

A Study on Food Wastage Reduction through Digital Food Redistribution

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Abstract: Food waste is a serious global concern, it affects food security, environmental sustainability, and social well-being. In a lot of places, India included, massive amounts of edible food get thrown away every day, while many people are still dealing with hunger and malnutrition. That mismatch between food surplus and food shortage really shows why we need a faster, more organized system for food reallocation, not just a few slow efforts here and there. Most traditional donation approaches are manual, slow, and somewhat fragmented. Donors, NGOs, and volunteers often rely on phone calls, informal messages, or local coordination. In practice, this can delay collection and lower the likelihood of on-time delivery, and the surplus food can become unsafe before it even reaches someone who needs it. So, there is, clearly, a need for a technology-based solution that can connect all stakeholders on one platform and enable real-time coordination to flow efficiently. This research suggests the study of food wastage through android platform by creating an application. It provides for a seamless connection between food donors, NGOs, and volunteers through using a single platform. The application includes a possibility of registering donated food, marking the locations where hungry people tend to congregate, and providing real-time feedback. These key functionalities include registering excess food, identifying areas prone to hunger problems, and offering real-time feedback for operations. In order to facilitate optimal recovery logistics, this model utilizes Firebase for real-time synchronization of information, along with AI/ML approaches and Traveling Salesperson Problem models. In addition, a historical delivery logs improve volunteer coordination, transparency, and overall system accountability. The key purpose of the application is food wastage minimisation and hunger relief support.

Keywords: Food Wastage Reduction, Android Application, Firebase, Google Maps API, Hunger Spot Mapping, Real-Time Tracking, Route Optimisation, Food Redistribution, Sustainability.

1. Introduction

Food waste is one of the critical around the world which causes social, economic, and environmental impacts. In India, it appears even more urgent because a lot of edible meals end up wasted every day while plenty of people are still dealing with hunger and malnutrition [1]. So, there's really a strong need for a workable system that connects surplus food with those who actually need it, right now.

This research aims to develop a Food Wastage Reduction App for Android to help address the issue. The app will bring together food donors, NGOs, volunteers, and recipients into a

single digital place. It should support real time food pickup requests, show locations of hunger spots, let donation tracking run efficiently, and use location-based coordination so redistribution becomes easier and also more transparent for everyone [2].

One important aspect of the proposed system is the maintenance of historical delivery logs to improve volunteer coordination, operational transparency, and overall system accountability. Alongside that, the plan is to add AI/ML based support for food assessment, demand prediction, and smarter matching of surplus food with recipient needs [3]. In other words, it is intended to be more adaptive and responsive compared with purely manual donation methods.

The proposed system also relies on Firebase, Google Maps, and cloud-based services for secure authentication, real-time synchronization, and route optimization [4]. By combining those technologies with volunteer incentives and a distribution system focused on recipients, the application hopes to reduce food waste, improve food recovery, and help create a more sustainable and socially responsible model for how food is managed.

A. Background of the Study

Food wastage has become a major global concern because it connects food security, environmental sustainability, and social welfare. In India, a huge amount of edible food gets wasted every day, during weddings, parties, restaurants, and other events and gatherings, while so many people are still struggling with hunger and malnutrition, too [1]. This overall picture points to the need for a workable system that connects surplus food sources with people in need, using an efficient, organized platform.

Usually, food donation happens in traditional ways that feel manual slow, and the coordination is not great. Often, Donors, non-governmental organizations, and volunteers depend on telephone conversations, oral negotiations, or small local communities that can lead to delays in food collection and scheduling [5]. Fresh food often gets wasted because there is no proper method for real-time coordination, identification of hunger spots, and tracking deliveries [2].

To address this limitation, the proposed study aims to develop a Food Wastage Reduction Application for the Android platform. The app will help combine the efforts of food donors,

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NGO representatives, volunteers, and recipients in one digital space. It should enable managing food pickup requests, hunger spot maps, monitoring donations, and organizing routes.

