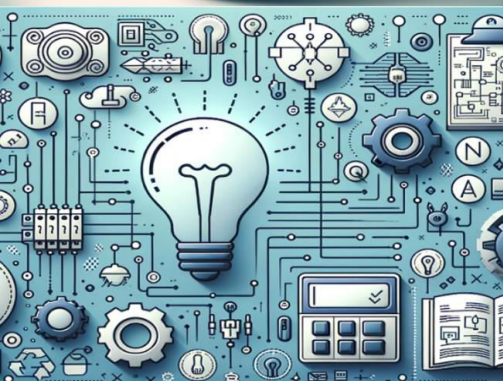


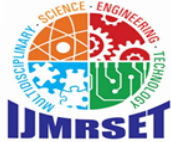
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Food Waste Management System

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ABSTRACT: Food waste is one of the most pressing global issues, directly contributing to hunger, environmental damage, and economic inefficiencies. In urban and rural areas alike, large quantities of food are discarded despite being consumable, largely due to lack of awareness, coordination, or storage facilities. Meanwhile, thousands of people struggle with food insecurity and malnutrition.

This project introduces an innovative web-based application named the "Food Waste Management System" that uses digital coordination and AI-enabled components to connect food donors (households, restaurants, or events) with NGOs and individuals in need. The system includes three main modules: Admin, User (Donor/NGO/Receiver), and Delivery. These modules work in harmony to facilitate food donations, approvals, requests, logistics tracking, and feedback mechanisms.

The Admin module is responsible for verifying and approving food donations and NGO registrations. The User module enables donors to post surplus food and NGOs to request it based on availability and urgency. The Delivery module manages the collection and delivery process, ensuring that food reaches the recipient safely and in a timely manner. The system also incorporates features like real-time notifications, a star-based feedback system, and a chatbot for user assistance.

Technologies used include PHP for the server-side scripting, MySQL for database management, and HTML/CSS/JavaScript for the front end. The platform is tested using XAMPP and is designed to be responsive across devices.

By offering a centralized, transparent, and efficient system, this project contributes to sustainable development by reducing food waste and promoting food equity. It aims to create a bridge between excess and need, ensuring that no food goes to waste and no person goes hungry.

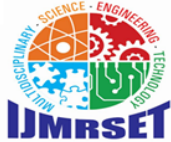
I. INTRODUCTION

Food waste and hunger represent two paradoxical challenges that continue to coexist globally. On one hand, billions of tonnes of food are wasted annually due to improper storage, excessive production, or inefficient distribution systems. On the other hand, millions of people suffer from food insecurity and malnutrition. This contradiction points to a major systemic failure in managing surplus food resources.

India, one of the world's largest food producers, faces a severe food waste problem, with studies estimating that nearly 40% of food produced in the country is wasted every year. Simultaneously, the Global Hunger Index continues to place India among nations struggling to provide consistent access to nutritious food for all its citizens. This disparity arises largely due to inadequate logistics, limited infrastructure for redistribution, and a lack of technological solutions to manage and coordinate food surplus.

Traditional efforts to reduce food waste have included charity initiatives and NGOs collecting surplus food manually. However, these methods lack scalability, often suffer from poor coordination, and depend on human intervention. Without a centralized platform, there is minimal transparency, delayed deliveries, and an absence of accountability.

The Food Waste Management System (FWMS) addresses these shortcomings by introducing an end-to-end digital platform that connects donors (who have surplus food) with NGOs and individuals in need. It provides distinct user modules for donors, NGOs, administrators, and delivery personnel. Through features such as food listing approvals, NGO verification, donation request handling, real-time delivery updates, and integrated feedback mechanisms, the system offers a structured approach to food redistribution.



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Furthermore, the system supports AI-enabled functionalities including a chatbot for automated user interaction and intelligent matching of donation requests based on urgency and location. By automating core tasks and providing a traceable workflow, FWMS ensures that food is not only saved from being wasted but is also delivered to those who need it most in a timely manner.

The Food Waste Management System is a step toward a sustainable and socially responsible future. It combines technology with humanitarian goals to ensure a more equitable and waste-free food distribution model.

II. LITERATURE REVIEW

Food waste is a growing concern globally, and numerous research efforts have been made to mitigate its impact through technology-driven approaches. Various organizations, both governmental and non-governmental, have initiated food redistribution programs, yet the need for scalable, automated platforms remains largely unmet.

Organizations such as **Feeding India**, **No Food Waste**, and **Robin Hood Army** have made significant contributions in redistributing surplus food to the needy. These organizations function mainly through volunteer networks and manual coordination. While impactful, these methods lack real-time tracking and efficient data management, which limits scalability.

