A SURVEY ON HOPEBITE: AI-POWERED SMART FOOD DISTRIBUTION FOR COMMUNITIES IN NEED

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ABSTRACT

Food wastage and hunger remain two of the most pressing global challenges, with millions of tonnes of edible food discarded daily while vulnerable communities such as orphanages, old age homes, and underprivileged families continue to face acute shortages. Conventional donation mechanisms—relying on manual coordination, telephone calls, or basic NGO networks—suffer from critical shortcomings including absence of real-time tracking, delayed collection, lack of donor-beneficiary verification, inefficient volunteer management, and no predictive intelligence for food expiry. These limitations result in continued wastage, inequitable distribution, and low community participation.

To address these gaps, the present survey introduces HopeBite — an AI-powered smart food distribution platform specifically engineered for urban and semi-urban communities in India. The system establishes a unified digital ecosystem that seamlessly connects four primary stakeholders: donors, volunteers, beneficiary organisations (old age homes and orphanages), and administrators through a dual web (Django) and mobile (Flutter) architecture. At its core, HopeBite integrates advanced artificial intelligence and machine learning techniques: Gemini AI for accurate food expiry prediction, natural language processing-based review mining for automatic identification of top-performing volunteers, and K-Means clustering for location-based detection of high-demand zones.

The platform implements a strict role-based verification workflow ensuring authenticity of all participants, real-time status tracking of every donation request, automated feedback and rating mechanisms, and intelligent ranking of best donors and volunteers. Comprehensive literature analysis of fifteen contemporary food donation applications reveals that while several mobile and web solutions exist, none combine AI-driven expiry forecasting, ML-based performance analytics, and geospatial clustering within a single verified ecosystem. HopeBite overcomes these deficiencies by providing end-to-end transparency, optimised routing, and data-driven decision support for administrators.

Implemented and tested in Phase-2 with full module integration and MySQL backend, the system demonstrates measurable reduction in food spoilage, faster response times, and enhanced stakeholder engagement. By transforming surplus food into a sustainable social resource, HopeBite exemplifies the practical application of AI and ML in addressing humanitarian challenges. The survey concludes that such intelligent, technology-driven redistribution platforms represent a scalable and replicable model for achieving zero hunger and environmental sustainability across developing nations.

Keywords: *AI-Powered Food Distribution, Machine Learning Review Mining, Food Expiry Prediction, Location Clustering, Volunteer Performance Analysis, Sustainable Food Redistribution*

1. INTRODUCTION

Food wastage and hunger continue to be two of the most critical global challenges in the 21st century. While millions of tonnes of edible food are discarded daily due to improper storage, lack of timely collection, and inefficient distribution networks, a large section of society—especially residents of orphanages, old age homes, and underprivileged communities—still suffers from acute hunger and malnutrition. Traditional donation mechanisms, which largely depend on manual coordination, telephone calls, or basic NGO networks, fail to address these issues effectively. These conventional systems lack real-time tracking, transparent verification of donors and beneficiaries, predictive intelligence for food expiry, and data-driven volunteer management, resulting in delayed deliveries, continued spoilage, and low participation from the community.

Several mobile and web-based food donation applications have been developed in recent years to bridge this gap. However, most of them are limited to simple posting and notification features without advanced technological support. As highlighted in the literature, existing platforms suffer from critical limitations such as platform dependency (Android-only), absence of real-time tracking, lack of AI-based expiry prediction, and no mechanism for performance analysis of volunteers or identification of high-demand areas through clustering. These shortcomings lead to inefficient resource allocation and reduced trust among stakeholders.

To overcome these deficiencies, the present work proposes HopeBite—an AI-powered smart food distribution platform specifically designed for communities in need. HopeBite integrates Artificial Intelligence (AI) and Machine Learning (ML) to create a unified, transparent, and efficient ecosystem that connects four key stakeholders: donors, volunteers, beneficiary organizations (old age homes and orphanages), and administrators. The system operates through a dual architecture comprising a web application (built with Django) for admins and organizations and a mobile application (developed using Flutter) for volunteers and donors.

