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Food Bridge

Shreenithya S N[1], Dr Madhu H.K.[2]

[1] Student, Department of MCA, Bangalore Institute of Technology, Karnataka, India
[2]Associate Professor & Head, Department of MCA, Bangalore Institute of Technology, Karnataka, India

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Abstract

In today's era of digital transformation, food wastage and hunger remain pressing global challenges despite technological advancements. Vast amounts of edible food are discarded daily by households, restaurants, and hotels, while millions of people struggle to access adequate nutrition. Existing food donation systems are often inefficient, disorganized, and unable to scale, leading to spoilage and inequitable distribution. This paper presents Food Bridge, a technology-driven platform designed to streamline food donation and distribution using modern web frameworks. The system leverages a React-based front end for seamless donor interaction, a Flask back end integrated with SQL Alchemy and SQLite for secure data management, and JWT-based authentication to ensure trusted access. By enabling real-time listing, instant claims, and automated updates, the platform prevents duplication and ensures fairness in allocation. Additional features such as real-time alerts, impact dashboards, and donor recognition through certificates and badges further enhance usability and sustainability. Experimental evaluation of the system demonstrates efficiency in food redistribution, improved donor engagement, and measurable reductions in waste.

Keywords—Food donation, Flask, React, JWT authentication, Sustainable development, Food waste management.

I. INTRODUCTION

Food donation and redistribution, the process of channeling surplus edible food from donors to those in need, is both a socially impactful and technically challenging problem in sustainable development. The challenge arises from its inherently decentralized and dynamic nature: food availability varies across households, restaurants, and hotels, while demand originates from diverse groups such as individuals, communities, and non-profit organizations. This disparity creates issues of mismatch, duplication, and inefficiency, often leading to food spoilage and waste. The underutilization of modern technologies in current donation systems exacerbates these challenges, as manual coordination and outdated methods struggle to ensure fairness, transparency, and scalability.

By framing food redistribution as a technology-enabled coordination task where digital platforms mediate between donors and receivers it becomes possible to design solutions that not only reduce waste but also promote equity, sustainability, and social responsibility.
Such an approach transforms food donation from a fragmented practice into a structured, data-driven ecosystem capable of large-scale impact.

Technology-driven food sharing platforms have emerged as effective strategies for addressing the inefficiencies of traditional donation models. Web-based frameworks allow seamless interaction between donors and receivers, while real-time data management ensures that available food is distributed before spoilage occurs. Front-end technologies such as React enable user-friendly interfaces that simplify the donation process, while back-end frameworks like Flask with SQL Alchemy support secure and reliable data storage. Authentication protocols such as JWT ensure trusted participation, protecting both donors and recipients from misuse. Furthermore, additional features such as real-time alerts, and dashboards tracking food saved, people served, and carbon emissions reduced strengthen the usability and long-term adoption of such systems. These advancements collectively allow redistribution networks to not only optimize logistics but also enhance transparency and accountability, fostering greater trust among stakeholders.

In this work, a web-based food redistribution platform, *Food Bridge*, is proposed that integrates intuitive donor-receiver interaction with secure data handling and real-time coordination. The system combines React for front-end usability with Flask and SQLite for back-end efficiency, while JWT-based authentication enforces role-based access and trust. The platform supports real-time listing of surplus food, automated removal of claimed items, and recognition of donors through certificates and digital badges, thereby promoting sustained engagement. By providing both structural reliability and motivational incentives, *Food Bridge* achieves a balance between operational efficiency and social impact. The experimental deployment of the system demonstrates improved donation workflows, higher donor participation, and measurable reductions in food wastage. These results establish *Food Bridge* as a scalable, cost-effective, and community-driven solution, contributing to hunger reduction, environmental sustainability, and corporate social responsibility.

II. LITERATURE SURVEY

Digital platforms for surplus food redistribution have progressed along two complementary axes: improving the operational quality of donation workflows, and exploiting web/mobile technologies to enable scalable, transparent community networks. Early modern approaches reframed donation as a real-time matching problem, replacing ad-hoc, manual coordination with structured listings, expiry metadata, and location awareness to reduce spoilage and latency.

