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Second Servings: A System for Food Resource Optimization

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Abstract: *Food waste is a growing global problem that is bad for the environment and bad for society. Second Serving App is an Android based solution that reduces food wastage through the redistribution of surplus food from donors to the needy people. The app is built using Java for the backend, XML for the frontend and MySQL for the database, offering a secure and userfriendly way for users to post, view and claim food donations. Real time notifications, GPS based location tracking and the efficient data storage adds up to the functionality of the application. Registration, logging in, posting food details or browsing and claiming available donations is very user friendly. The app makes sure that the users are updated regularly and share accurate information. The Second Serving App, through the encouragement of responsible food sharing, contributes to sustainable development goals by creating community support. Because of its scalable architecture, it is a practical and impactful solution to minimize food waste and support hunger relief efforts*

Keywords: Food Wastage, Food Waste Management , Donors , Customer Service

I. INTRODUCTION

Food wastage is perhaps the most critical issue the world grapples with at the moment. Every year, a massive amount of food that has been cultivated goes to waste, as millions of others still starve and perish from malnutrition. The Food and Agriculture Organization (FAO) estimates that almost one-third of all food globally produced is lost, amounting to some 1.3 billion tons yearly. Not only does this create food insecurity but also creates environmental issues like added greenhouse gas emissions from landfills. There is an increasing requirement for technology-based solutions that are innovative and are able to close the gap between surplus food and lack of food. The Second Serving App is an Android smartphone application that is created to address this problem by facilitating the redistribution of surplus food. It is an online platform through which the excess food from individuals and establishments like restaurants and hotels can be donated, and the recipients in need can obtain it. The act of donating is made easier by the application through a simple interface, instant messages, and GPS mapping of locations. Implemented by Java and XML on Android Studio, and utilizing MySQL for database management, the application is assured of having safe and effective processing of donated food. The application can register, upload foods, check donations offered, and get notified. In its mission to promote responsible sharing of food, the Second Serving App promotes sustainability practices and helps curb food wastage among communities. This research paper provides the inspiration, concept, design, and potential impact of the Second Serving App, showing the way that mobile technology can be leveraged to solve real social and environmental issues.

II. LITERATURE REVIEW

Waste management, especially food waste management, has become an urgent issue in the 21st century due to the growing volume of waste in landfills and significant financial losses faced by governments. There is an immediate need for effective solutions to address this problem. This research paper proposes an ICT-based approach to reduce food waste and encourage responsible consumer behavior. The suggested solution is a cross-platform mobile application that

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enables users to donate surplus food to those in need, thereby minimizing food waste. The system could be enhanced by incorporating food wastage statistics and introducing a point system to incentivize users for their donations.[1]

Food loss and waste (FLW) is a global issue that occurs at various stages of the food supply chain (FSC), including farming, processing, transportation, retail, and consumption. FLW has adverse effects on the environment, society, and the economy, and its occurrence is expected to rise. To address this challenge sustainably, several solutions have been introduced, particularly in the form of digital technologies (DTs).[2]

This innovative surplus food management application addresses the pressing issue of surplus food by offering a comprehensive platform for efficient redistribution. The application leverages advanced technology to simplify data input, inventory management, and the redistribution process. With intuitive interfaces, it allows donors—from food establishments to individuals—to easily contribute surplus food, while enabling real-time tracking and monitoring. Intelligent algorithms and matching mechanisms ensure that food is allocated to the most suitable recipients or donation centers. The app promotes user engagement through its accessible design, encouraging a community-driven approach to reducing food waste. Its feedback loops continuously improve user experience, while stringent data security measures ensure the safe handling of sensitive information, building trust among users.[3]

Food waste is becoming a significant global threat to sustainability, exacerbating environmental degradation and food insecurity. To address this, innovative solutions are needed to improve food donation systems, particularly in managing excess food. This overview introduces an innovative smartphone application designed to reduce food waste in UAE households by leveraging artificial intelligence (AI). The app helps users manage their food more effectively by tracking expiration dates and scanning barcodes before donating excess food to nearby food banks.[4]