At its core, HopeBite employs Gemini AI for accurate food expiry prediction, ML-based review mining for automatic ranking of top-performing volunteers, and K-Means clustering for location-based identification of high-demand zones. The platform enforces a strict role-based verification workflow, provides end-to-end real-time tracking of every donation, and ensures accountability through feedback and rating mechanisms. By transforming surplus food into a sustainable social resource, HopeBite not only minimizes wastage but also promotes community engagement, environmental sustainability, and responsible technology use. This survey paper presents a comprehensive analysis of the proposed system, its architecture, implementation, and impact, demonstrating how intelligent AI/ML integration can effectively address the pressing issues of food wastage and hunger in urban and semi-urban India.

2. INFORMATION

Neha D. Shinde and Abhijeet Patil (2021), “Designing a Mobile Application for Food Wastage Reduction”. The authors developed a dedicated Android application that allows donors to upload details of surplus food while admins and agents handle the collection and distribution process. The system focuses on simplicity and ease of use to encourage more people to donate leftover food instead of throwing it away. It successfully reduces food wastage through quick notifications and basic management features. However, the application is restricted to Android devices only and does not include advanced real-time tracking or predictive capabilities.

Pritom K. Rajvor, Md. S. I. Shovon, Minira Akter, Farzana Nawrin, and Suraiya Yasmin (2021), “Reduction of Food Wastage through Donation Using Online Food Management System for Orphanage”. This research presents a web-based portal built with PHP and MySQL that enables donors to post surplus food items, allows admins to verify and approve requests, and lets orphanages or NGOs collect the donations directly. The platform creates a straightforward

connection between donors and beneficiary organizations, thereby reducing overall food waste. Its major limitation is that it remains purely web-based with no real-time tracking or mobile support for volunteers.

Ajay K. Harijan, Abhaykumar Patel, Bijay Yadav, Mumtahina Afrin, and Kiran Macwan (2024), "Food Serving Application System". The team designed an Android application using Java, Firebase, and Google Maps to connect donors, NGOs, and needy individuals in real time. The system provides transparent donation tracking and easy coordination through location services. Although it offers good usability and transparency, it was developed only as a prototype and lacks scalability for large-scale deployment across multiple cities.

B. Kabilan, C. Karthickraja, A. Karthik, and M. Arun (2021), "Food Conservation Application – Mobile App". This Android application, developed in Java/XML, lets donors post excess food items while receivers receive instant notifications. It creates a simple and quick link between providers and consumers, helping minimise household-level food wastage. The main drawbacks are the absence of real-time tracking and limited scalability for wider adoption.

Vidhi Panchal, Kajal Kuchekar, and Snehal Tambe (2020), "Availability of Food for NGO through Mobile Application: FOOD FOR ALL". The authors built an Android app that allows donors to post available food and automatically notifies nearby NGOs. The system offers a fast and straightforward donor–NGO connection that reduces wastage effectively. However, it lacks real-time tracking features and has limited scalability for growing user bases.

Dr. Musheer Ahmed and Abhilash Trivedi (2023), "The AI-Powered Plate: Examining Customer Perspectives on Next-Gen Food Delivery". Through a detailed survey of 556 app users, the study analyses how people perceive and accept AI features in food delivery services. It provides valuable insights for improving customer-focused strategies and increasing AI adoption. The research highlights that data privacy concerns significantly reduce user trust and willingness to use AI-powered features.

Alok Kumar Gupta et al. (2018), "Remnant Food Donation System Using Full Stack Web Development". The team created the "Seva" Android application where donors post food details, an agent receives immediate notification, and redistribution is handled using AI and HCI principles. The app displays locally available food, improves donor well-being, and sends instant alerts to NGOs. It effectively tackles large-scale wastage and inefficient charity supply chains while addressing economic and environmental costs.

Dr. K. Suvarna Vani B.E. et al. (2021), "An Android Application on Food Salvage". This "Seva" Android app allows donors to log surplus food details and notifies a local agent for quick collection and redistribution. It helps tackle hunger and waste, improves donor satisfaction, and benefits the environment through instant NGO alerts. The system highlights the major challenges of food wastage in densely populated countries and the limitations of traditional supply chains.

Rahul Srinivas Sucharitha and Seokcheon Lee (2022), "Application of Clustering Analysis for Investigation of Food Accessibility". The researchers applied the Gaussian Mixture Model (GMM) on food bank and demographic data to identify underserved areas with poor food access. The method accurately detects regions needing more support. However, the Expectation-Maximization algorithm sometimes converges only to local optimal solutions, limiting its overall effectiveness.

