A Smart Food Waste Management System With Donation Tracking, Expiry Monitoring, Recipe Search, and AI-Based Compost Suggestions.

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Abstract— Food waste is a significant global concern that contributes to resource loss and environmental degradation. This project, "Smart Food Waste Management System with Donation Tracking, Expiry Monitoring, Recipe Search, and AI-Based Compost Suggestions,"presents an integrated web platform designed to minimize waste and promote sustainability. The system incorporates four main modules: food donation management, expiry tracking, recipe search, and AI-powered compost suggestions. The Django backend handles authentication, donations, and expiry tracking, while a React frontend ensures user-friendly navigation. An Express.js microservice connected to the Google Gemini API provides intelligent composting advice. Users can list surplus food for donation, receive expiry alerts, and find recipes using available ingredients to reduce spoilage. The AI module offers personalized composting methods for different food wastes, encouraging eco-friendly disposal. By integrating automation, artificial intelligence, and community participation, the system provides a sustainable solution to reduce food waste, support donations, and promote environmental awareness.

Index Terms— Food Waste Management, AI-Based Composting, Donation Tracking, Expiry Monitoring, Recipe Recommendation, Digital Food Platforms, Sustainable Development, Household Food Waste Reduction

I. INTRODUCTION

In today's world, food waste has emerged as a critical social, economic, and environmental challenge. Large quantities of edible food are discarded daily by households, restaurants, and retail outlets due to poor storage management, lack of awareness, and inefficient redistribution systems. While millions of people continue to face hunger and malnutrition, significant portions of food end up in landfills, generating methane and contributing to climate change. This imbalance highlights the urgent need for intelligent systems that can optimize food utilization and minimize waste.

The Smart Food Waste Management System is developed as a technological response to this global concern. It integrates digital tracking, community engagement, and artificial intelligence to reduce food wastage at multiple stages—from consumption to disposal. The system provides a unified platform that assists users in tracking food expiry, redistributing surplus food through donations, finding recipes to reuse ingredients, and receiving composting guidance for unavoidable waste.

The project employs a Django backend for authentication, data management, and food donation tracking; a React-based frontend for interactive user experience; and an Express.js microservice integrated with the Google Gemini API to generate AI-powered compost suggestions. This combination ensures modularity, real-time performance, and scalability across different user groups such as households, NGOs, and community organizations.

It offers an automated, user-friendly interface for individuals to understand and address their health conditions without delays. By providing accurate diagnostic suggestions and tailored health advice, the system serves as a first point of contact for users seeking medical insights.

II. Literature Review

Food waste is a pressing global issue, with approximately 1.05 billion tonnes of food wasted worldwide in 2022, while 783 million people experience hunger. Household food waste alone accounts for a significant portion, with each person wasting an average of 79 kilograms of food annually, generating 8–10% of global greenhouse gas emissions and economic losses exceeding $1 trillion annually (UNEP Food Waste Index Report, 2024). These statistics highlight the urgent need for interventions targeting household-level food management to reduce waste and improve sustainability.

Understanding the behavioral and psychological drivers of household food waste is essential for designing effective solutions. Pilone et al. [1] conducted a bibliometric review of household food waste studies, identifying patterns in consumer decision-making and waste generation behaviors. Srivastava et al. [2] further demonstrated, through a systematic review and meta-analysis using the Theory of Planned Behavior (TPB), that attitudes, subjective norms, and perceived behavioral control significantly influence household intentions to reduce food waste. These studies suggest that effective interventions must address both psychological and demographic factors influencing consumer behavior.

Technological innovations offer promising solutions for household food waste management by integrating multiple intervention strategies. Anandhi et al. [8] developed a smart grocery expiry date reminder application that utilizes barcode scanning and Optical Character Recognition (OCR) to track perishable items and send timely notifications, enabling users to consume, donate, or otherwise utilize items before expiration. Similarly, Bansal et al. [9] proposed Best Before, a web application built using the MERN stack with Twilio SMS notifications, which tracks the expiry of food and medicinal items, helping households prevent unsafe consumption and unnecessary waste.