One important aspect of the proposed system is the maintenance of historical delivery records and volunteer activity logs, which helps encourage active participation by recognizing volunteer contributions in pickup coordination, delivery assistance, and food redistribution activities. The study also takes into account AI/ML-based support for food demand prediction and better matching of surplus food with recipient needs, which should make the whole system more intelligent and scalable, for long-term use.

B. Research Objectives

1. To develop a mobile platform for reporting surplus food from weddings, parties, restaurants, households, and other sources.
2. To enable real-time coordination between donors, NGOs, volunteers, and recipients for efficient food pickup and redistribution.
3. To support hunger spot identification and mapping using location-based services so food reaches areas with urgent need.
4. To incorporate AI-based food quality assessment using donor-provided details and food images to help judge whether donated food is fresh, usable, or unsuitable for redistribution.
5. To maintain historical volunteer activity records to encourage participation in pickup, delivery, and hunger spot coordination tasks.
6. To apply route optimization, such as TSP, for improving the efficiency of food pickup and delivery.
7. To design a scalable and secure system using Android, Firebase, Node.js, and Google Maps that can support future expansion.

C. Research Questions

- How can the proposed Android Application improve the collection and distribution of surplus food from donors to needy people?
- How can the system connect donors, NGOs, volunteers, and recipients through real-time coordination, hunger spot mapping, and donation tracking?
- How can real-time status tracking and historical delivery logs improve volunteer coordination, transparency, and overall system accountability?
- How can AI-based food quality assessment and donor-provided details help determine whether donated food is fresh, usable, or unsuitable for redistribution?
- How can route optimization and scalable system design improve the overall efficiency, transparency, and sustainability of the proposed food wastage reduction system?

2. Literature Review

Food loss and wastage are major global concern with serious

economic, social, and environmental effects. In India, the problem is especially important because surplus food and food insecurity coexist. Existing research shows that while food loss at production and storage stages has received attention, less focus has been given to the last-mile redistribution of surplus food from events, restaurants, and households to people in need [7].

A. Food Wastage in India

Studies on food wastage in India show that large losses occur due to poor storage, weak cold chains, inefficient transport, and post-harvest handling issues [1]. At the same time, food is also wasted at weddings, parties, hotels, and households due to inefficient collection and redistribution systems [1]. This creates a strong need for a practical and technology-based food recovery platform.

B. Social and Environmental Impact

Food wastage has both social and environmental consequences. Socially, the inefficiency in the process of capturing and redistributed the surplus food amounts to a wasted chance at solving the problem of food insecurity in the region. Then, environmentally, when food decomposes, it increases greenhouse gas emissions, while also wasting water, land, and the energy that went into growing, farming and processing that food. Because of all this, cutting down on food waste is not just a small thing; it's a major sustainability concern.

C. Technology-Based Food Distribution

Mobile apps have emerged as useful tools for food donation and moving surplus. In a bunch of current systems and initiatives, Android-based platforms, real-time databases, and location services can help facilitate the flow of information between donors, NGOs, and people in need [8]. This enables NGOs and volunteers to accurately identify areas requiring food assistance and coordinate targeted delivery operations. Despite the fact that previous studies have addressed the utilization of AI systems in analyzing the quality of the foods, the implementation of the real-time logistical tracking system along with the AI-driven food classification is undoubtedly a new approach to the literature. In addition to this, the proposed architecture involves a specific route optimization component that makes use of the well-known shortest-path algorithm in order to achieve the maximum speed and efficiency of picking up and delivering goods. However, despite the aforementioned improvements, there is still a significant need for a unified system involving dynamic maps of hunger spots and other components.

D. Mobile App in Food Waste Management

Mobile tech can make food donation easier; it somewhat links the extra food folks with the organizations that hand out meals to people who need them. The strategic application of location services, real-time notifications, and tracking data is designed to streamline logistical workflows and reduce transit time [3]. On the other hand, a centralized database allows for systematic analysis of donor behavior on the part of NGOs,

which in turn minimizes the likelihood of spoilage [9].

E. Government and Policy Gap

Even though initiatives like food sharing networks and NGO driven redistribution programs are around, there is still no broadly standardized setup for keeping track of food waste and where it goes, in real time, limited. There's a policy gap, along with digital infrastructure and stronger data gathering, so that food recovery can be more effective at scale and kinda consistent across places [3].