Md. Johirul Islam Tutul et al. (2023), "Smart Food Monitoring System Based on IoT and Machine Learning". IoT sensors continuously collect environmental data such as temperature and gas levels, while a machine learning model predicts food freshness and displays results on a mobile app. The system provides real-time alerts that significantly reduce food waste and offers a user-friendly interface. Its limitations include the need for constant internet connectivity, dependence on accurate sensor data, and high implementation cost at scale.

Temilade Abass, Esther Oleiye Itua, Tabat Bature, and Michael Alurame Eruaga (2023), "Innovative Approaches to Food Quality Control: AI and Machine Learning for Predictive Analysis". The authors proposed an AI/ML-based predictive model for data analysis, anomaly detection, and real-time monitoring of food quality. The system enables proactive control, reduces waste, saves costs, and improves accuracy. Challenges remain in data privacy, system integration, and overall reliability of AI predictions.

Komal Pagere et al. (2022), "System to Reduce and Manage Waste Food". An Android application developed with Firebase and Google Maps API connects food donors with NGOs and farmers for surplus donation and composting of spoiled items. It decreases waste, helps people in need, provides real-time data, and is easy to use. The system depends heavily on internet connectivity and the accuracy of user-provided information.

Hadeel Ibrahim Alzahrani et al. (2021), "E-Sharing Developing a Web Based Online Donation System". The web-based system built using ASP.NET and SQL Server (with UML design) allows secure donation of various items including food to charities. It streamlines the entire donation process, connects donors with NGOs, and reduces overall resource wastage. Limitations include the requirement of internet access, restriction to web users only, and initial setup and maintenance costs.

Geremy Farr-Wharton, JazHee-Jeong Choi, and Marcus Foth (2014), "Food Talks Back: Exploring the Role of Mobile Applications in Reducing Domestic Food Wastage". The study observed three popular apps over three weeks and interviewed users to understand how mobile applications can increase food awareness at home. It successfully showed increased awareness and reduced domestic wastage. However, trust issues in food sharing and time-consuming manual data entry remain significant barriers.

Hitesh V. Raut, Swapnil R. Rajput, Dhananjay B. Nalawade, and Karbhari V. Kale (2018), "Smartphone Based Waste Food Supply Chain for Aurangabad City Using GIS and Google Web Services". The client-server model with PhoneGap app, PHP/MySQL, and GIS technology provides fast donor–charity linkage and optimised location-based delivery routes. It creates an efficient supply chain for waste food management. No major disadvantages are specifically highlighted in the study.

Ms. Snehal Chaudhari, Ms. Sneha Dighe, Ms. Rucha Desai, Ms. Sofiya Mulla, and Mrs. Yugchhaya Dhote (2020), "An Online Platform for Connecting NGO". The web platform developed with HTML, CSS, JS (frontend) and MySQL/PHP (backend) successfully links NGOs, donors, and volunteers on a single platform. It simplifies NGO management and record-keeping while addressing issues of fund misuse and resource wastage. The system aims to create a more accountable donation ecosystem.

Mr. Md Sums Munir Alam and Dr. N. Malarvizhi (2022), "Food Bank Management System - Feeding Humanity Through Mobile App". The mobile application built with CSS Android and MySQL provides 24×7 donation management service at zero cost and saves significant time while feeding needy people. It offers a practical solution for leftover food distribution. The main challenge is that donors sometimes fail to transport food due to personal reasons.

Shinta Oktaviana R., Diana Ambarwati Febriani, Intan Yoshana, and L.R. Payanta (2021), "FoodX: A System to Reduce Food Waste". Using the Prototyping Model with continuous user feedback, the system connects communities with people and organisations donating excess food. It supports different types of communities and provides convenience for citizens. Successful operation requires collaboration with food safety experts and government bodies.

Yasith Chandula, Akila Kavinda, Thushal Shaminda, Sachintha Gunaratne, D. I. De Silva, and Dulanji Cooray (2023), "Food-For-All Web Application for Donation Management". Developed using the MERN stack with MVC architecture and multiple user roles, the web platform increases trust through admin approvals and supports fundraisers. It enhances overall engagement and solves limited donation options and communication gaps between donors and beneficiaries.

Prof. Rupali Maske, Rohit Wagh, Akash Verma, Omkar Thopate, and Basant Bhagat (2022), "A View on Surplus Food Donation App". The MERN-stack web application connects donors and receivers with third-party transport services on a single platform. It provides an efficient way to donate surplus food and helps reduce overall waste effectively. The study does not mention any specific disadvantages.

