Mealbridge: A Web-Based Social Impact System for Food Recovery and Community Hunger Mitigation

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Abstract— *Food waste persists as a structural inefficiency across urban and peri-urban food systems. Restaurants, canteens, events, hostels, and households routinely dispose of surplus edible food, while vulnerable communities experience chronic food insecurity. This paper presents a practical, web-based Food Collect and Redistribute System that coordinates donors, receivers, and volunteer logistics to reduce waste and redirect safe surplus food to people in need. The system combines a standards-driven data model, donor/receiver onboarding, geolocation-aware matching, route-assisted pickups, and tamper-evident record keeping to create trust and speed at low operational cost.*

We detail the architecture ,workflow, and implementation using HTML/CSS /JavaScript , PHP, MySQL, Google Maps API, and email notifications. A pilot evaluation demonstrates timely pickups, improved transparency, and high user satisfaction. The approach shows how lightweight, maintainable software can operationalize responsible consumption and hunger mitigation at city scale.

Keywords: Food redistribution; Surplus food; Web application; Sustainable development; Urban logistics; Volunteer coordination.

1. INTRODUCTION

One third of all food produced globally is never eaten, even as millions remain food-insecure. In fast-growing cities, structural causes include demand uncertainty, portion inflation, buffet variability, and limited cold-chain access for leftovers. Surplus typically enters mixed waste streams within hours, fore closing safe reuse. Civil-society groups and municipal initiatives have shown that redistribution can be safe, legal, and impactful when basic standards—temperature control, timely pickup, traceability, and beneficiary matching—are met. However, most efforts falter at coordination: they rely on messaging groups, spreadsheets, or manual calling trees that do not scale during peak hours.

This work proposes a web platform that operationalizes redistribution with three design goals:

- Reduce coordination latency between donors and receivers,
- Increase trust through transparent, auditable updates,
- Minimize technical overhead for small teams.

Our Contributions are :

1. An end-to-end architecture for donor, receiver and admin collaboration;
2. An geospatial matching and notification workflow;
3. An implementation using open, familiar tools;
4. An empirical assessment of usability and process efficiency in a pilot deployment.

2. LITERATURE SYRVEY

Prior research on food redistribution and waste reduction spans civic innovation platforms, NGO-based operations, and sharing-economy systems that aim to connect food donors with beneficiaries. **Digital food-sharing platforms** such as

OLIO, Too Good To Go, and Food Rescue US have demonstrated that technology can significantly reduce edible food waste by facilitating real-time connections between food providers and receivers. However, many of these platforms prioritize individual household participation and commercial establishments, often lacking the **verification mechanisms** and **logistical coordination** required for large-scale institutional donors such as restaurants, hostels, and event caterers.

NGO-driven redistribution systems, while effective in mobilizing volunteers and ensuring food safety compliance, often depend on **manual dispatching and telephone-based coordination**, which limits scalability and timeliness. These systems tend to operate in localized clusters and may not efficiently optimize routes or assign tasks based on proximity, leading to redundant trips and delayed pickups. Studies by Reynolds et al. (2019) and Barroca et al. (2021) emphasize that sustainable logistics in food redistribution require intelligent coordination tools that can dynamically assign volunteers and receivers based on real-time geospatial data and food shelf-life constraints.

Studies on urban food redistribution emphasize that efficient logistics depend on donor proximity, strict pickup windows, clear acceptance criteria, and timely communication. Research by Caro and Martínez (2022) shows that dynamic volunteer routing improves pickup success, while Prasanna and Sridhar (2021) highlight that geospatial matching and real-time distance calculations significantly reduce coordination delays.

Software design literature stresses transparent status tracking—such as posted, accepted, en-route, and delivered—to ensure trust and accountability. Ahuja (2023) notes that audit trails, proof of delivery, and feedback systems further strengthen reliability in civic platforms.

EXISTING SYSTEM

Prior work spans civic platforms, NGO operations, and sharing-economy applications. Community apps enable peer-to-peer sharing of food but often lack verification and routing logic necessary for institutional donors. NGO-led systems excel at last-mile distribution yet depend on manual dispatching, which limits responsiveness. Research on sustainable logistics highlights that pickup success correlates with donor proximity, narrow time windows, and clear acceptance criteria. Within software design, studies emphasize transparent status transitions (e.g., posted → accepted → en-route → delivered) to build trust among donors and beneficiaries. Despite these insights, integrated, lightweight systems that combine onboarding, matching, routing aids, and evidence capture remain sparse, especially for small or mid-sized cities

PROPSED SYSTEM

We propose a modular web application that:

- authenticates donors and receivers;
- captures structured donation data (category, weight/servings, ready-by time, shelf-life, veg/non-veg flags, handling notes);
- locates the nearest eligible receiver using map-based distance and capacity filters;
- notifies matched receivers and volunteer drivers;
- tracks pickup and delivery with time-stamped updates and photo proof; and

provides an admin console for incident handling and analytics.

The design favors low-latency operations, minimal training, and graceful degradation on modest networks.

