



A Smart AI-Based Food Redistribution System for Reducing Food Waste and Supporting Community Welfare

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Abstract: The increasing rate of food wastage and food insecurity has become a major global concern affecting environmental sustainability and social welfare. Large amounts of edible food produced by restaurants, hotels, functions, and households are discarded daily due to the absence of an efficient redistribution mechanism. To address this issue, the AI-Powered Residual Food Distribution System is proposed as an intelligent platform that automates the collection, analysis, and redistribution of surplus food to needy individuals and organizations. The proposed system integrates Artificial Intelligence, machine learning, image processing, geolocation services, and web technologies to create a centralized and efficient food redistribution platform. Donors can upload surplus food details along with food images, while the AI module analyzes food quality and determines whether the food is safe and suitable for distribution. Based on location and availability, the system automatically identifies nearby NGOs and volunteers and sends real-time notifications for food pickup and delivery. The system also incorporates secure authentication, centralized database management, GPS-based route optimization, and real-time tracking to improve operational efficiency and transparency. Experimental analysis shows that the proposed system significantly reduces food spoilage, improves coordination among stakeholders, minimizes wastage, and ensures timely food delivery. Overall, the system provides a smart and sustainable technological solution for efficient food redistribution and community welfare.

Keywords: Artificial Intelligence, Food Waste Management, Smart Food Distribution, Machine Learning, Food Donation System, Food Quality Detection, Geolocation Services, Web Application

I. INTRODUCTION

Food wastage and hunger continue to coexist as major global challenges affecting society, the environment, and economic development. Large quantities of edible food are discarded daily by restaurants, hotels, households, and event organizers, while millions of people continue to suffer from hunger and malnutrition. This imbalance highlights the urgent need for a smart and efficient food redistribution mechanism. Traditional food donation systems mainly rely on manual communication between donors and NGOs through phone calls, social media messages, or personal contacts. These methods are inefficient, time-consuming, and unorganized. Due to delays in coordination and lack of real-time tracking, surplus food often spoils before reaching the intended recipients. Recent advancements in Artificial Intelligence, Machine Learning, image processing, and geolocation technologies provide opportunities to build intelligent systems capable of automating food redistribution processes.

II. RELATED WORK

Over the years, Artificial Intelligence and smart digital technologies have significantly transformed the way food waste management and food redistribution systems are developed. Skollias and team [1] proposed an AI-enabled food supply chain framework that focused on improving food safety, logistics management, and operational efficiency using Artificial Intelligence technologies. Nascimento and researchers [2] explored Artificial Intelligence techniques for reducing food waste using predictive analytics and monitoring systems. Onyeaka and team [3] studied the role of Artificial Intelligence in food waste management and sustainability. Sigala and researchers [4] focused on reducing food waste in the HORECA sector using AI-based waste tracking systems. Devaraj and Balasubramanian [5] proposed intelligent routing algorithms for surplus food redistribution. Clark [6] discussed AI-driven food waste management strategies for sustainable communities.



Most existing systems mainly focus on individual functionalities such as waste monitoring, predictive analytics, or logistics optimization. Very few platforms integrate Artificial Intelligence, geolocation services, food quality analysis, real-time tracking, volunteer coordination, and centralized management into a single intelligent system.

III. METHODOLOGY

The methodology of the AI-Powered Residual Food Distribution System follows a systematic and structured approach to design, develop, and implement an intelligent platform for food redistribution.

1. System Architecture

The architecture of the AI-Powered Residual Food Distribution System is designed using a multi-layer client-server model that enables smooth communication between donors, NGOs, volunteers, administrators, and the AI engine.