Several academic studies have examined the integration of technology in food waste management. Research papers have discussed the implementation of inventory systems for perishable goods, mobile applications for donor-recipient matching, and decision support systems for logistics optimization. However, most of these systems are limited to theoretical frameworks or lack features such as admin moderation, real-time status tracking, or AI-driven support.

Mobile applications like OLIO (UK) and Too Good To Go (Europe) have shown the potential for peer-to-peer food sharing. These apps allow users to post surplus food and notify nearby users. Yet, such solutions are mostly community-focused and often exclude institutional actors like verified NGOs or public kitchens.

Furthermore, web-based platforms explored in university projects often implement CRUD-based modules with donor listing and basic request management. However, these implementations typically omit features like multi-role user handling, approval workflows, AI chatbots, real-time updates, and delivery integration.

A few systems also propose blockchain-based tracking or IoT integration for perishables, but these remain resource-intensive and complex to implement in low-resource settings.

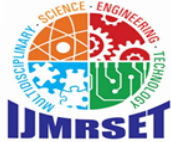
Our proposed Food Waste Management System (FWMS) is a more comprehensive approach that bridges these gaps. The platform integrates several best practices from existing models while introducing key features that enhance operational efficiency and trust, including:

- Multi-role access control with donor, NGO, delivery, and admin panels.
- Admin-based approval and monitoring to ensure food quality and authenticity.
- Real-time status tracking of food pickup and delivery.
- Notification-based communication.
- Star-rating and feedback system to build accountability.
- Integration of an AI-based chatbot to handle FAQs and streamline user interaction.
- Plans for future enhancements such as Google Maps integration and expiry prediction.

III. MATERIALS AND METHODS

3.1 System Overview

The system was built using the **LAMP Stack (Linux, Apache, MySQL, PHP)** along with front-end technologies and JavaScript-based interactivity. Bootstrap is used for responsive design.



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Technologies Used:

- **Frontend:** HTML, CSS, JavaScript, Bootstrap
- **Backend:** PHP
- **Database:** MySQL
- **Server:** XAMPP (localhost testing)
- **AI Integration:** Chatbot using Chatling, basic logic for matching requests

3.2 System Modules

a. Admin Module

- Login secured with credentials.
- Can approve or reject food donation entries and NGO registrations.
- Can assign delivery personnel.
- Has full access to user activities and food listings.

b. User Module (Donor / Receiver / NGO)

- Registration and login features.
- Donors can add food listings with details (type, quantity, expiry date, location).
- NGOs and needy individuals can request food from verified listings.
- NGOs can track request history and manage pickup schedules.

c. Delivery Module

- Delivery personnel view approved deliveries.
- Update food pickup status: Pending → In Progress → Completed.
- Notifies donors once food is picked up.

3.3 Database Structure

- **login:** Stores user credentials (Donors, NGOs)
- **admin:** Stores admin credentials
- **food_donations:** Stores donation data with status flags
- **delivery_persons:** Stores delivery personnel data

3.4 Features Summary

- Real-time notifications
- Food status tracking
- NGO verification before access
- Star-based rating system
- AI chatbot integration
- Admin privilege enforcement
- One-to-one messaging between users (PHP-based)

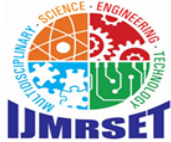
IV. RESULTS AND DISCUSSION

The Food Waste Management System (FWMS) was tested extensively in a local development environment using XAMPP. Functional testing, integration testing, and user acceptance testing were performed across all modules: Admin, User, and Delivery.

4.1 Functional Validation

The donor registration and login process worked seamlessly. Once logged in, donors were able to submit food listings with complete details, including type, quantity, expiry date, and pickup location. The listings entered a 'Pending Approval' state until verified by the admin.

Admin users had access to all submitted listings, user activities, and NGO registration requests. The approval process was effective, and notifications were successfully triggered for each approval, rejection, or update. NGOs, upon approval, could browse food items and request them according to location and urgency.



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Delivery personnel logged into their portal and viewed approved pickups assigned by the admin. They were able to update statuses from 'Pending' to 'In Progress' and finally to 'Completed', at which point a final notification was sent to the donor and NGO. These workflows demonstrated smooth transitions and accurate tracking.

4.2 Interface and Usability Evaluation The user interface, built using Bootstrap, offered a responsive experience across devices. User feedback collected during testing indicated that the layout was easy to navigate and the forms were intuitive. The presence of status labels (e.g., Pending, Approved) and structured menus helped users understand the system's state at any time.