Despite the potential benefits of Industry 4.0 technologies in the agri-food sector, the adoption of digital solutions prevent and reduce food loss and waste (FLW) throughout the agri-food supply chain is still under exploration. While improving supply chain operations using digital technologies can bring positive changes, it would only be a partial solution if FLW prevention and reduction are not adequately addressed. Although some companies are beginning to adopt digital technologies to eliminate FLW, the implementation processes and results are often presented at a superficial level, with a lack of practical guidance. [5]

India's food system faces several sustainability challenges, including climate change, biodiversity loss, soil degradation, water scarcity, and food insecurity. To address these issues, a more sustainable approach to food production and consumption is essential. One such approach is "design thinking," a method of problem-solving that can help bring about lasting change in the food system. This research paper explores how design thinking can be applied to create a better food system in India. Through a literature review of relevant studies, reports, and case studies, the authors analyzed the findings to identify common themes and best practices. [6]

Food waste management is a significant issue locally, requiring urgent solutions. This review article critically examines the complex problem of food waste by analyzing its root causes and exploring the environmental and social impacts associated with it. The discussion covers food waste across various stages of the food supply chain, including production, processing, distribution, retail, and consumption. The article evaluates the environmental impacts, particularly the contribution of food waste to greenhouse gas emissions and resource scarcity. Additionally, it addresses the social consequences, such as the rise in food poverty and hunger. The review also assesses current strategies and technologies for reducing food waste and proposes comprehensive, long-term solutions to mitigate the issue.[7]

The Internet of Things (IoT) has significant potential in improving various aspects of daily life, but its application in addressing social issues remains underdeveloped. In India, where there is a large number of orphanages, challenges exist in efficiently distributing critical information, making it difficult for donors to access accurate data about food reserves. This project proposes an IoT-based system to resolve this issue, using Node MCU IoT devices connected to sensors that transmit data through a network, which can be accessed and monitored via web applications. [8]

Food waste continues to be a major global issue, leading to environmental degradation and economic losses. This paper introduces "Tinira ni Benny," a recipe recommender system aimed at minimizing food waste by suggesting recipes based on the ingredients users already have. The system utilizes the TF-IDF (Term Frequency-Inverse Document Frequency) Vectorizer method to match available ingredients with a recipe database, enabling users to create meals without needing to purchase extra ingredients. It preprocesses a vast collection of recipes into a structured format for

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TF-IDF analysis, evaluating the relevance of ingredients across various recipes. "Tinira ni Benny" identifies the best recipe options based on the ingredients at hand. [9]

Food wastage is a significant challenge in human communities, and effectively managing it is crucial for enhancing both environmental sustainability and financial savings. To address this, we propose using web technology to facilitate food waste reduction. As part of this approach, we have developed a Django Python application that allows users to share and donate leftover food to those in need. The Django project provides various features, including user account creation, login, browsing available food items, adding or removing items from the cart, and logging out. The system relies on MySQL for data storage and uses a real-time database to ensure smooth and efficient operation, promoting a streamlined process for food redistribution.[10]

The global food security crisis has been worsened by the Russia-Ukraine war, with one-third of the world's food production being lost or wasted each year. Food loss and waste (FLW) are closely linked to issues of food security, safety, quality, and sustainability. The purpose of this comprehensive review is to provide valuable information and guidance to governments, stakeholders, public organizations, and individuals, encouraging them to take action and develop practices aimed at minimizing food loss and waste. These actions are crucial for the betterment of society, the environment, and the economy. The review uses secondary research and content analysis to explore sustainable pathways for achieving food security, focusing on FLW management. Ultimately, the study concludes that pursuing sustainable food security through the reduction of food loss and waste is a promising and necessary approach.[11]

Food waste is a significant global issue with detrimental effects on both the environment and the economy.