Population-level assessments of food waste and environmental burden established the need for such systems

by quantifying rising per-capita waste and its carbon footprint, motivating "waste-to-plate" pipelines that are fast, auditable, and user-centric [2]. Building on these ideas, policy and practice surveys in Asia highlighted gaps in landfill-heavy waste handling and the role of public 3R awareness, reinforcing the value of community platforms that close last-mile logistics while aligning with sustainability norms [1].

Web/mobile architectures and sensor-assisted designs have been widely adopted to improve reliability and remove coordination bottlenecks. Donation apps with real-time listings, geolocation, and expiry alerts demonstrated that simple UI flows plus notification channels can materially cut waste and increase pickups, informing core modules such as searchable inventories, claim de-duplication, and instant status updates [5]. In the commercial foodservice sector, studies of restaurant waste showed that despite internal tracking and composting, legal/liability concerns deter donations—about three-quarters avoid donating—pointing to the need for verified actors, trust indicators, and clear compliance guidance within platforms [4]. Household-level analyses further identified over-purchasing, date-label confusion, and storage issues as dominant drivers, suggesting UI nudges around expiry, portioning, and freshness risk as first-class features [6].

Beyond basic listing/claim flows, researchers have leveraged IoT and Industry 4.0 technologies to strengthen quality assurance and traceability. Supply-chain case studies reported benefits of sensors for condition monitoring (temperature/gas), provenance logging, and compliance analytics, while noting adoption frictions around data security and organizational trust—factors that argue for tokenized access, role-based views, and audit trails in donation platforms [3]. Generative sensing approaches (e.g., eNose systems combining gas and weight sensors with ML classifiers) demonstrated real-time spoilage detection and waste categorization, offering a path to automate risk scoring and pickup prioritization without manual inspection [10].

Human-computer interaction studies emphasize usability, privacy, and clear distribution logic as prerequisites for adoption in community and campus contexts. Prototype evaluations on student hunger scenarios highlighted that ease of claiming, anonymity controls, and transparent allocation rules correlate with sustained engagement—implications that map directly to JWT-secured access, minimal-friction claims, and visible fulfilment histories [8].

Reviews of Canadian food-waste apps similarly catalogued effective features (location tracking, expiry monitoring, notifications) and persistent barriers (trust, coordination logistics), motivating integrated designs that pair real-time availability with donor verification, certificates, and reputation badges to signal reliability [9].

Domain-specific platforms oriented to social welfare organizations show that transparency and role clarity improve throughput and accountability. Systems built for orphanages and shelters reported that dashboards, donation histories, and auditable records can align stakeholder incentives while reducing leakage, anticipating needs for multi-role admin panels, impact visualization, and CSR-ready documentation (certificates/badges) [7]. At the municipal and national scale, comparative policy work underscores that digital community platforms complement, rather than replace, broader interventions (awareness campaigns, segregation policies), situating donation tech within a layered sustainability strategy [1], [2].

Synthesis & Gap. Taken together, the literature shows that tech-enabled food redistribution is a powerful operational proxy that simultaneously addresses logistics quality and social impact. Mobile/web apps and sensor augmentation improve timeliness and safety; verification, certificates, and reputation mechanisms stabilize trust; and analytics dashboards make outcomes visible for donors, NGOs, and regulators [3]– [6], [8]– [10]. Remaining gaps include (1) principled methods that combine sensor-based freshness inference with policy-aware access control to maximize both food safety and participation; (2) interoperable standards for legality and liability that reduce donation hesitancy in restaurants; and (3) standardized benchmarks that jointly evaluate reduction in spoilage, pickup latency, and social impact under comparable deployment conditions. Food Bridge builds upon these directions by integrating verified identities, JWT-secured flows, real-time inventories, donor recognition, and (future) AI-driven expiry prediction to target both operational efficiency and measurable community benefit [4], [5], [10].