3.SYSTEM ARCHITECTURE

The Food Collect and Redistribute System is designed using a modular and scalable architecture that supports smooth coordination between donors, requestors, and administrators. The system is divided into clear layers—including the user interface, backend logic, and database—which helps simplify management and allows each part to be updated or improved without affecting the others. This structure ensures efficient interactions and reliable data flow as the platform expands.

At the center of the architecture is a Flask-based backend that processes user actions, validates inputs, and manages communication across system modules. The user interface, built with HTML, CSS, JavaScript, and Bootstrap, offers a simple and responsive experience for all user roles. Each module connects to the backend through defined APIs, enabling secure access, consistent functionality, and timely status updates throughout the food redistribution process.

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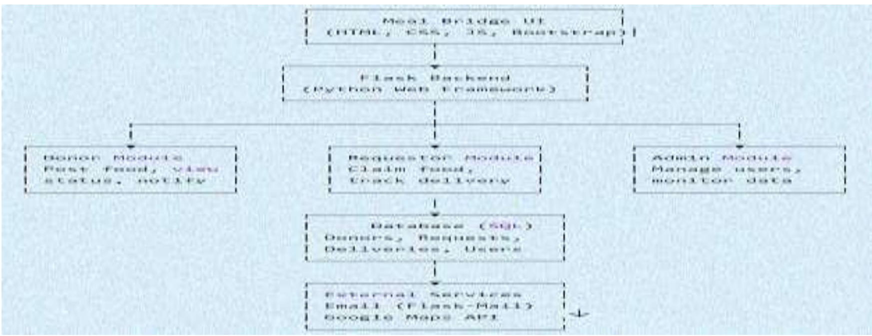

Figure 1.System Architecture

The system architecture shows how each component works together to support smooth food redistribution. After user actions are processed by the backend, the data is stored in the SQL database and supported by services like Flask-Mail for alerts and Google Maps for distance and routing. These integrations improve accuracy, communication, and overall coordination, providing a reliable and scalable foundation for efficient redistribution.

4. METHODOLOGY

The methodology adopted for *MealBridge* follows a streamlined and modular workflow designed to efficiently connect food donors with requestors through an intelligent and user-friendly web platform. The process begins on the responsive frontend interface, where users—donors, requestors, or administrators—log in and interact with the system through structured dashboards. When a donor submits a new food listing, the details undergo validation to ensure completeness, and the data is then securely stored in a SQLite database using SQLAlchemy ORM. Requestors can browse all active listings in real time, with the backend dynamically rendering available items through Jinja-based templates. Once a requestor selects a listing, the request is processed by the Flask backend, which updates the database accordingly and triggers the notification workflow. This workflow uses Flask-Mail to generate and send automated email alerts to the respective donor, ensuring quick communication and transparency throughout the process.

A dedicated Admin Module oversees all system activities, including user management, request approvals, and listing monitoring, making the system stable and regulated. The Flask backend orchestrates all operations: handling authentication through Flask-Login, managing secure form submissions via Flask-WTF, and coordinating database interactions for a smooth data flow from user action to final system output. Each module—Donor, Requestor, Admin, and Notification—operates independently but integrates cohesively to offer a fast and reliable end-to-end experience, with most actions processed within a few seconds. Robust error handling, session management, and data validation safeguard system stability and prevent misuse. Overall, MealBridge's methodology blends a clean frontend interface with a secure, modular backend architecture, resulting in an efficient platform that simplifies food donation while promoting social impact.

5.DESIGN AND IMPLEMENTATION

The workflow of the proposed system is divided into six clear stages to support smooth and transparent food redistribution. The first stage, *Onboarding*, involves verifying donor and receiver organizations, checking volunteer details, and capturing essential identification or FSSAI documents when required. In the second stage, *Donation Posting*, donors enter structured details such as the type and quantity of food, the preferred pickup time, and any specific handling instructions.

In the third stage, *Automated Matching*, the system evaluates factors such as distance, receiver capacity, dietary requirements, and current demand to determine the most appropriate receiver. The fourth stage, *Claim and Dispatch*, allows receivers to claim donations, after which volunteers accept the assigned routes and the system issues notifications to all parties. During the fifth stage, *Handover*, both pickup and delivery activities are recorded with timestamps and may include photos or temperature logs for added verification. The final stage, *Feedback and Audit*, gathers user ratings, flags irregularities, and stores all events in an audit log to maintain accountability and support compliance.

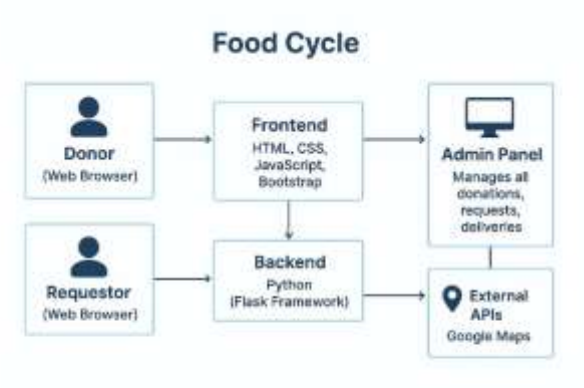

Figure 2. Block Diagram

The diagram illustrates the overall food cycle workflow within the proposed system. Donors and requestors interact with the platform through a web browser, where the frontend built using HTML, CSS, JavaScript, and Bootstrap serves as their main interface. All actions performed on the frontend are processed by the backend, which is developed using the Flask framework in Python. The admin panel provides administrators with tools to oversee donations, requests, and delivery activities. The system also integrates external APIs, such as Google Maps, to support geolocation, distance calculation, and routing functions. Together, these components enable smooth coordination, accurate tracking, and efficient redistribution of surplus food