The chatbot, integrated using Chatling, provided basic guidance to users on registration, food posting, and contact details. This minimized the burden on admin support and created a more autonomous user experience.

4.3 Efficiency and Coordination The system significantly reduced communication delays by implementing automatic notifications and real-time status updates. For instance, food donors were instantly notified once their food was picked up. Likewise, NGOs were alerted about food availability and the status of their requests.

The star-based rating system was also functional and allowed users to review their experience with NGOs or donors. This feature is vital for building trust and enabling informed decision-making within the platform.

4.4 Challenges During Implementation Some challenges were encountered, including integrating the chatbot across different pages and managing session persistence for multiple user roles. These were addressed through PHP session handling and modular chatbot deployment.

4.5 Key Observations

- Real-time tracking improved accountability.
- Admin moderation prevented spam or fake listings.
- Chatbot and notifications improved user engagement.
- Delivery status transitions ensured food reached recipients on time.

V. CHALLENGES AND LIMITATIONS

While the Food Waste Management System has shown strong potential in addressing food redistribution, certain challenges and limitations emerged during development and testing. These insights are crucial for guiding future enhancements and real-world deployment.

Real-Time Integration and Mapping The current system does not feature real-time geolocation or dynamic map-based NGO tracking. Although locations are captured as text inputs, integrating tools like Google Maps API for live tracking of donors, NGOs, and delivery personnel remains a future objective. This integration requires additional API keys, infrastructure setup, and continuous data streaming which can be resource-intensive.

Verification Process for NGOs and Donors Verification of users, particularly NGOs, currently relies on manual admin approval based on limited data. There is no document upload or identity validation system integrated yet. This creates a risk of unverified or illegitimate users being granted access. For improved trust, future versions should implement document-based verification and optional government API validation.

Scalability and Hosting Limitations The current platform has only been deployed and tested locally using XAMPP. A live, cloud-hosted version will require additional considerations such as database scaling, load balancing, and data security protocols. Transitioning to a real-time online system will also demand SSL encryption, secure authentication, and proper hosting infrastructure.

Mobile Application Accessibility Although the system is mobile-responsive, there is no standalone Android or iOS application. Users accessing the platform from mobile browsers may experience limitations in features such as background notifications or offline access. Developing a native mobile app with push notification support would greatly enhance user convenience.



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User Engagement and Retention Initial testing showed promising results in terms of usability, but long-term engagement metrics such as repeated logins, donation frequency, or feedback loop completion were not tracked. Incorporating analytics and user behavior tracking tools in future versions can provide insights into improving user retention and platform impact.

VI. CONCLUSION AND FUTURE SCOPE

The Food Waste Management System (FWMS) stands as a practical and socially impactful innovation aimed at bridging the gap between food surplus and food scarcity. By integrating web technologies, real-time coordination, and AI components, the system offers a comprehensive platform for facilitating food donations, ensuring timely delivery, and promoting food equity. Throughout the development and testing process, FWMS demonstrated its ability to manage and monitor food donations effectively while maintaining user accountability and system transparency.

The modular architecture of the platform supports distinct roles for Admin, Donor, NGO, and Delivery personnel. Features such as request approval workflows, delivery tracking, chatbot integration, and notification systems contribute to the platform's functionality and reliability. These characteristics collectively support the project's goal of reducing food waste and ensuring that edible surplus food reaches the needy without delay or mismanagement.

User feedback and testing showed high usability, engagement, and potential for wider adoption. Admin verification helped ensure legitimacy, and the feedback/rating system introduced transparency into user interactions. Despite the platform currently being hosted locally, it is well-positioned for deployment on a live cloud server.

VII. FUTURE SCOPE

The system lays the groundwork for future enhancements and large-scale deployment. Key areas identified for future development include:

1. **Google Maps Integration:** Dynamic mapping of donors, NGOs, and delivery agents to provide live location-based tracking and route optimization.
2. **AI-Driven Features:** Integration of advanced machine learning models to predict food demand, automate food-need matching based on location, urgency, and expiry, and improve decision-making.
3. **Document-Based NGO Verification:** Inclusion of document upload modules for KYC and identity validation to enhance trust and authenticity.
4. **Mobile Application Development:** Creation of native Android and iOS apps with push notifications, background location services, and offline capabilities for greater user convenience.
5. **Data Analytics and Reporting:** Dashboards for admins and users to visualize donation metrics, food recovery trends, and impact statistics for better monitoring and evaluation.
6. **Blockchain for Transparency:** Leveraging blockchain to record immutable transactions of donations and deliveries, ensuring complete transparency and traceability.
7. **Multilingual Interface:** Introducing language support for regional users to make the platform more inclusive and accessible.

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