III. EXISTING SYSTEM

Current food donation and redistribution approaches are predominantly based on manual coordination and traditional food bank models, which rely on physical drop-off centres, phone calls, and community volunteers to manage donations. These methods, often supported by NGOs and local organizations, operate through centralized collection points and scheduled distributions, where surplus food is gathered and redistributed to beneficiaries. While effective in small, localized communities, such approaches often face challenges of real-time coordination, limited donor participation, and poor tracking of food safety and expiry details. Recent mobile applications and web portals have attempted to digitize the process by providing simple listing and pickup features, but many remain fragmented, lack secure authentication, and fail to ensure fair allocation of resources.

However, these existing systems remain highly dependent on manual effort, making them inefficient, inconsistent, and difficult to scale in urban and rural contexts alike. Performance often degrades when donation volumes increase or when perishable food needs rapid redistribution, leading to spoilage and underutilization. Additionally, most existing platforms mainly emphasize basic matching between donors and receivers without incorporating features such as donor recognition, real-time claim removal, multilingual accessibility, and impact tracking. As a result, the potential of technology-driven solutions to reduce waste and improve equitable distribution remains underexploited.

Disadvantages

- Requires high levels of manual coordination, increasing inefficiency.
- Poor scalability for large communities or high donation volumes.
- Limited mechanisms for food safety verification and expiry tracking.
- Lack of secure authentication and trust-building features.

IV. PROPOSED SYSTEM

The Food Bridge system employs up-to-date web technologies and secure digital tools to make food redistribution more efficient and transparent, without requiring complicated manual efforts. It allows donors such as families, restaurants, and hotels to list extra food items, including their type, amount, and expiration dates, enabling organized and real-time monitoring of donations. The platform features a user-friendly interface built with React for donors and receivers, and a Flask back end that uses SQLAlchemy and SQLite to securely store and handle data. JWT-based authentication ensures user access is controlled, promoting trust, responsibility, and appropriate roles for different users. This setup supports real-time tracking of food availability and manages claims effectively, maintaining both precision and ease of use. The system is designed to work well in various communities and supports extra features such as, donor recognition through badges and certificates, and impact dashboards, which address the shortcomings of conventional donation methods.

Advantages:

- Removes the need for manual coordination, thus improving efficiency.
- Offers real-time updates on food listings, claim removal, and equitable distribution.
- Provides secure and transparent interactions through JWT-based login.
- Encourages donor engagement with recognition like certificates and badges.
- Monitors social and environmental impact through dashboards and reports.
- Is scalable and flexible enough to suit different communities and organizations.