F. Challenges in the Existing System

Various issues arise from food redistribution systems including:

- Identifying areas of Hunger.
- Issues surrounding the safety and freshness of foods being distributed.
- Lack of Volunteer participation.
- Lacking in tracking and accountability and
- Architectural bottleneck across various urban settings.

These challenges show the need for a more structured and intelligent application.

G. Future Trends and Project Relevance

Recent trends in food waste management include AI-based freshness detection, geospatial hunger spot mapping, multilingual access, and smarter route planning [3]. In this project, the system includes historical volunteer activity tracking to encourage participation and an AI-based food quality assessment module using donor-provided details and images. These additions make the proposed system more engaging, practical, and responsive to real-world donation conditions.

Gap Identified:

Despite the emergence of various mobile-based platforms to facilitate the donation of food, the analysis of the existing literature indicates certain flaws in dealing with practical problems. These include the following:

1. *Lack of Volunteer Activity Tracking* - Most existing Setups still don't quite record or monitor volunteer involvement for food pickup, delivery, and even hunger spot identification [10]. As a result, it becomes hard to gauge actual contribution, refine accountability, or really steer volunteer performance in a smooth, consistent way.
2. *Absence of AI-Based Food Quality Assessment* - Current food donation apps accept food details submitted by donors without any intelligent validation or quality check. There is no system that uses AI or image-based analysis to evaluate whether donated food is fresh, usable, or unsuitable for redistribution, which can result in unsafe food reaching recipients [11].
3. *Limited Recipient and Hunger Spot Integration* - Most existing systems focus on donor-NGO communication and do not provide a structured way to identify, map, and update recipient communities or hunger spots in

real time [12]. This reduces volunteers' & NGOs' ability to direct food to areas of actual need.

4. *Inefficient Delivery Route Planning* - Existing food redistribution apps lack route optimization features. Without a mechanism such as TSP-based routing, food pickup and delivery can become time-consuming and inefficient, increasing the risk of food spoilage before it reaches recipients [13].
5. *Weak Real-Time Coordination Among All Stakeholders* - Most systems link only two user groups, typically donors and NGOs, but do not fully bring in volunteers and recipients into a single platform. That results in coordination gaps, which slow down the redistribution flow and reduce transparency [14].
6. *Limited Scalability* - Many existing solutions are region-specific and are not designed to scale across multiple cities or user bases. They also lack cloud-based architectures capable of supporting large concurrent user activity [15].

3. Methodology

Building a system like the Food Waste Reduction Application requires more than just writing code — it needs a clear plan, a practical design, and a development process that can adapt as things evolve. This methodology outlines the plan in several stages: understanding the problem, assessing whether the solution is feasible, designing the system, building its features, testing it, and ensuring it handles user data responsibly. Since this is a proposal paper, the focus here is on what the system is intended to do and how it is planned to be built, not on reporting results from a completed product.

A. Research and Requirement Analysis

This first stage focused on identifying the causes of food allocation failures. In many cases, the donated food never reaches its intended beneficiaries, mainly due to a lack of coordination, poor planning, and inefficiencies within the existing system. At this stage, the study was particularly concerned with analyzing current food donation systems and mobile food swap platforms to identify their main flaws, such as poor coordination among volunteers and others.

From this study, the functional requirements of the proposed system were drawn out. These include donation request submission, hunger spot mapping, real-time tracking, user role management, historical delivery and volunteer activity tracking, AI-based food quality checking, and route optimization. On the non-functional side, the system needs to be scalable, secure, reliable, and fast enough to handle time-sensitive food pickup and delivery situations.

B. Feasibility Study

A feasibility study checks whether the proposed application can actually be built and then deployed in a realistic and sustainable way over time. On the technical side, the work looks feasible, mainly because the project uses a technology stack that many teams already use: Android with Java, Firebase Firestore,

Node.js, Express.js, the Google Maps API and Firebase Authentication. Operationally, the planned interaction flow between donors, NGOs, volunteers, and recipients closely align with well-known food redistribution practices, so it should be easier for the target users to adopt without too much friction. Regarding the economics of product development, using cloud-based platforms and free software will help keep costs low, and the solution can be implemented gradually with scope for future scaling.

