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FoodShare Hub: An AI-Enabled Excess Food Redistribution App for Smart and Inclusive Waste Management

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Abstract

Food wastage and food insecurity persist together because surplus food is often not redistributed in a timely, safe, and accountable manner. This paper presents FoodShare Hub, an excess food redistribution application designed to improve coordination among donors, NGOs, volunteers, and beneficiaries. The system integrates AI-based freshness prediction, intelligent matching, route optimization, traceability, waste redirection, and offline SMS support. Testing indicated faster allocation, improved delivery efficiency, reliable synchronization, and stronger user trust, demonstrating the potential of the proposed platform for reducing food waste and enabling inclusive redistribution.

Keywords: food redistribution, food waste management, artificial intelligence, route optimization, mobile application

1. Introduction

Food wastage and food insecurity remain closely linked social and environmental concerns. In many developing regions, edible surplus from households, restaurants, hotels, and social gatherings is discarded each day, while a large population continues to experience food scarcity. This imbalance increases pressure on waste management systems and contributes to landfill accumulation and greenhouse gas emissions.

The primary reason for this wastage is the absence of an efficient redistribution mechanism. Existing donation practices often depend on manual coordination, delayed communication, and limited transparency. Consequently, food is frequently discarded before it reaches beneficiaries. In addition, uncertainty about freshness, weak logistics, and limited support in low-network areas reduce the effectiveness of existing platforms.

To address these issues, FoodShare Hub is proposed as a mobile-first excess food redistribution application. The system is designed to support timely donation registration, intelligent donor-to-recipient allocation, volunteer route optimization, and end-to-end traceability. It also includes offline SMS-based access and sustainable waste redirection. The objective is to reduce spoilage, improve accessibility, and support a scalable community-driven redistribution network.

2. Literature Review

Recent studies have examined food sharing platforms through simulation, behavioral analysis, and mobile application development. System dynamics models have shown that digital platforms can support circular economy objectives, while social network analysis has demonstrated how food exchange patterns vary across user groups. Route optimization studies have also confirmed that geospatial planning can reduce collection time and logistics cost in food recovery processes.

Despite these contributions, several gaps remain. Many systems are limited by platform-specific deployment, weak freshness intelligence, inadequate traceability, and limited support for users in rural or low-connectivity regions. In addition, several studies focus only on collection or donation listing rather than the complete redistribution cycle. These limitations justify the need for an integrated system that combines AI, routing, transparency, and offline accessibility.

Table 1: Literature Comparison

S. No.	Study	Technique Used	Key Observation	Limitation / Gap
1	Meisam Ranjbari et al. (2024)	System Dynamics simulation	Modeled the adoption of food-sharing platforms and their circular economy impact	Active usage was inferred from membership data
2	John Harvey et al. (2020)	Longitudinal Social Network Analysis	Revealed platform-specific redistribution patterns and role shifts	Limited generalizability and no real-time logistics support
3	Itaru Kaneko et al. (2022)	Open data and Integer Linear Programming	Produced optimized collection routes in real time	Focused mainly on collection rather than the full distribution cycle
4	Dr. K. Akila et al. (2025)	MERN stack with AI prediction	Combined expiry prediction with geospatial notifications	Rural connectivity and logistics remained difficult

Table 1: Literature Comparison

3. Methodology

FoodShare Hub was developed as an Android-based mobile application with role-based access for donors, NGOs, volunteers, and administrators. The backend was implemented using Firebase services, REST APIs, and cloud functions for real-time data processing. The AI and matching logic were developed in Python, while Google Maps API was used for location awareness and route computation. Structured data were stored in Firestore and Realtime Database to enable fast synchronization and tracking.

When a donor submits a donation, the system captures food type, quantity, preparation time, and environmental condition. These inputs are validated and forwarded to the AI-based food freshness prediction module. The model classifies the donation as safe to distribute, near expiry, or unsafe. If the food is safe, the smart matching algorithm identifies the most suitable NGO or shelter using proximity,

capacity, quantity, and urgency. The volunteer route optimization module then computes the most efficient pickup and delivery path to reduce delay and fuel consumption.

Each donation is assigned a unique tracking identifier. The status is updated through the stages registered, picked up, delivered, and distributed. If the food is not suitable for human consumption, the system redirects it to animal feed or compost mode to support near-zero waste. To improve inclusiveness, an offline SMS mode is provided for low-network areas. SMS requests are parsed, stored locally, and synchronized with the server once connectivity is restored.