This article proposes a comprehensive food waste management system using full-stack technology, which integrates data gathering, analytics, and decision-making procedures to tackle the problem. The system employs advanced techniques to reduce food waste and optimize resource use across its entire lifecycle. By leveraging this technological stack, the system provides valuable data-driven analysis to help users identify waste reduction opportunities. It allows users to generate reports and visualizations that highlight inefficiencies, set waste reduction goals, and track progress over time [12]

This research study aims to address the global challenges of food waste and hunger, two issues that have significantly worsened in recent years. According to the Food and Agriculture Organization (FAO), over 1.3 billion tons of food are wasted annually, which represents one-third of all food produced for human consumption. Meanwhile, the World Health Organization (WHO) reports that 20% of the global population faces severe food scarcity. To combat this, the study proposes the development of a mobile application that enables individuals, restaurants, and cafes to donate leftover food to those in need, effectively bridging the gap between food waste and hunger.[13]

Efficient supply chain management is a complex task in any industry, but the food industry faces additional challenges, especially in food waste management. Poor management of food waste can compromise consumer safety, affect the shelf life of goods, and disrupt the entire supply chain. One potential solution to this issue is the use of blockchain technology, which can enhance the integrity, security, and transparency of the food supply chain. This study proposes a blockchain-based food supply system designed to trace the journey of boxed leftovers from restaurants to non-governmental organizations (NGOs) and ultimately to the underprivileged.[14]

This study focuses on a specialized program designed to address the critical issue of leftover food donations from gatherings, hostels, and other sources. Food waste is a significant concern in densely populated countries like India, where landfills, trash bins, and cluttered streets often become dumping grounds for excess food. Events such as weddings, canteens, restaurants, social gatherings, and family events contribute substantially to the large quantities of food wasted. This issue not only results in economic hardships and environmental damage but also reflects a broader trend of waste associated with lifestyle changes and high living standards, including waste of clothing and other products.[15]

Food waste is a persistent issue that society faces regularly. Proper food waste management can significantly benefit both the environment and the economy. By reducing food waste, poverty can be alleviated, and environmental conservation can be achieved. This research aims to develop a mobile application that will streamline the process of collecting and delivering donated food and other items. The app will allow both donors and recipients to register their details and post information about the availability or need for food. It will accept both cooked and raw food donations.

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Donors can upload photos of the food they are offering, which will serve as proof of availability and help encourage others to contribute. This platform aims to create a more efficient way to redistribute excess food, reducing waste while addressing hunger and poverty.[16]

Sub-Saharan Africa (SSA) is facing a severe food insecurity crisis, worsened by declining agricultural production and high levels of food loss and waste (FLW). This situation is not only undermining the income of farmers and retailers but also negatively impacting the well-being of the region's population. Given the pressing nature of food insecurity in SSA, this review paper examines potential opportunities for applying digital technologies in agrifood chains to address FLW and promote more effective food waste management.[17]

In today's digital age, online applications have become an integral part of everyday life, with food delivery apps (FDAs) being particularly popular due to the variety of food choices and attractive offers they provide. However, with the abundance of food delivery options available, it remains unclear what factors influence users to continue using the same FDA or order from the same restaurant. This study aimed to identify the factors that drive user satisfaction and their intention to reuse food delivery apps.

Using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method, the research model examined the relationship between seven key variables. Data from 571 university students in Malaysia revealed that information quality, ease of use, convenience, and perceived value significantly contribute to the continued use of FDAs. Interestingly, the variety of food choices did not have a significant impact on users' decisions to reuse the app.[18]

The purpose of this study was to identify the factors that influence users' decisions to reuse online food delivery services. The research model used was based on the Technology Acceptance Model (TAM), enhanced with several additional variables to better understand customer behavior. Data was collected through online questionnaires distributed among residents of Jakarta, Indonesia. The data was analyzed using the Structural Equation Modeling-Partial Least Squares (SEM-PLS) method.

