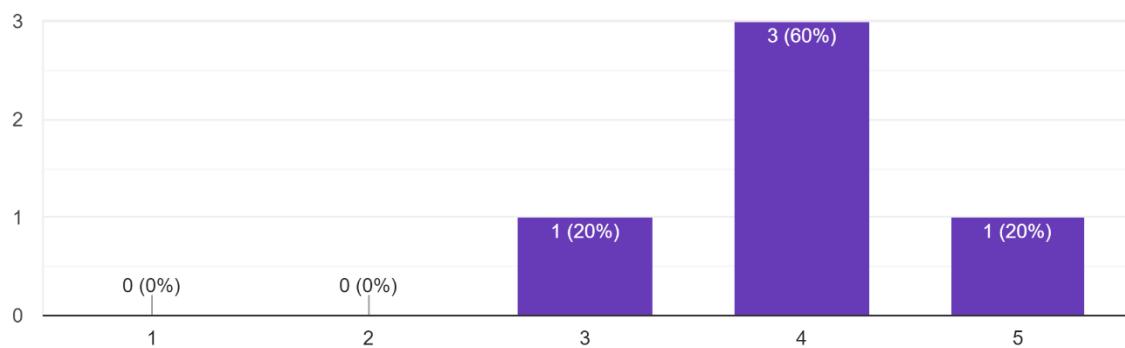


Figure 75-10.8-Response 32

How satisfied were you with the responsiveness and helpfulness of the support team?
5 responses

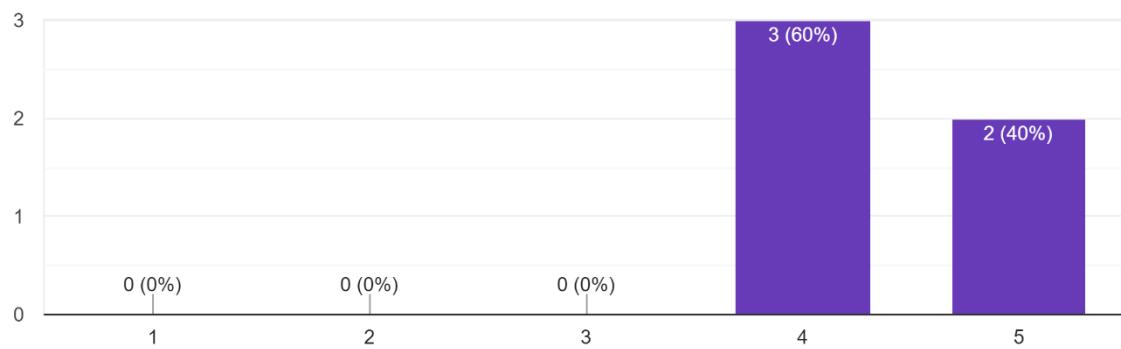


Figure 76-10.8-Response 33

Did you experience any lag, crashes, or other performance issues while using the app?
5 responses

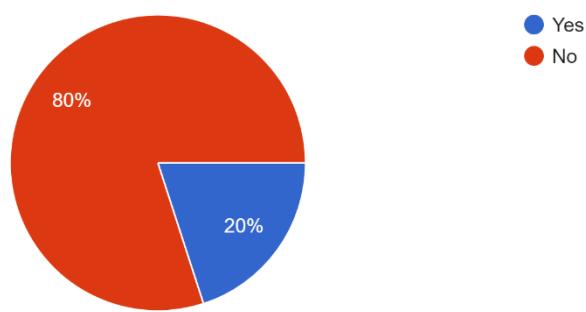


Figure 77-10.8-Response 34

How would you rate the overall speed and reliability of the app?

5 responses

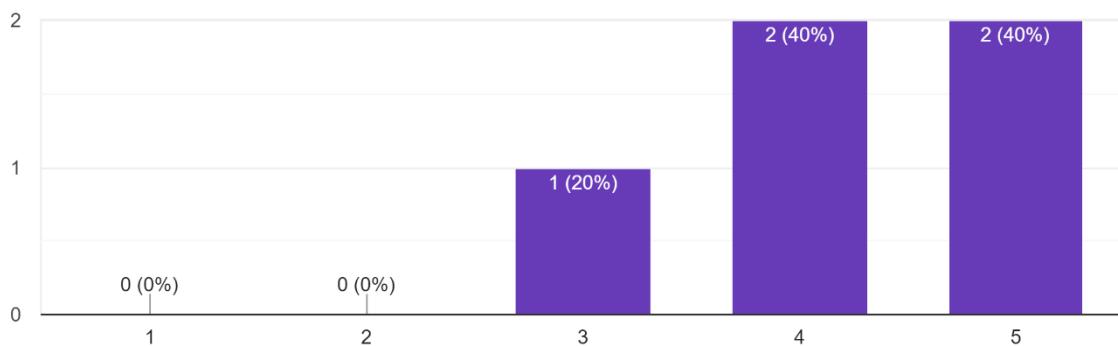


Figure 78-10.8-Response 35

How confident are you in the security and privacy measures of the app, especially regarding personal information and donation details?