Digital platforms for food donation have demonstrated effectiveness in redistributing surplus food. Sammer et al. [5] introduced AI-FEED, an AI- and blockchain-powered platform targeting four stakeholder groups—food charities, donors, clients, and community leaders—to optimize donation management, enhance transparency, and generate educational content for charities. Chandula et al. [6] developed Food-For-All, a web application connecting donors with recipients, incorporating admin approval and real-time tracking to reduce fraudulent activity and improve trust. Uddin and Ansary [7] presented Share-a-Meal, an IoT-enabled mobile app facilitating peer-to-peer food sharing with cloud-based notifications and an embedded system for collection and distribution, demonstrating efficient surplus food management within communities.

Ingredient-based recipe recommendation systems offer another approach to reducing household food waste by helping users creatively utilize available ingredients. Rodrigues et al. [10] developed RecipeIS, a web application using ResNet-50 for ingredient recognition, achieving 96% classification accuracy over 36 food classes and integrated with the Edamam API to suggest contextually appropriate recipes. Nyeche [11] further developed Smart Recipe Finder, a web application leveraging the Edamam API to provide personalized recipe recommendations based on ingredient availability, cuisine preferences, and dietary needs, promoting healthier and waste-conscious meal planning.

Composting remains a critical environmentally sustainable solution for food items that cannot be consumed or donated. Temel et al. [12] reviewed machine learning applications in composting, highlighting algorithms such as Artificial Neural Networks, Random Forest, Support Vector Machines, and Deep Neural Networks for predicting compost quality and optimizing processing parameters. Cai et al. [13] proposed a multi-source data and adaptive intelligence framework to enhance composting efficiency and output quality. Inarda et al. [14] developed Compost Buddy, a conversational AI chatbot that guides citizens through the composting process, making sustainable waste disposal accessible and engaging.

Digital solutions in food supply chain management also contribute to reducing waste at systemic levels. Fatorachian et al. [4] demonstrated that IoT and AI-enabled technologies in smart cities can optimize inventory management, transportation, and supply chain coordination, reducing overstocking, spoilage, and associated environmental impacts. These approaches align with circular economy principles and enhance urban sustainability.

Despite these technological advances, existing systems often operate in isolation. Donation platforms rarely integrate with expiry tracking, recipe recommendation systems are seldom connected to inventory management, and composting guidance is not commonly linked with broader waste reduction strategies. An integrated approach combining these interventions is therefore critical for effective household food waste management.

In summary, the literature highlights four primary intervention strategies to reduce household food waste: (1) donation facilitation through digital platforms, (2) proactive expiry tracking with automated notifications, (3) ingredient-based recipe recommendation systems, and (4) AI-powered composting guidance. Implementing these strategies in a unified, technology-enabled system can empower households to manage food more sustainably, convert waste reduction intentions into actionable behaviors, and minimize environmental, economic, and social impacts associated with food waste.

III. System Architecture and Methodology

The methodology involved in Smart Food Waste Management System is as represented in figure. The process involved are as shown in the below steps.

Register: A user creates an account with secure credentials through Django's authentication system.

Login: A user logs in with their username and password to access the system, and upon successful authentication, Django redirects to the React landing page.

Select Module: Users choose from four feature modules displayed on the landing page: Food Donation, Food Expiry Tracker, Recipe Finder, or Compost Ideas

Food Donation Module:

Create Donation: Donors list surplus food with details (name, type, quantity, pickup time, location) through a user-friendly interface, setting initial status to "available". Browse Listings: Receivers view available donations excluding their own submissions. Request Donation: Receivers submit requests with contact details, triggering email notifications to donors and updating donation status to "requested". Manage Requests: Donors accept or reject requests; acceptance updates donation status to "accepted," auto-rejects other pending requests, and sends detailed emails to all parties.