The findings revealed that four key factors—online ratings, online tracking, perceived usefulness, and perceived ease of use—have a significant influence on customer satisfaction. This satisfaction, in turn, plays a critical role in determining the user's intention to continue using online food delivery services. These insights are valuable for food delivery platforms aiming to enhance user engagement and retention.[19]

This study aims to determine the influence of various attributes of Food Delivery Applications (FDAs) on customer satisfaction and their intention to reuse the services. Primary data was collected through an online questionnaire conducted between May and June 2022, targeting 142 FDA users in Indonesia who use platforms such as GrabFood, GoFood, TravelokaEats, and ShopeeFood. The data was analyzed using structural equation modeling with six hypotheses. The findings reveal that several FDA attributes, including delivery experience, ease of use, user reviews, and the foodrider's performance, have a positive and significant influence on customer satisfaction, accounting for 91.7% of the variation in satisfaction. Furthermore, customer satisfaction has a strong positive impact on the intention to reuse the FDA, explaining 81.7% of the variation in reuse intention.Based on these results, it is recommended that FDAs focus on improving the ease-of-use of their interfaces and enhancing the overall customer delivery experience. Key improvements include offering real-time order tracking, continuous delivery fee discounts, advanced menu filtering, and upgrading the soft skills of food riders to ensure better customer service and retention.[20]

III. METHODOLOGY

The Second Serving App has a design structure with three different layers; a User Interface Layer developed in XML using Android Studio, an Application Layer developed in Java, and a Database Layer developed in MySQL. The User Interface layer is the direct user interface for donors and recipients of the donation. User will register, log-in, post the food donation, and browse and claim food donations through the User Interface. The Application Layer contains all of the business logic of the application - that is, its the layer that runs the app. The Application Layer contains logic to verify user input, manage user sessions, allow real-time updates, GPS functionality, and more. The Application Layer is used for communicating between User Interface Layer and Database Layer as necessary for these actions. The Database Layer contains and securely manages user profiles, food donation selection, and food donation status within MySQL. The overall flow of the application is to authenticate the user, choose a user type, the donor post the food donation

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details, and the recipient browses food donations and can claim a donation. User data will updated in the database after certain app interactions, including notifications in the application development to remind the user to perform updates as necessary