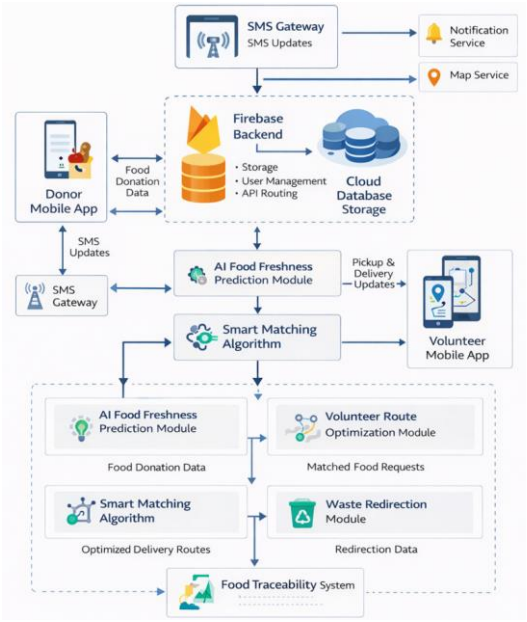

Fig 1: System Architecture Diagram

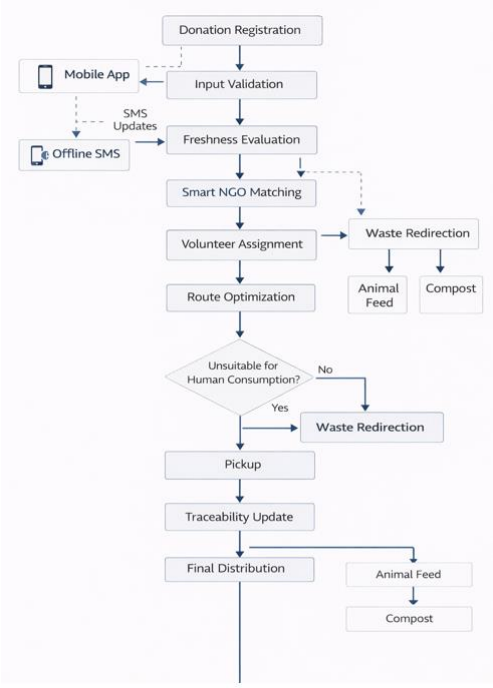

Fig 2: Workflow Diagram

4. Results and Discussion

The system was evaluated through unit testing, integration testing, offline SMS testing, beta testing, and performance testing. The AI freshness module produced stable classifications on the test dataset and reduced the risk of unsafe redistribution. The smart matching logic reduced allocation time compared with manual assignment, and the route optimization module shortened travel distance for volunteers. These results indicate that automated decision support improved operational efficiency.

Traceability also strengthened transparency throughout the donation process. Donors were able to monitor status updates in real time, which increased confidence in the platform. The offline SMS mode expanded access for users in low-connectivity areas and synchronized successfully after network restoration. User feedback showed that the donation workflow was simple, the tracking interface was useful, and volunteer navigation was improved. No major crashes or data loss were reported during testing.

A few usability improvements were identified, mainly related to interface clarity and notification timing. Nevertheless, the overall results indicate that AI-based freshness prediction, geospatial routing, traceability, and offline access together provide an effective framework for community food redistribution. The system therefore offers a practical approach for reducing food waste while improving beneficiary access.

Metric	Observed Value	Interpretation
Freshness prediction accuracy	93.8%	Unsafe food was filtered reliably
Average donor-to-NGO matching time	2.0 s	Allocation was completed quickly
Route distance reduction	17.5%	Volunteer travel was optimized
SMS registration success rate	98.2%	Offline access was highly reliable
Average notification latency	2.4 s	Real-time updates were delivered promptly

Table 2: System Performance

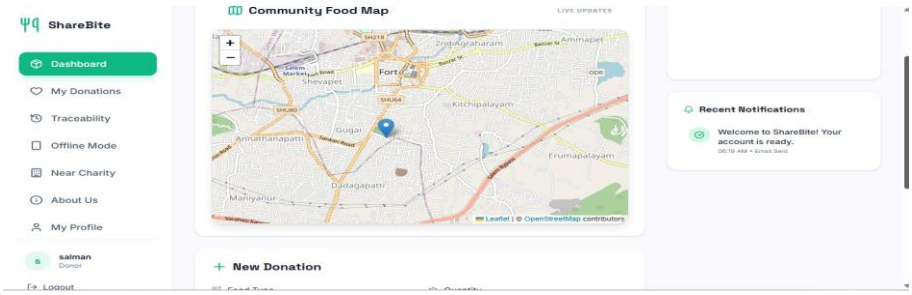

Fig 3: Application Screenshot – Home Page

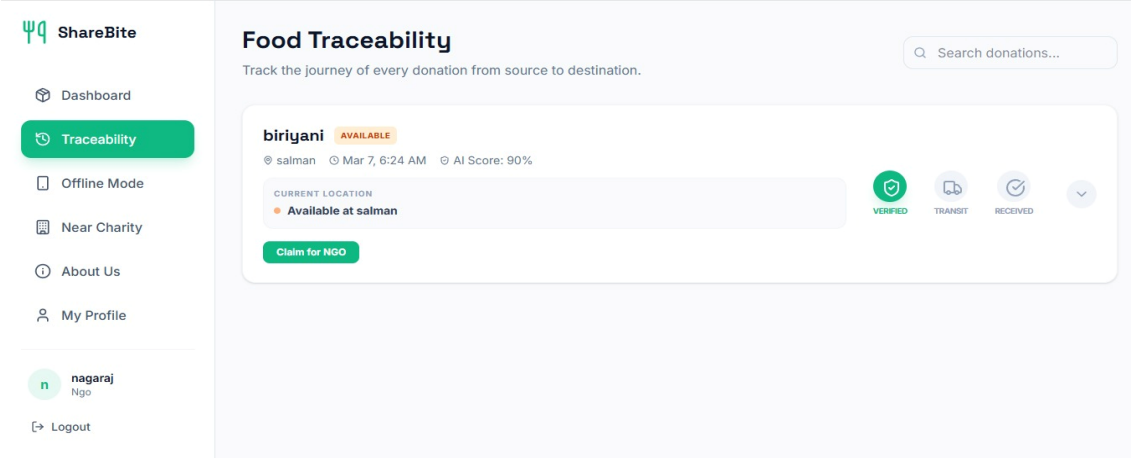

Fig 4: Application Screenshot – Results Page

5. Conclusion

FoodShare Hub was developed as an integrated solution for excess food redistribution. The proposed platform combines AI-based freshness prediction, smart matching, route optimization, traceability, waste redirection, and SMS-based offline access. Testing results demonstrated improved allocation speed, efficient volunteer movement, better transparency, and strong usability. The system therefore provides a scalable and socially beneficial framework for reducing food waste and strengthening inclusive redistribution networks.

6. Acknowledgement

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