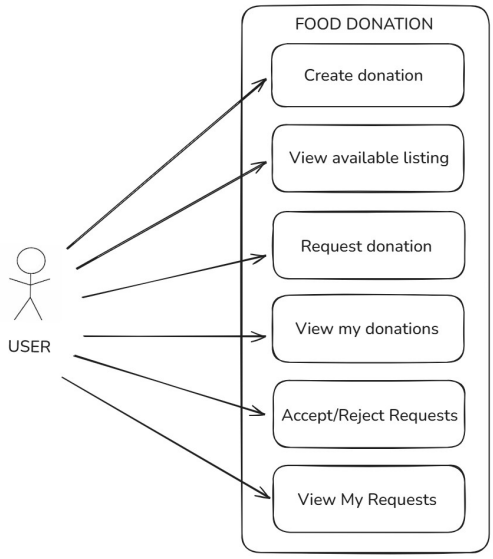

Fig1: Usecase diagram of Food Donation

Food Expiry Tracker Module:
Add Food Items: Users input food details with expiry dates through the interface.
Calculate Status: The system automatically analyzes expiry dates using date-based algorithms and categorizes items as Fresh (>6 days), Expiring Soon (4-6 days), Very Close to Expiry (1-2 days), or Expired (≤0 days).
Display Dashboard: The system presents a visual dashboard with color-coded status indicators and statistics (total, fresh, expiring, expired counts).
Send Notifications: Automated email alerts are triggered at predefined thresholds (6 days, 2 days, expired) to prevent food waste.

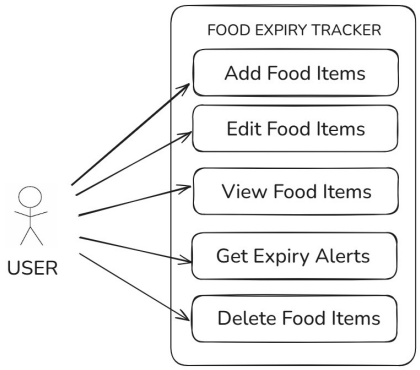

Fig2: Use case diagram of Food Expiry

Recipe Finder Module:
Input Ingredients: Users enter comma-separated ingredients they have available.
Search Database: The system searches the local recipes.json database containing over 1500 Indian recipes, matching user inputs against the "Cleaned-Ingredients" field.
Display Results: Recipe cards are rendered with images, cooking time, complete ingredient lists, and step-by-step instructions to help users utilize food before expiry.

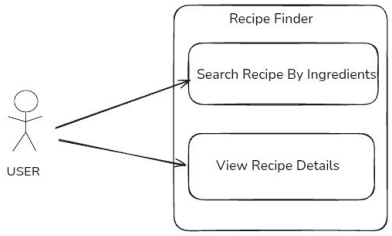

Fig3: Usecase diagram of Recipe Finder

Compost Ideas Module:
Input Waste Item: Users submit food waste items (e.g., banana peels, expired oats) through the interface.
Process Request: The frontend sends a POST request to the Express.js microservice running on port 3000.
Generate AI Suggestions: The Express.js server constructs an optimized prompt and calls the Google Gemini API to generate personalized composting advice.
Display Recommendations: The system returns structured advice containing method name, 2-4 actionable steps, and practical tips for beginners, along with six educational information cards about different composting techniques.

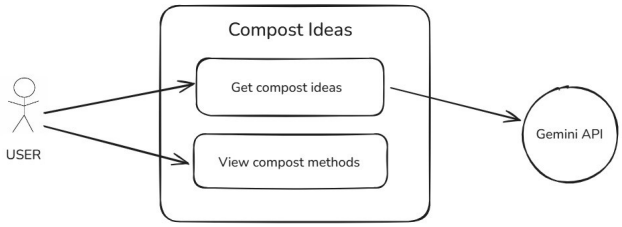

Fig4: Usecase diagram of Compost Ideas

IV. Results and Discussion

The Smart Food Waste Management System was successfully implemented and tested across all four integrated modules, demonstrating effective functionality and user-centric design. The system evaluation was conducted based on usability, response time, feature accuracy, and overall effectiveness in addressing food waste reduction objectives.