FLOWCHART

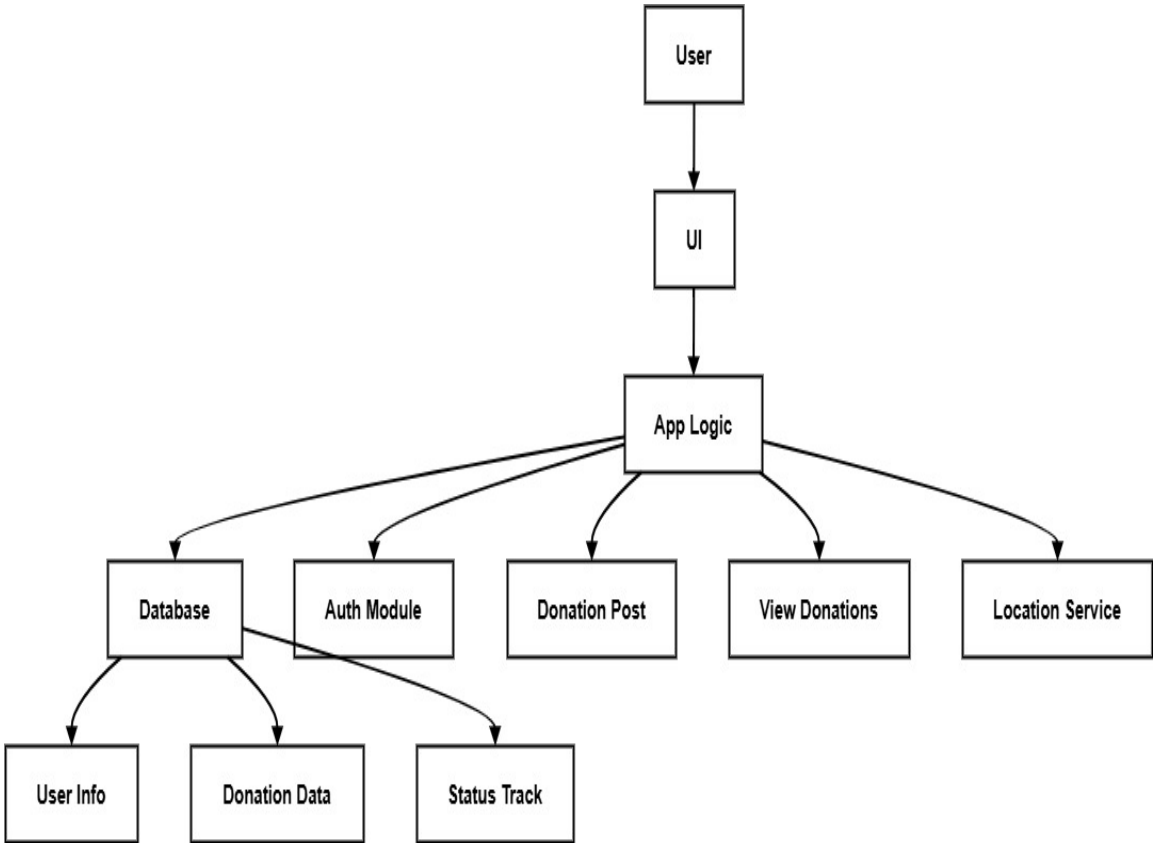

Fig3.1: Flow Chart

1. User Authentication- The user starts by opening the Second Servings app. They are prompted to log in if they already have an account or sign up as a new user.
2. Selection of Role- Once logged in, the user selects his role—either a Donor who wants to donate excess food, or a Recipient who wants to collect food.
3. Donor Actions- When the user happens to be a Donor, the app can take inputs relating to food donation—type of food, how much, at what time expired, and place. The inputs are published and stored within the MySQL database.
4. Recipient Actions- In case the user is a Recipient, the application fetches existing food donations from the database. The recipient is able to browse through the list and choose donations based on location and availability.
5. Donation Claim- The recipient selects a donation and claims it. The system updates the status of the donation in the database to avoid duplicate claims.
6. Logout or Continue- After they have completed their action, the user may proceed with the application or choose to log out

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DATA FLOW DIAGRAM

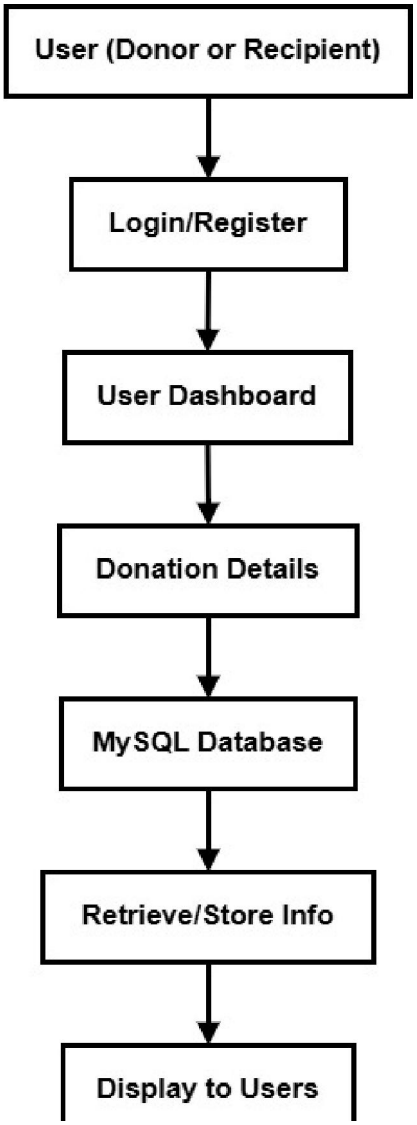

Fig 3.2: System Data Flow

1. User (Donor or Recipient) This is where the system begins. Users may be Donors, who give away surplus food, or Recipients, who wish to receive food. They access the application via a mobile interface.
2. Login/Register Prior to accessing aspects of the app, users have to register a new account or log into an existing one. This ensures safe access and tailored experiences.
3. User Dashboard Upon successful login, the users are routed to the dashboard. Here, donors are able to add details of the food donation, and the recipients are able to explore available food donations.
4. Donation Details This functionality enables users to enter or read information regarding donations. It has fields such as food type, quantity, expiry date, and pickup location. This information enables management and tracking of all donation processes.
5. MySQL Database The backend utilizes MySQL for storing all data, such as user accounts, donation information, and transaction records. It is the core that handles data with efficiency.