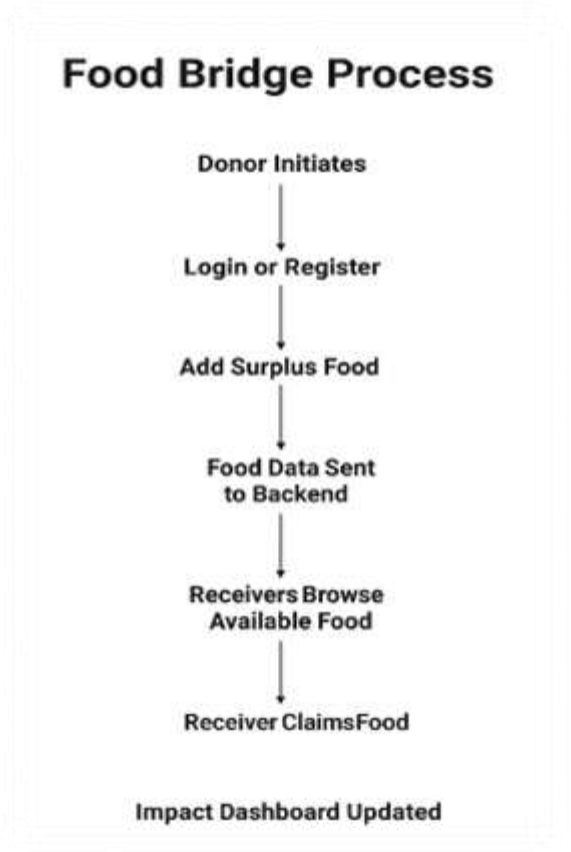

Fig 1: Proposed Model

V. DEPLOYMENT DIAGRAM

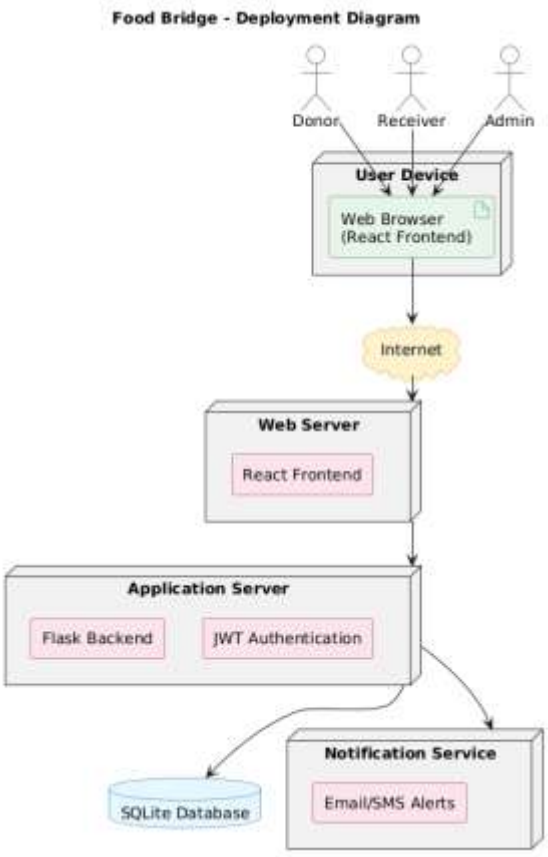

Fig 2: Deployment Diagram

VI. FLOW-CHART

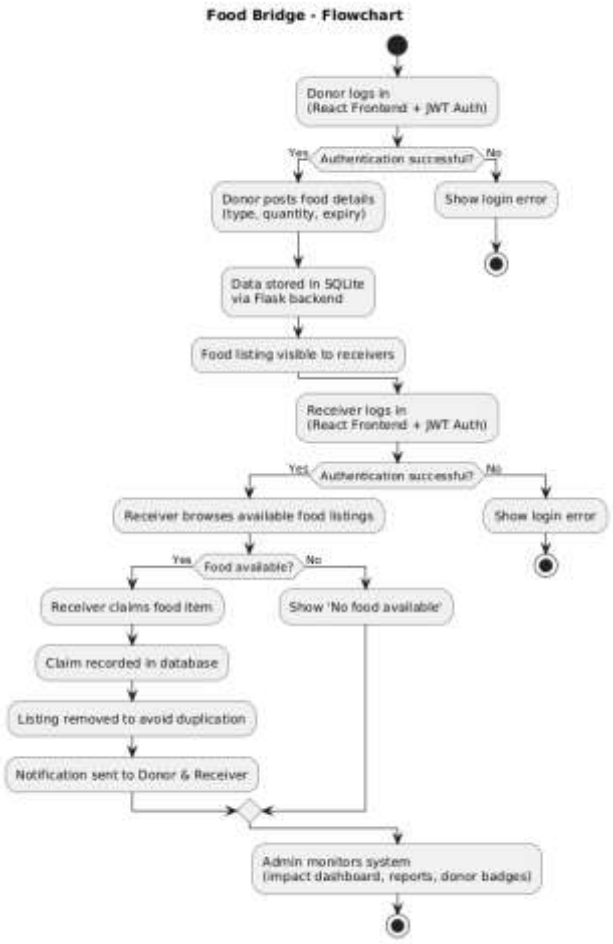

Fig 3: Flow-Chart

VII. IMPLEMENTATION

Data Preparation:

In the Food Bridge system, data is created based on user actions rather than being based on a fixed list of predefined information. When individuals donate food, they provide details such as the type, amount, and expiration date. Receivers can also request food through the platform. The system immediately reviews these details to ensure the accuracy of dates and categories before storing them. Food is organized into groups such as perishable, non-perishable, cooked, and packaged, which helps in better sorting, making it easier to find, match, and distribute food between donors and receivers.