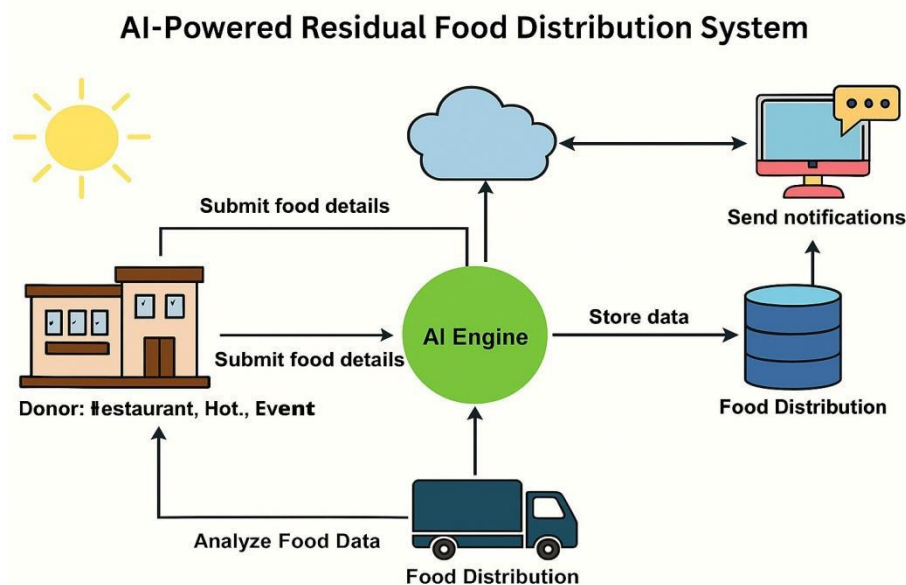


Figure 1: System Architecture of AI-Powered Residual Food Distribution System

2. System Workflow

The workflow of the AI-Powered Residual Food Distribution System begins when donors register on the platform and upload surplus food details such as food type, quantity, expiry time, and food images through the web interface. The uploaded information is securely stored in the centralized database, while the food images are analyzed using Artificial Intelligence and image processing techniques to determine freshness and suitability for redistribution. This automated verification process helps ensure food safety and minimizes the chances of distributing spoiled food. After successful food verification, the system automatically identifies nearby NGOs and available volunteers using geolocation services and AI-based matching algorithms. Notifications are immediately sent to the selected NGOs and volunteers regarding the donation request and pickup details. Volunteers can accept the request through the platform, and the system generates optimized pickup and delivery routes using GPS and Google Maps integration to reduce transportation delays and food spoilage. During the distribution process, the system continuously tracks volunteer movement and updates the delivery status in real time. NGOs receive notifications regarding food delivery progress and confirm successful receipt after completion of the distribution process. All donation records, tracking information, delivery confirmations, and AI analysis results are stored in the centralized database for monitoring, reporting, and future analysis. This workflow ensures efficient coordination, transparency, and timely redistribution of surplus food to needy communities.

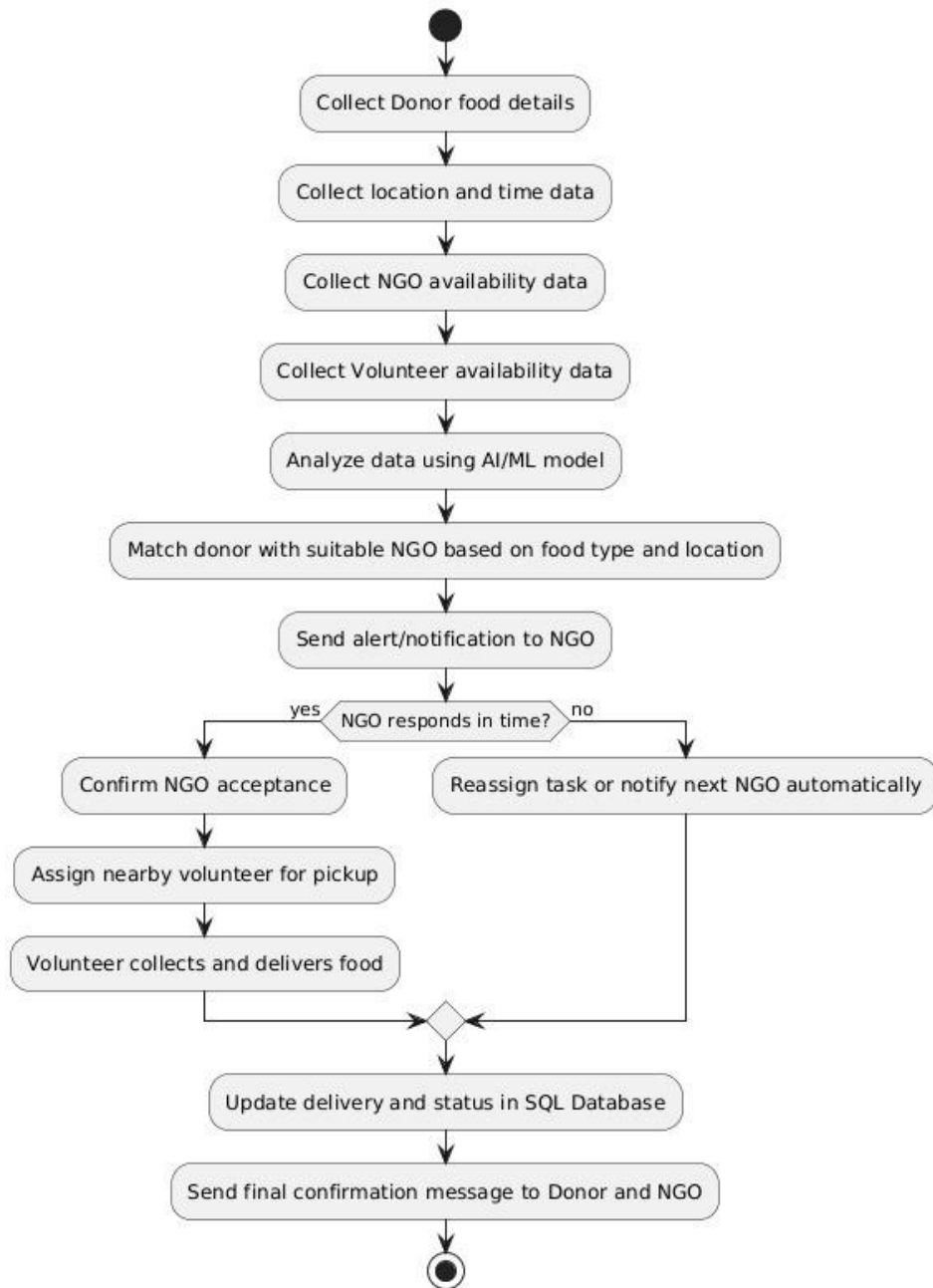
**AI-Powered Residual Food Distribution System - Activity Diagram**