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6. Retrieve/Store Info A new data storage or the retrieval of existing data from the database is done every time users interact with the system—e.g., posting a donation or seeing available food—is done by the app.
7. Display to Users Lastly, the system presents appropriate information to the users depending on their actions. Donors view donation status and history, whereas recipients view the list of donations available

IV. SYSTEM REQUIREMENT

SOFTWARE REQUIREMENT

1. Android Studio (IDE)
2. JDK (Java Development Kit)
3. XML (Extensible Markup Language)
4. Java (Programming Language)
5. MySQL Database

HARDWARE DESCRIPTION

1. Android Devices (Mobile Phones/Emulators)
2. Development Workstations
3. Server (For Hosting Backend and Database)
4. Router/Internet Connection
5. Testing Devices

V. IMPLEMENTATION & RESULT

INTEGRATED SYSTEM- The Second Servings app consolidates a number of elements, all working harmoniously together to coordinate food donations and minimize food waste. This is an outline of the integrated system:

Mobile App (Client-Side)- The mobile application is the primary platform utilized by donors and recipients. It is developed in Java and XML. Users can register, donate food, and redeem food through the application. The application communicates with the backend via APIs to exchange data. Donors provide information about the donated food, whereas recipients can see and redeem it. Users also receive real-time updates regarding new donations and changes.

Backend (Server-Side)- The backend does all the work of processing requests from the mobile app. The backend is coded in Java. It performs the login and registration of users, posting of food donations, and updating. The backend also provides a middle level between the database and the app. Whenever a user does any action on the app, the backend processes information and makes things work smoothly.

Database (MySQL)- MySQL database holds all the vital information. This consists of user information, records of donations of food, and history. It ensures that the data is properly saved and can always be accessed when needed. When someone posts or claims food, the backend updates the database. This keeps the system in order and accurate.

System Flow- To start with, the donor inserts food information such as type, amount, and location into the application. This is transmitted to the backend that saves it to the database. Subsequently, a recipient checks the application for food availability. The backend retrieves data from the database and communicates it to the application. On claiming the food, the database is updated and real-time notification is received by both users.

Integrated Features- The application provides push notifications to users about new or acquired donations. User registration and login are securely managed by the backend to avoid abuse. The MySQL database aids in managing data swiftly and securely so that users do not experience delays. All these components work together to provide a seamless food donation experience.

Monitoring

1. Splash Screen:

The splash screen features four buttons: "View All Available Food" to browse food options, "Search by Category" to filter by food types, "Search by Area" to find food by location, and "Donor Login" for donors to access their accounts. Each button provides an intuitive way to navigate the app's food offerings and donor functionalities.

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Fig 5.1: Donate Food

2. Donor Login:

The Donor Login page prompts users to enter their username and password to access their account, with a dedicated button for new registration, allowing first-time users to sign up. This page ensures secure login while providing an easy path for new donors to join the platform.

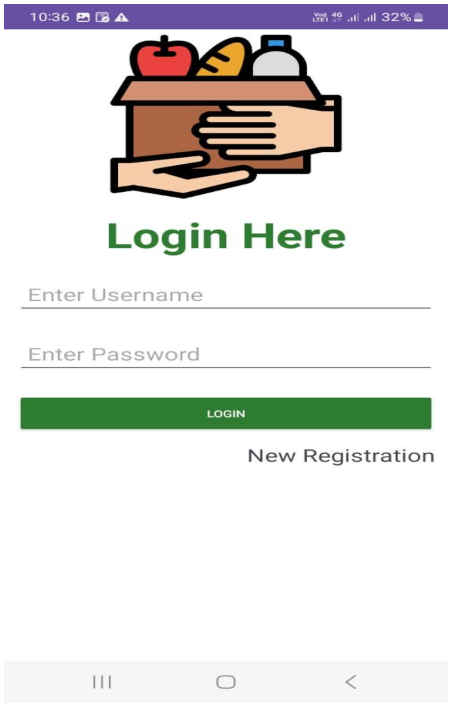

Fig5.2: Login Page

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3. Welcome Page:

The "Welcome Page" gives idea to the users about whole application.