C. System Design

The design of the system is structured using the Model View Controller design approach, which helps in achieving the separation of concerns. The approach makes it easier for the developer to keep adding new functionalities into the system without having to make many changes. On the frontend, it will be built as an Android application using Java and XML layouts, so users have a clear, easy experience when submitting food donation details. They can also keep track of active requests and then get real time notifications.

For the backend, Node.js with Express.js will be used to handle requests, run the main application logic, and handle inter-module communication. As for data, Firebase Firestore will act as the main store for food records, user profiles, volunteer activity logs, and even hunger spot information, and it syncs everything in real time across all connected clients.

Other supporting services include the Google Maps API for location-based hunger spot mapping and delivery routing, Firebase Authentication to secure user identification, and Firebase Cloud Messaging to send push notifications when it matters.

D. Development Approach

The project will be executed using the agile methodology for software development, making it possible to develop the system incrementally. The suggested software development process will involve collecting requirements, designing the interface, coding modules, developing the back-end with integration to the database, and finally, validating the entire system. The benefit of adopting this model is that the new capabilities may need further improvement. The implementation goes on, and as practical constraints become clearer.

The system is built around several connected modules that work together to manage the food redistribution process from start to finish. Donors can enter data on the availability of extra food, including the nature of the food, quantity, pick-up point, and contact details. Such a system will allow NGOs and volunteer groups to pinpoint areas in need of food aid and conduct food transportation efforts efficiently. While previous studies have covered self-governing applications of AI technology for assessing the quality of food products, the current combination of real-time logistical monitoring and an AI-based approach to categorization represents a fresh perspective within the body of literature. In addition to these, there is a specialized route optimization feature incorporated into the design, which employs traditional shortest-path techniques for the purpose of accelerating the process of

logistics management.

E. Testing and Evaluation

This paper presents the architectural design and explains the activities to be carried out during the implementation phase. Individual modules will be tested using unit tests, whereas integration testing will test whether the various components of the system will operate effectively together. User acceptability testing will test the usability aspects of the software through the eyes of the donor, NGOs, and volunteers. The system's performance will be tested by measuring response time, concurrency issues, and scalability under several concurrent donations and usage scenarios. Authentication and identity verification procedures will be used to ensure that only registered, verified users have access to the site. Data will be protected using database encryption in accordance with data protection policies. In addition, the proposed system will enforce compliance with existing food safety standards in order to allow only viable surplus to be approved for redistribution. Furthermore, to ensure maximum user engagement without compromising on donor privacy, an anonymity feature has been built into the platform's architecture.

4. Existing System

The system of managing food waste in India still consists of outdated and insufficiently coordinated methods, such as food donations, food banks, and various programs initiated by the government. NGOs and volunteers are essential in distributing extra food to people who need it; nevertheless, effective distribution is often complicated due to inadequate coordination on a regular basis, problems with logistics, issues associated with food safety, and poor visibility of the problem [16]. What is more, the problem lacks data-based support that prevents the tracking of donation flows and identification of high-risk communities in terms of hunger, as well as efficient handoff of surplus food [17]. All these obstacles point towards the necessity of taking a more systematic, technology-oriented approach in order to make the process of donating food easier and more efficient in India.

A. Overview of Existing Food Wastage Reduction Apps

Some mobile apps have been developed worldwide to minimize food waste by connecting surplus food with regular people, NGOs, and food banks. In practice, these applications made food sharing more doable and accessible, though each works a bit differently, maybe depending on the setup.

1) Too Good To Go

- A European app that allows restaurants, bakeries, and supermarkets to sell surplus food at reduced prices.
- Users can buy "surprise bags" of excess food, which helps cut waste while still offering value to consumers.

2) Olio

- A community-based app that lets individuals and businesses share surplus food with nearby users.
- It encourages local food sharing and helps prevent edible food from being thrown away.