Figure 5 presents the Food Expiry Tracker dashboard displaying real-time inventory monitoring with four color-coded statistics cards (Total Items: 2, Fresh: 1, Expiring Soon: 1, Expired: 0) and individual food items (1 day left, Expiring Soon badge) and (7 days left, Fresh badge), demonstrating automated expiry status calculation. Figure 6 showcases the AI-Powered Compost Ideas module featuring four educational cards highlighting composting benefits (Reduce Waste by 50%, Nourish Soil, Save Money, Fight Climate Change) and an interactive section where users input waste items like "expired oats" to receive personalized AI-generated guidance from Google Gemini API, displaying structured advice with method names and actionable steps for proper composting. Both modules collectively demonstrate the system's comprehensive approach to food waste management through automated monitoring and AI-driven sustainability solutions.

Fig5.Food Expiry Tracker

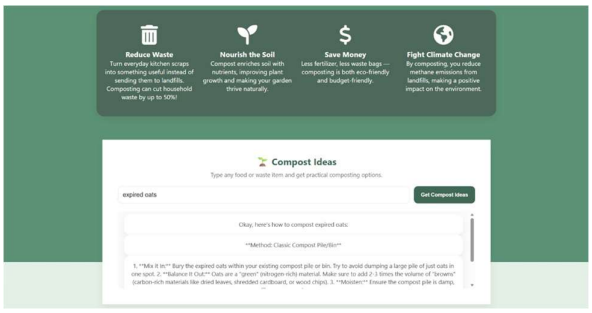

Fig6:Compost Ideas

Figure 5 illustrates the Recipe Finder module featuring a visually appealing interface with the heading "RECIPE FINDER" and a user-friendly search functionality that allows users to input comma-separated ingredients they have at home, enabling the system to query a local JSON database containing over 1500 Indian recipes and return matching recipe cards with comprehensive information including preparation steps, cooking time, and ingredient lists. Figure 6 showcases the Food Donation module with the inspiring tagline "Give a helping hand to those who need it!" and five intuitive navigation buttons Donate Food, My Donations, Available Donations, My Requests, Requests for My Donation that facilitate seamless interaction between donors and receivers. The interface includes "Our Vision" and "Our Mission" sections that emphasize creating a community where no food goes to waste and connecting donors with receivers through a simple, efficient, and safe process to reduce food waste, fight hunger, and promote sustainability. Both modules demonstrate the system's comprehensive approach to food waste reduction by enabling users to creatively utilize available ingredients before expiry and facilitating surplus food redistribution to those in need through a transparent, community-driven platform.