3 responses

Very much confident

Yeah, it feels safe

Confident

Is there anything specific about the app's security that concerns you?

2 responses

No

Nope

10.9 Literature Surveys

- a) Food waste is a global issue with environmental, economic, and social consequences. It arises at two stages in the food system: pre-consumption waste and post-consumption waste. The United Nations Sustainable Development Goals call for halving per capita. Global food waste and reducing food losses along production and supply chains by 2030. This paper adds to the waste valorization literature by examining products made from food waste. Value-added surplus products (VASP) can be a promising solution to the food waste crisis if properly marketed to consumers. This study aims to examine Consumers' willingness to buy novel VASP by identifying promising consumer segments and shedding light on purchasing motivations. The research is the first attempt

to assess Consumers' willingness to buy VASP in Australia and the UK, making three original contributions to the field of research and business practice. The results reveal market prospects for VASP in culturally similar countries, identify factors influencing acceptance, and assist with targeted and effective communication strategies from a policy and marketing point of view.

(Breda McCarthy. (2020) *Completing the Food Waste Management Loop: Is there market potential for value-added surplus products*)

- b) Food waste is one of the challenging issues humans are facing. A third of the food produced in the world is wasted at various points along the food supply chain. Food waste can be reduced by developing technology that can be utilized in different parts of the food value chain and through education programs that focus on consumers' behavior on healthy lifestyles and sustainable consumption. This article examines the problem of food waste and provides insights into the approaches to food waste management. Different techniques, such as education-based or structure-based, are used to encourage food waste prevention and management. Therefore, highlighting the current development in food waste management becomes important. The paper uses a systematic review that supports screening of the literature to answer the research questions and find the research gaps. According to the findings, food is either thrown out during the supply chain or even at the last stages of preparation and consumption. The review shows that the current food waste management treatment methods may be effective, but they do not provide an environmentally sustainable solution for food waste management. Therefore, the proposed article deeply investigated food waste prevention and social innovations to reduce food waste. This review complements the previous reviews by adding social and economic innovation focus on food waste management. The article recommends a course of action for future food waste management research.

(Muna Al-Obadi. (2022) *Perspectives on Food Waste Management: Prevention and Social Innovations, Sustainable Production and Consumption*)

- c) Surplus food redistribution can be a way to relieve co-existing food insecurity and food waste. The food waste hierarchy ranks surplus food donations for human consumption as the next best strategy, when food waste cannot be prevented. However, the effectiveness of food donation in terms of the amount consumed, or food donation as a food waste management measure have rarely been assessed. The few studies conducted to date report substantial environmental savings, but the results may be sensitive to assumptions regarding substituted food. Rebound effects are also not included but are likely to offset environmental savings from food donation. Therefore, this study investigated the effectiveness, carbon footprint, and rebound effect of a food donation

system run by a charity in Sweden and compared the results with those of anaerobic digestion. Multiple analytical methods were used, including material flow analysis, life cycle assessment, questionnaire, and 24-hour dietary recall. In the life cycle assessment, carbon footprint of substituted products was credited to the overall results using a system expansion. In addition, direct and indirect rebound effects associated with re-spending of substitution-related monetary savings were included. The results revealed a complex but effective network aimed at salvaging as much of the redistributed food as possible, with 78% of redistributed food eaten, but there was also a substantial rebound effect, offsetting 51% of potential carbon emissions savings from food donation.

(Niina Sundin. (2022) *Surplus food donation: Effectiveness, carbon footprint, and rebound effect, Resources, Conservation and Recycling*)

- d) In all European countries, there is a tradition of charities taking care of the delivery of basic goods (foods, clothing, medicines) either in case of emergency or as a support to particularly vulnerable groups, such as asylum seekers, homeless people or those with drug and alcohol addictions (Zimmer and Evers 2010). Thus, public action in the field of food poverty has mainly limited its role to allowing such civil society-driven actions to continue.

(Baglioni, S., Pieri, B.D. and Tallarico, T. (2016) *Surplus food recovery and food aid: The pivotal role of non-profit organizations. insights from Italy and Germany* -: *International Journal of Voluntary and Nonprofit Organizations*)



Figure 79-10.9-Food waste management market size