3) *No Food Wastage (India)*

- An Indian initiative that collects surplus food from events, restaurants, and households and distributes it to people in need.
- Volunteers play a key role in identifying hunger spots and delivering food.

4) *Feeding India (Zomato)*

- A non-profit initiative that connects food donors with NGOs.
- It works with restaurants, caterers, and corporate offices to distribute food to needy communities.

5) *SaveEat (India)*

- A mobile-based initiative that works with restaurants to offer surplus food at lower prices.
- It focuses on reducing food wastage in the hospitality sector.

B. *Limitation of Existing Apps*

Even though these applications have contributed to reducing food waste, they still have several limitations.

- *Limited Coverage:* Many existing apps operate only in a few cities or regions, so their impact remains limited [3].
- *Lack of Real-time Tracking:* Most applications do not provide live monitoring of food pickup and delivery [18].
- *Logistics Challenges:* Transporting perishable food is still difficult because timing and handling are important.
- *Low Public Awareness:* Many potential donors are still unaware that these platforms exist [17].
- *Limited User Coordination:* Most apps don't bring donors, NGOs, volunteers, and recipients into a single app [3].
- *No volunteer Recognition Mechanism:* Existing systems often lack a structured way to acknowledge and track volunteer contributions.
- *Limited decision-making Intelligence:* Most platforms don't use AI-based food assessment or route optimisation to improve redistribution efficiency [3].

These limitations show that existing food waste reduction apps address only part of the issues. What is still needed is a more complete system that connects donors and NGOs and supports real-time tracking, volunteer coordination, hunger spot identification, and smarter decision-making. For this reason, the proposed Food Wastage Reduction Application is designed to offer a more organized and practical approach to food redistribution, so that surplus food can reach the right people more efficiently and with less delay.

5. Proposed System

The proposed Food Wastage Reduction Application is made so food donation and redistribution feel easier, faster, and more organized. Rather than relying on manual coordination, the system assists people to follow donations in real time, spot hunger points, and handle food recovery with a cleaner flow, so

that extra food can reach the people who need it more quickly. By bringing NGOs and individual volunteers into the same space on a simple Android platform, the application wants to cut down food waste, smooth the delivery steps, and also improve food security in a more practical manner.

A. *Objective of the Proposed System*

The proposed framework will eliminate drawbacks associated with existing food donation processes by introducing an improved technology-supported model. Its key goals include the following points:

1. *Efficient Food Redistribution* – To facilitate the collection of surplus food from restaurants, events, households, and similar sources, and ensure its timely delivery to hunger-prone locations.
2. *Real-Time Donation Tracking* – To provide live monitoring of food pickup, transit, and delivery in order to improve transparency and coordination throughout the redistribution process.
3. *Hunger Spot Identification and Mapping* – To use location-based services and Google Maps integration to identify, map, and update hunger-prone areas dynamically based on need.
4. *User-Friendly Mobile Application* – The objective of this research project is to build a simple Android app that will help NGOs and volunteers carry out donation processes efficiently.
5. *Food Safety Compliance* – To incorporate food safety guidelines and basic quality checks so that donated food is suitable for redistribution.
6. *Data Analytics for Optimization* – Ensure food safety and quality control procedures are followed so that food can be distributed further.
7. *Scalability and Sustainability* – To design the system so that it can expand across multiple cities and regions and support broader food redistribution efforts over time.
8. *Route Optimization* – To improve the efficiency of food pickup and delivery through better route planning using location-aware services.
9. *Need based distribution of Food* – Distributed food in need-oriented ways based on hunger spots.
10. *Possibility of AI Integration* – Make provisions for future integration of AI-driven solutions for monitoring food quality and locating hunger spots as outlined in the enhancement roadmap.

B. *System Architecture*

The suggested system uses the MVC architecture to facilitate scalability and modular maintenance. It consists of three basic layers.

1) *Frontend: Mobile Application*

- Technology used: Java for Android development and XML for design.
- Core features:
 - Food donation request form.
 - Hunger spot mapping.