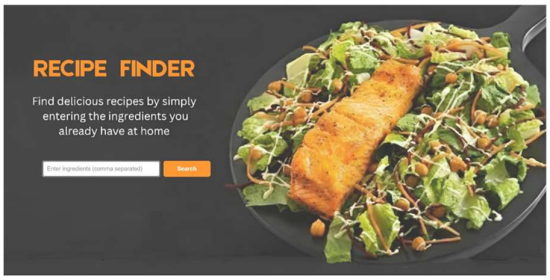

Figure7. Recipe Finder

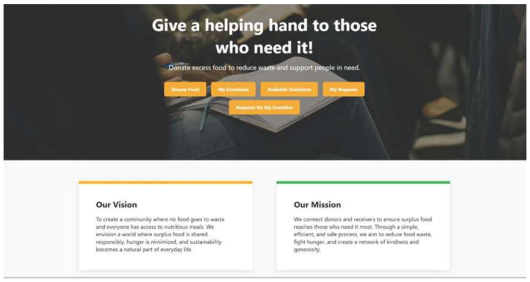

Fig8.Food Donation

V. CONCLUSIONS

The Smart Food Waste Management System successfully integrates technology and sustainability to minimize food wastage while promoting community welfare. By combining features such as food donation tracking, expiry date monitoring, recipe recommendations, and AI-based composting suggestions, the system provides a holistic approach to handling surplus food responsibly. The layered architecture—comprising a React-based user interface, Django backend, and an AI-powered microservice—ensures seamless performance, scalability, and data security. Through intelligent automation and user engagement, the platform encourages individuals and organizations to contribute to waste reduction efforts while aiding those in need. Overall, this project demonstrates how modern web technologies and artificial intelligence can be leveraged to create an efficient, user-friendly, and socially impactful solution that not only combats food waste but also fosters a more sustainable and environmentally conscious society.

VI. REFERENCES

[1]. Pilone, M., et al. A bibliometric review of household food waste: Understanding consumer behavior and decision-making patterns. Journal of Consumer Studies, 2022.

[2]. Srivastava, A., et al. Household food waste reduction using the Theory of Planned Behavior: A systematic review and meta-analysis. Waste Management, 2023.

[3]. Devi, K. Sharmila & Sundareshwar, S. Food Waste Management System. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 2023. https://doi.org/10.22214/ijraset.2023.52028.

[4]. Fatorachian, H., Kazemi, H., & Pawar, K. Digital technologies in food supply chain waste management: Sustainable practices in smart cities. Sustainability, 2025, 17(5), 1996. https://doi.org/10.3390/su17051996

[5]. Sammer, M., Seong, K., Olvera, N., Gronseth, S. L., Anderson-Fletcher, E., Jiao, J., Reese, A., & Kakadiaris, I. A. AI-FEED: Prototyping an AI-powered platform for the food charity ecosystem. International Journal of Computational Intelligence Systems, 2024, 17, 259.

[6]. Chandula, Y., Kavinda, A., Shaminda, T., Gunaratne, S., De Silva, D. I., & Cooray, D. Food-For-All Web Application for Donation Management. International Journal of Engineering and Management Research, 2022, 12(5). https://doi.org/10.31033/ijemr.12.5.11

[7]. Uddin, M. S., & Ansary, F. R. Share-a-Meal: A mobile app-based food sharing system. IEEE, 2023.

[8]. Anandhi, T., Ajitha, P., Sivasangari, A. S., Gomathi, R. M., Praisey, G. K., & Yateesh, D. Smart grocery expiry date reminder: Available to purchase. AIP Conference Proceedings, 2025, 3257, 020053. https://doi.org/10.1063/5.0265279

[9]. Bansal, S., Khokar, R., & Chandran, S. Best Before: An Expiry Date Checker Website to Track the Expiry of Perishable Items. Proceedings of the International Conference on Innovative Computing & Communication (ICICC), 2022. https://ssrn.com/abstract=4041034

[10]. Rodrigues, M. S., Fidalgo, F., & Oliveira, Â. RecipeIS—Recipe recommendation system based on recognition of food ingredients. Applied Sciences, 2023, 13(13), 7880. https://doi.org/10.3390/app13137880

[11]. Nyeche, E. Smart Recipe Finder: A web-based application for recipe discovery using Edamam API. UAS Thesis, 2025, Lab University of Applied Sciences.

[12]. Temel, F. A., Yolcu, O. C., & Turan, N. G. Artificial intelligence and machine learning approaches in composting process: A review. Bioresource Technology, 2022, 128539. https://doi.org/10.1016/j.biortech.2022.128539

[13]. Cai, D., Wang, Y., Zhao, X., Wu, J., Lu, Y., & Xi, B. A paradigm shift driven by multi-source data, mechanistic insights, adaptive intelligence, and multi-objective optimization for intelligent composting. Critical Reviews in Environmental Science and Technology, 2025.

[14]. Inarda, C., Kandah, E., Sajan, M., Khan, S., Crowe, C., Hill, T., & Chen, Y. Compost Buddy: Educating citizens on composting through a chatbot. Emergent Research Forum (ERF), San Jose State University, 2024.