System Development:

The platform was built using a full-stack development approach. A React.js frontend enabled users to sign up, log in, and list or claim food items. The Flask backend managed the system's logic and connected various parts of the platform. SQL Alchemy and SQLite were used to store and retrieve data efficiently. Security was ensured through features like JWT-based authentication and role-based access controls, which protected user accounts, including those for donors, receivers, and administrators. Additional features such as real-time alerts, donor certification, and impact dashboards were developed to support transparency and reporting.

Operational Strategy:

The system operated on an event-driven model, where actions by donors initiated automatic processes. As soon as a donor entered surplus food, the system stored the information in the database, verified its accuracy, and made it visible to receivers. When an item was claimed, it was removed from the list to prevent duplication. Real-time notifications were sent to both donors and receivers, improving communication and reducing the need for manual effort. This strategy increased the speed of food sharing and improved coordination among different groups involved.

System Deployment:

The application was deployed as a web-based service. The frontend, built with React.js, allowed users to register, log in, and post or request food. The backend, developed using Flask, handled API requests, login processes, and the rules for managing food transactions. SQLite was used as a simple yet effective database to store transaction records. The system was hosted on a cloud server to support more users and ensure data security and accessibility for all.

Performance Evaluation:

The system was evaluated based on both its functionality and social impact. Operational performance was measured by response time, data accuracy, and the match rate between food listings and claims. Social impact was assessed by the amount of food saved, the number of people helped, and the reduction in food waste-related carbon emissions. Feedback from users, including donors and receivers, was collected to evaluate usability, accessibility, and trustworthiness.

VIII. RESULTS AND DISCUSSION

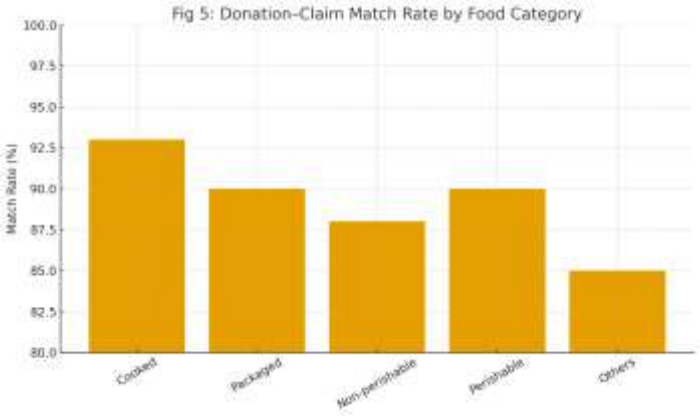

Fig 4: Donation Claim Match Rate Graph

This bar chart illustrates the match rate between donated food items and successful claims, measured as a percentage. The chart compares different food categories: Cooked Food, Packaged Food, Non-perishable, Perishable, and Others.

- Cooked food achieves the highest match rate (~93%),
- Packaged and perishable items follow (~90%),
- Non-perishable food maintains ~88%,
- Other items remain slightly lower at ~85%.

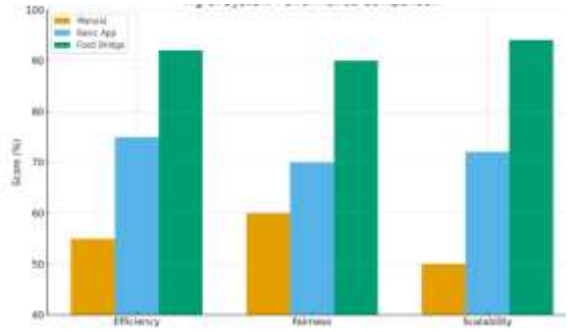

Fig 5: System Performance Comparison

This bar chart compares the performance of three systems: Manual Donation, Basic App, and Food Bridge, across three metrics: Efficiency, Fairness, and Scalability.