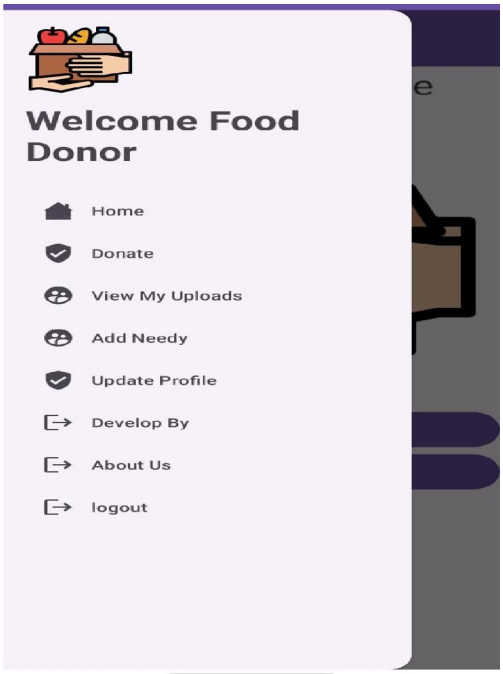

Fig5.3: Welcome Page

4. Registration Page:

The registration page requires users to enter their name, contact number, email, password, and select their type of donor (e.g., food donor, financial donor) to complete the registration process. This allows new donors to provide necessary details for account creation and participation

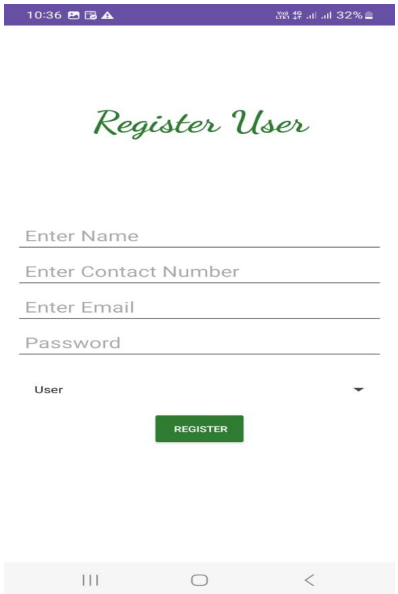

Fig5.4: Registration Page

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5. Available Food Page:

The "Available Food" page displays a list of all the food options currently offered, including details like food type, quantity, and availability. Users can browse through the options and choose the food they wish to donate or request.

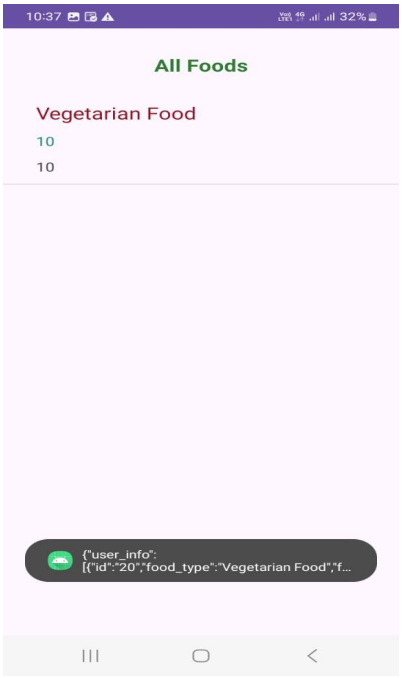

Fig5.5:Available Food Page

6. Food Details Page:

The "Food Details" page displays detailed information about a specific food item, including description, quantity expiration time, etc.