Figure 2: System Workflow of AI-Powered Residual Food Distribution System

3. Sequence Diagram

The sequence diagram illustrates the interaction between donors, the AI system, NGOs, volunteers, and the centralized database during food redistribution activities.

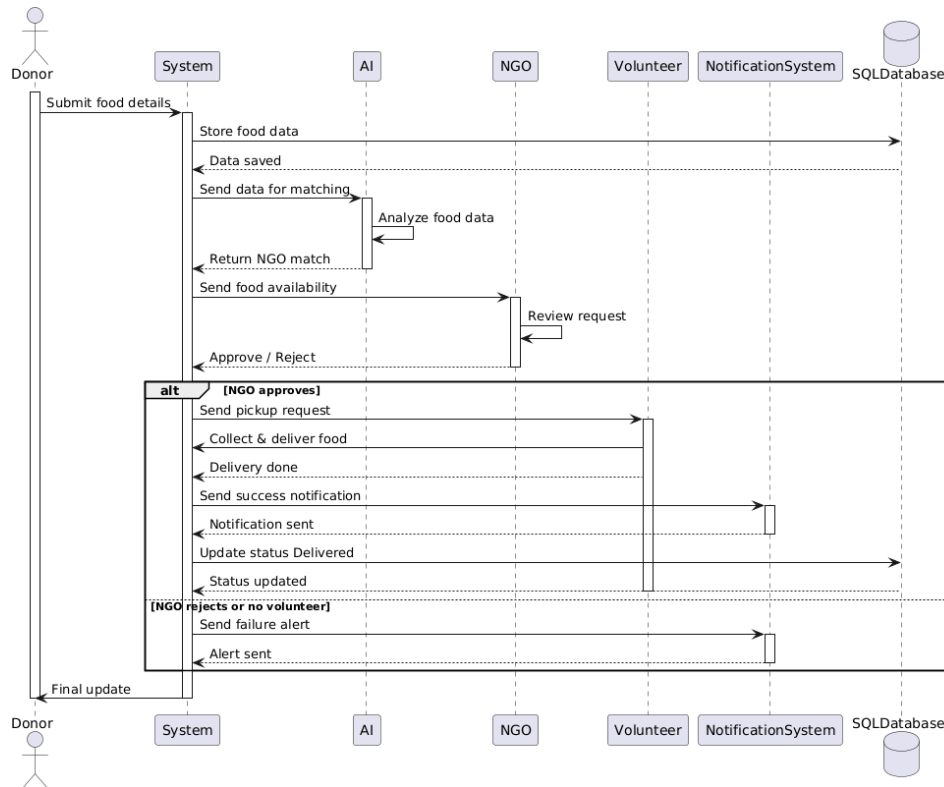


Figure 3: Sequence Diagram of AI-Powered Residual Food Distribution System

4. System Modules

- **User Registration and Authentication Module**
This module allows donors, NGOs, volunteers, and administrators to securely access the platform.
- **Food Donation Management Module**
This module enables donors to upload surplus food details and food images.
- **AI-Based Food Quality Detection Module**
This module utilizes machine learning and image processing techniques to analyze food freshness and suitability.
- **Location-Based Matching Module**
This module identifies nearby NGOs and volunteers using GPS and geolocation services.
- **Notification and Communication Module**
The system sends real-time notifications and alerts regarding food donations and delivery activities.
- **Distribution Tracking Module**
This module monitors food pickup and delivery operations using real-time tracking mechanisms.