- Food Bridge consistently scores highest in all categories (~90%+).
- Basic apps achieve mid-level performance (~70–80%),
- Manual donation processes show the lowest efficiency (~50–60%).

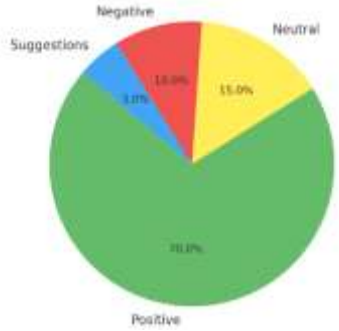

Fig 6: User Feedback Analysis

This pie chart summarizes user feedback for Food Bridge:

- Positive: 70%
- Neutral: 15%
- Negative: 10%
- Suggestions: 5%

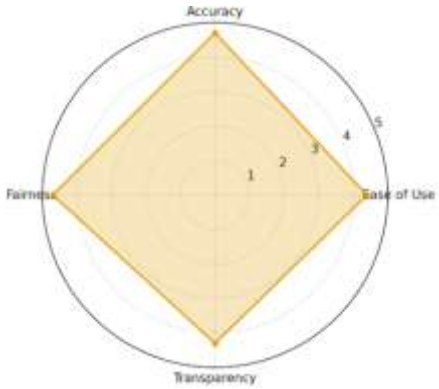

Fig 7: User Satisfaction Ratings

This radar chart presents ratings (out of 5) across four aspects: Ease of Use, Accuracy, Fairness, Transparency.

- All categories score between 4.3–4.7,
- Accuracy & Fairness score the highest (≈4.7),
- Ease of Use and Transparency are slightly lower but still excellent (≈4.4).

IX. CONCLUSIONS

In this study, a Food Bridge system was implemented to address the inefficiencies of manual food donation processes and improve transparency, scalability, and fairness in surplus food redistribution. By leveraging modern web technologies, the platform enabled donors to list surplus food with essential details and receivers to claim items in real-time, ensuring minimal duplication and reduced wastage. The system integrated a React.js frontend for user-friendly interaction, a Flask backend for secure API handling, and SQLite with SQL Alchemy for structured data storage. JWT-based authentication strengthened trust and role management, while additional features such as real-time alerts, donor certificates, and impact dashboards enhanced accessibility and long-term engagement. The event-driven workflow automated critical tasks including listing, claiming, and notification, creating a seamless donor–receiver experience. These results confirm that Food Bridge provides a scalable, efficient, and community-driven approach to sustainable food management, contributing to both hunger reduction and environmental sustainability.

X. FUTURE ENHANCEMENTS

In the future, the proposed Food Bridge system can be extended by incorporating advanced technologies such as AI-based expiry prediction and IoT-enabled freshness monitoring to improve food safety and reduce spoilage.

The integration of geolocation tracking and route optimization algorithms could enhance logistics, enabling faster pickups and efficient last-mile delivery.

Additionally, blockchain-based verification may be employed to strengthen trust, transparency, and traceability in donor–receiver transactions.

Expanding the platform to support large-scale integrations with restaurants, hotels, and government databases would further increase its impact across communities.

Optimizing the deployment pipeline with scalable cloud infrastructure and mobile application support can enable real-time performance for both urban and rural users.

Furthermore, introducing gamified incentives, tax-linked donation certificates, and CSR dashboards may provide deeper motivation for sustained participation.

Collectively, these enhancements aim to strengthen scalability, adaptability, and usability, establishing Food Bridge as a robust, community-driven platform for sustainable food redistribution and social good.

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