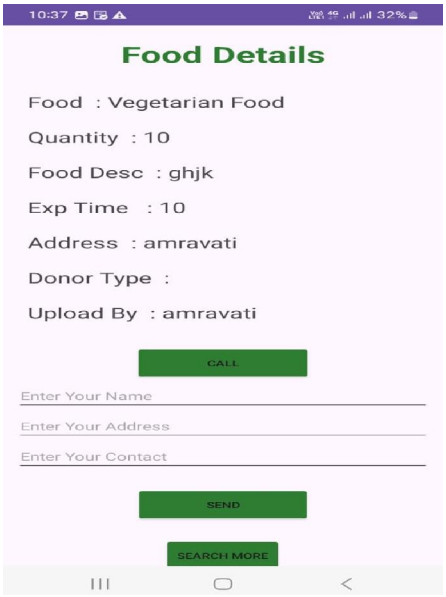

Fig5.6: Food Details Page

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7. Search by Category Page:

The "Search by Category" page allows users to filter and browse food options based on specific categories, such as type of cuisine, dietary needs, or food preferences.

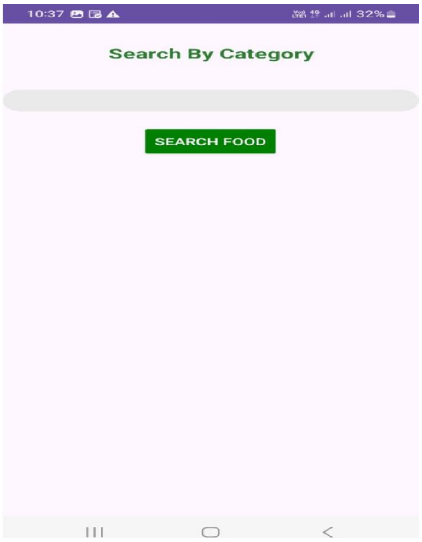

Fig 5.7: Category Page

8. Search by Area Page:

The "Search by Area" page enables users to find available food options based on their location, allowing them to browse food offerings nearby

Fig 5.8: Search by Area page

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9. Add Needy:

The "Add Needy" page enables user to first contact with needy people in the list.

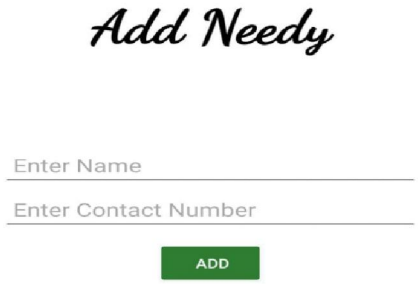

Fig 5.9: AddNeedy Page

10. Feedback:

It enables users to give a response or reaction about the quality of food and the performance of application

Fig5.10: Feedback page

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VI. RESULT

The Second Serving App was developed and tested to work on Android devices, and is ready to be used by food donors and recipients alike without issue. Testing demonstrated that the app enabled users to register, to log in, to post food donation information, and to claim their donation. The app also provided accurate updates to the user and relevant notifications. Donors could enter information about food type, quantity, expiration time, and location for pick up, which then updated and stored successfully in the MySQL database. Recipients were able to view food donations in their area and claim food donations successfully within a few taps. The app demonstrated the ability to retrieve and store data in the MySQL database accurately - even updating donation status to reflect claimed donations. The use of GPS search and push notifications were effective and assisted usability and response time. Transitioning between screens and modules worked smoothly without confusion. Real time updates between the front end, back end, and database demonstrated reliability while revealing the system was effectively responding to "typical" use patterns.

VII. CONCLUSION

The Second Serving App successfully tackles the problem of food waste by implementing a digital platform that allows users to redistribute surplus food from donors to those in need. The app has a user-friendly interface, has instantaneous push notifications, GPS functionality, and handles data securely. Donor meals can now be donated quickly and easily managed. The incorporation of XML, Java, and MySQL provides impressive back-end data processing and user interaction. Furthermore, the user experience allows individuals to post, browse, and claim food via the app building responsible food sharing in communities. With the capabilities of the app, it shows technical competence in Android development, but also socially good character to minimize food waste and to aid clients facing food insecurity. With the additional functionality, further improvements in interface, and scalability of the app, it could ultimately make a greater impact and be a model for others to follow in future community-focused projects

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