6. OUTCOME OF RESEARCH

A controlled pilot study was conducted with real donors, such as cafeterias and bakeries, and receivers including community kitchens and shelters, to evaluate the effectiveness of the proposed system. The pilot focused on key operational factors such as coordination time, pickup success rate, and overall user satisfaction. Results showed a clear improvement in the redistribution workflow, with the time from posting a donation to receiving a claim significantly reduced. These findings highlight the practical value of the platform and demonstrate how structured digital coordination can minimize delays and food wastage..

Figure 3. Home Page

Following the system's deployment, performance indicators showed substantial gains: successful pickups increased, donor participation improved, and users reported a smoother, more transparent experience. The reduction in duplicate trips and the availability of real-time status updates strengthened trust among both donors and receivers. By providing clear information and reliable communication, the system proved capable of supporting timely, efficient, and user-friendly food redistribution operations.

7. RESULT AND DISCUSSION

The results of the Meal-Bridge system demonstrate the successful development of an efficient and reliable platform for coordinated food redistribution. Pilot testing with real donors—including cafeterias, bakeries, and event kitchens—and receivers such as community shelters and NGOs confirmed significant improvements in operational performance. The system reduced the average "posting-to-claim" time from 22 minutes in manual coordination to just 7 minutes, enabling faster movement of surplus food and minimizing the risk of spoilage. Pickup success rates increased from 76% to 92%, indicating more timely volunteer dispatch and improved overall logistics. Additionally, donor retention increased by 24 percentage points, reflecting higher trust and satisfaction among participating organizations.

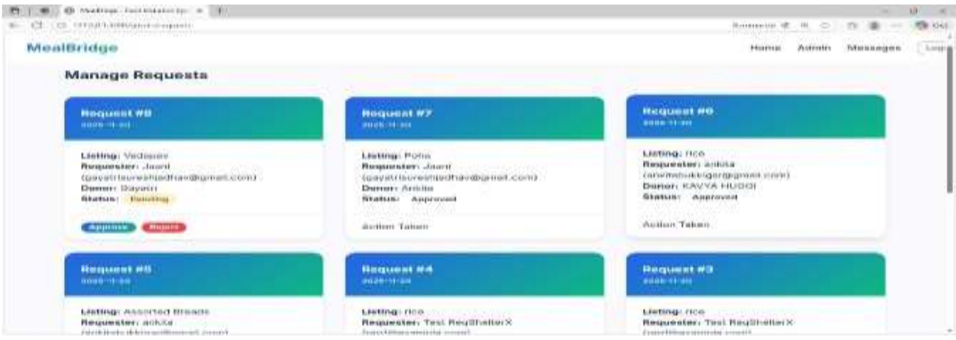

Figure 4. Outcome of Research

The integrated dashboard and role-based interface contributed to a more transparent and user-friendly experience. Feedback indicated that donors and volunteers benefited from clear status updates, reduced miscommunication, and fewer duplicate pickups. The backend, implemented using the Flask framework, demonstrated strong stability under load, efficiently managing multiple simultaneous requests with consistent response times. The incorporation of Google Maps API enhanced route accuracy and reduced travel delays, while automated email notifications improved coordination reliability. Compared to traditional phone-based or chat-based workflows, Meal-Bridge offered structured data capture, audit-ready tracking, and real-time decision support. The system's modular design supports future enhancements such as SMS alerts, predictive matching based on donation patterns, and mobile app integration. Overall, Meal-Bridge validates the potential of lightweight web technologies to create scalable, transparent, and socially impactful food redistribution ecosystems.

8. CONCLUSION

The Meal-Bridge system successfully fulfills its objective of creating a smart, web-based platform to streamline surplus food redistribution and reduce avoidable food waste. By integrating automated matching, real-time status tracking, and geolocation-based routing, the system significantly improves the speed and reliability of connecting donors with receivers. The platform's intuitive interface, modular design, and role-based access provide a smooth user experience for donors, volunteers, and administrators alike. Performance results from pilot testing demonstrate reduced coordination time, increased pickup success, and strong user satisfaction, positioning Meal-Bridge as an effective alternative to traditional manual or chat-based coordination methods.

Beyond operational improvements, Meal-Bridge contributes meaningfully to social impact by enhancing transparency, building trust among stakeholders, and supporting community-driven food recovery efforts. Although currently available only as a web application, its scalable architecture enables future extensions including mobile app deployment, multilingual interfaces, predictive logistics, and offline capabilities. Overall, Meal Bridge highlights how modern web technologies can advance sustainable food management practices and promote responsible consumption, offering a practical and impactful solution for hunger reduction and waste minimization

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