Tools and Technologies

The frontend of the system is developed using HTML, CSS, JavaScript, and React.js. The back-end is implemented using Node.js and Express.js. The Artificial Intelligence component uses TensorFlow, OpenCV, Scikit-learn, NumPy, and Pandas for food image analysis and prediction. MySQL is used as the centralized database for storing user information, donation records, tracking details, and system logs. Google Maps APIs and GPS technologies are integrated for route optimization and volunteer tracking.

5. Development model

The AI-Powered Residual Food Distribution System follows the Agile Development Model for designing, developing, testing, and deploying the application. Agile methodology is a flexible and iterative software development approach that allows continuous improvement, faster development, and regular feedback throughout the project lifecycle. Instead of developing the complete system at once, the project is divided into smaller modules such as user registration, food donation management, AI-based food quality detection, location-based matching, and real-time tracking. In the Agile model, each module is developed, tested, and improved in multiple iterations called sprints. This approach helps identify errors early, improve system performance, and easily incorporate new requirements or modifications during



development. Frequent testing and continuous feedback from users help ensure better functionality, reliability, and usability of the system.

The Agile Development Model is suitable for this project because the system integrates multiple technologies such as Artificial Intelligence, machine learning, image processing, GPS tracking, and web technologies. Agile methodology supports flexibility, teamwork, faster deployment, and efficient project management, making it highly effective for developing intelligent and scalable software systems like the AI-Powered Residual Food Distribution System.

IV.RESULTS AND DISCUSSION

The proposed system was tested using multiple food donation and redistribution scenarios involving donors, NGOs, volunteers, and administrators. The system successfully performed food quality verification, NGO matching, notification generation, and real-time tracking operations. The AI-based food quality analysis module effectively identified whether uploaded food images were suitable for redistribution. The location-based matching system improved delivery efficiency and reduced food wastage during transportation. The following screenshots show the implementation results and system outputs obtained during testing and evaluation.

This screen displays the homepage of the Bite2life system, showing the project info and a "Start" button that allows the user to begin the process. This screen allows the user to select a role at starting of the process.

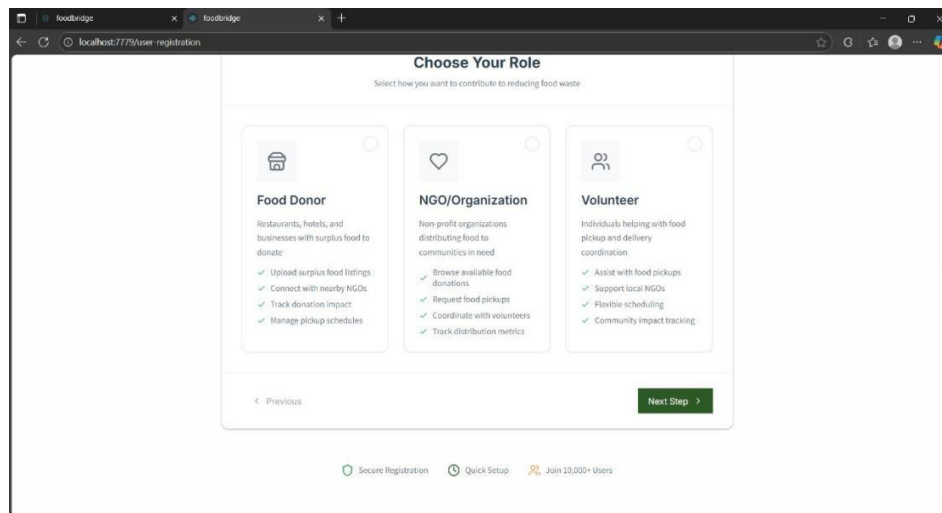


Figure 4: Role selection

This screen shows the overview of donor dashboard where we can add new donations and view food map. This screen allows donors to upload the food details along with food safety information so that user can confirm the donation.