- Real-time delivery and pickup tracking.
- User role management for NGOs and individual volunteers.

2) Backend: Server and Database

- Technology used: Node.js + Express.js, used for handling incoming requests and for the backend processing.
- Database: Firebase Firestore for real-time data storage and retrieval of donation records, hunger spot information, and user details.
- Integrated services:
 - Google Maps API for tracking the location and route optimization.
 - Firebase Authentication for secure login and verification of user.
 - Firebase Cloud Messaging for live alerts and updates of donation.

3) Data Processing and Analytics

- Donation history, hunger spot data and user activity records are kept, mostly for monitoring and then for analysis.
 - An analytics component can help NGOs and administrators evaluate donation trends, identify demand patterns, and improve redistribution planning.
- Advantages of the Proposed System

C. Advantages of Proposed System

The proposed Food Waste Reduction Application offers several advantages over traditional donation methods and basic food sharing systems.

1. *Real-Time Tracking and Updating* – Makes sure that transparency is maintained throughout the procedures for collecting and delivering food donations.
2. *Dynamic Map of Hunger Zone* – Helps identify hunger zones in real time for better distribution of the food.
3. *Automated Notifications* – Keeps NGOs and volunteers updated about food donations and deliveries, among other activities related to the same.
4. *Better Coordination* – Helps facilitate coordination between all users who are part of the process of redistributing food items.
5. *Data-Driven Decision Making* – Helps in analyzing donation trends and overall system performance in order to make better decisions.
6. *Scalable Design* – Makes sure that the system can easily be expanded to cover a larger geographic area in the future.
7. *Increased Food Safety Assurance* – Facilitates a more hygienic way of donating and distributing food by implementing compliance measures.
8. *Geographically Aware Delivery Optimization* – Helps reduce delays in delivery by optimizing routes.
9. *Foundation for Introducing Future Intelligent* – Can lay the foundation for the future introduction of AI-enabled assessment of food donations and intelligent hunger spot identification.

6. Future Enhancement

The application for reducing food wastage is designed to be efficient and scalable, with the aim of reducing food wastage while making food redistribution easy. There are, however, several areas where the application can be improved.

- AI-powered food waste prediction: Use machine learning to analyze donation trends and predict high-demand hunger spots more accurately.
- Automated food quality detection: Use image recognition and IoT-based sensors to check the freshness and safety of donated food before distribution.
- Blockchain for transparency: Keep a tamper-proof trail of donations and deliveries, so people trust it more, and there is clearer accountability even when things get problematic.
- Multilingual and voice assistance: Add language options and voice navigation to make the app easier for a wider range of users.
- Integration with government and food supply chains: Work together with agencies like FSSAI and food supply network people to help scale the system, and relatively standardise the food donation guidelines, so it all matches, not all random.
- Gamification and incentives: Introduce reward points, badges, or leaderboards to encourage active participation from donors and volunteers.
- Crowdsourced delivery and volunteer network expansion: Team up with nearby delivery services, then grow the volunteer scheduling for smoother, quicker last-mile distribution.

Advanced analytics and impact measurement: Provide dashboards for NGOs to monitor donation trends, hunger spot activity, and distribution efficiency.

7. Conclusion

The Food Waste Reduction Application has been proposed as a practical, technology-supported response to the growing problem of food waste and unequal food distribution. Instead of relying on manual and often delayed donation methods, the system brings together donors, NGOs, and volunteers through a single Android platform to make food recovery more organized, transparent, and efficient.

This proposal has strength because it really hinges on practical features that address the main issues in food redistribution. This process will be characterized by the need for real-time tracking and locating of hunger spots as well as coordination using Google Maps and managing information using Firebase. Together, these processes are supposed to improve efficiency of food surplus distribution and communication between the organizations. With regard to analytics, they are supposed to help NGOs understand how donations are being made and hence plan better in terms of distribution.

Thus, the current framework provides an appropriate basis for implementing a scalable product to promote food security

and reduce waste, but with some room left for future improvements, such as demand analysis and food quality assessment powered by AI, blockchain integration, implementation of multi-language support, better cooperation with government and supply chains.

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