Christina Varghese, Drashti Pathak, and Aparna S. Varde (2023), "Seva: A Food Donation App for Smart Living". Designed using HCI principles, wireframes, and evaluation, and coded with Android, Java, and SQLite, the app provides local food resources and reduces both hunger and waste. It aligns with UN Sustainable Development Goals and supports smart living concepts. The system is currently in the prototype phase and uses basic backtracking without advanced heuristics.

George Zhou, Marisabel Chang, and Yu Sun (2022), "A Mobile Platform for Food Donation and Delivery System Using AI and ML". The app includes profiles for food banks, customers, and volunteers, and was tested for reducing food waste and increasing volunteer sign-ups. It successfully delivers groceries to those in need and boosts community involvement. Expansion remains difficult because many pantries hesitate to change their existing systems.

Arfandi Andres, Joshua Christian Sandhi, Edwin Setiawan Tanjaya, Harco Leslie Hendric Spits Warnars, and Ghaniyardi (2021), "Sharing Food with Food Life Savr Smartphone App". Using SWOT analysis, class diagrams, use case diagrams, MySQL, and UI mockups, the app simplifies food sharing and reduces global waste while helping needy people. It creates an easy platform for excess food donation. The system heavily depends on transport resources and available couriers for successful distribution.

G. Nirmala, T. Naresh, Dr. S. Suresh, I. Venu K. Mallaiah, and K. Padama (2023), "A Charitable Donation Platform Based on Leveraging AI/ML". The E-service app uses image processing with CNN (YOLOv5) for automatic object detection and sorting of donations. It improves efficiency in managing donations and greatly helps NGOs. Manual processes are still time-consuming, and future enhancements are needed for GPS, face recognition, and item-quality detection.

Nowshin Sharmile, Isaac A. Nuamah, Lauren Davis, Funda Samanlioglu, Steven Jiang, and Carter Crain (2023), "Predicting and Optimizing the Fair Allocation of Donations in Hunger Relief Supply Chains". The study uses hierarchical forecasting models (ETS, ARIMA, STL) combined with an optimisation model to predict donations and ensure fair distribution across food aid networks. It improves forecast accuracy and enables efficient allocation. Data variability and inconsistent supply still cause forecasting errors.

3. CONCLUSION

This survey has systematically analysed the existing literature on food donation and waste management systems and clearly identified their major shortcomings — lack of real-time tracking, absence of predictive intelligence for food expiry, no performance analysis of volunteers, and absence of location-based demand clustering. Most of the reviewed systems are limited to basic posting and notification features, remain platform-dependent (Android-only or web-only), and fail to provide end-to-end transparency and accountability between donors, volunteers, and beneficiary organisations.

To overcome these critical gaps, the proposed HopeBite system introduces a complete AI-powered smart food distribution platform specifically designed for communities in need. By integrating Gemini AI for accurate food expiry prediction, machine learning-based review mining for automatic ranking of top-performing volunteers and donors, and K-Means clustering for identification of high-demand areas, HopeBite creates a unified, secure, and transparent ecosystem. The dual architecture of a Django-based web portal for admins and organisations combined with a Flutter mobile application for volunteers and donors ensures seamless role-based access, real-time status tracking, and instant feedback mechanisms.

The literature survey clearly establishes that no previous work has combined all these intelligent features within a single verified platform. HopeBite successfully bridges this gap by enforcing strict admin verification workflows, providing end-to-end donation tracking, and delivering data-driven insights through an intelligent admin dashboard. Implemented and tested in Phase-2 with full module integration, the system has demonstrated measurable reduction in food spoilage, faster response times, improved stakeholder coordination, and enhanced community trust.

In conclusion, HopeBite stands as a socially impactful and technologically advanced solution that transforms surplus food into a sustainable resource while addressing the twin challenges of food wastage and hunger. By leveraging modern web and mobile technologies with powerful AI and ML capabilities, the platform not only minimises waste but also promotes community engagement, environmental sustainability, and responsible social responsibility. With planned future enhancements such as IoT-based quality monitoring, blockchain for traceability, multi-language support, and advanced automated matching, HopeBite holds strong potential to scale across urban and semi-urban regions of India and beyond, making a meaningful contribution toward achieving zero hunger and building a more sustainable society.

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