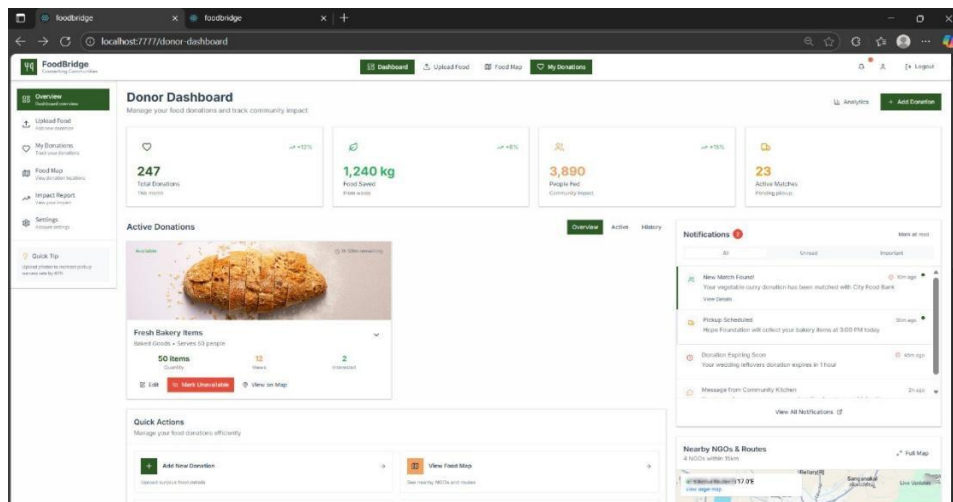


Figure 5: Dashboard for donor



This screen shows the region within Bellary region as defined in scope.

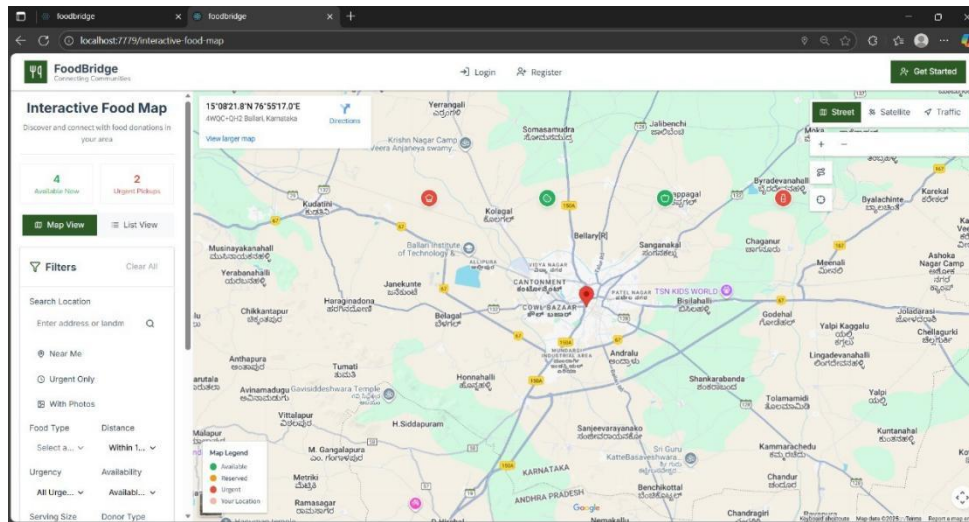


Figure 6: Map for location

IV. CONCLUSIONS AND FUTURE WORK

The AI-Powered Residual Food Distribution System provides an intelligent and efficient solution for reducing food wastage and improving food redistribution processes. By integrating Artificial Intelligence, machine learning, image processing, geolocation services, and real-time tracking technologies, the system successfully connects donors, NGOs, volunteers, and administrators through a centralized digital platform. The implementation of AI-based food quality analysis, automated NGO matching, route optimization, and notification mechanisms improves operational efficiency, minimizes food spoilage, and ensures timely delivery of surplus food to needy individuals and communities. Overall, the proposed system contributes toward environmental sustainability, social welfare, and responsible resource utilization through intelligent automation and efficient food management. Future enhancements of the system may include development of Android and iOS mobile applications for improved accessibility and user convenience. Advanced deep learning models such as Convolutional Neural Networks (CNNs) can be integrated to improve food freshness prediction accuracy and overall system performance. The platform can also be expanded using IoT-based food monitoring sensors, blockchain-based transparency mechanisms, multilingual support, and cloud technologies to support larger geographical regions, real-time monitoring, and scalable food redistribution operations more effectively.

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