

Annabachao – Intelligent Food Rescue and Logistics Platform

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Abstract – Food wastage and food insecurity remain two critical and interconnected challenges in urban environments, where surplus edible food is often discarded while vulnerable populations face hunger. Existing food donation systems largely rely on informal communication, manual coordination, and lack standardized safety checks, leading to inefficiencies, delays, and potential health risks. To address these challenges, this paper proposes *Annabachao – Intelligent Food Rescue and Logistics Platform*, a mobile-first system designed to streamline the redistribution of surplus food from donors to verified Non-Governmental Organizations (NGOs). The platform enables donors to register and submit food donation details, while NGOs can discover and manage collection tasks through a centralized logistics interface. A key innovation of the system is the integration of a science-based Spoilage Detection Algorithm, which evaluates food safety using environmental factors such as temperature exposure, humidity levels, and time elapsed since preparation. This ensures that only safe and consumable food enters the distribution pipeline. Additionally, the system incorporates geospatial analysis to optimize donor-NGO matching based on proximity and operational feasibility, improving response time and reducing waste. By combining real-time coordination, algorithmic safety validation, and intelligent logistics, Annabachao enhances transparency, efficiency, and reliability in food redistribution systems, contributing to sustainable resource utilization and social welfare.

Keywords – Food Waste Management, Food Redistribution, Logistics Optimization, Geospatial Systems, Artificial Intelligence, Sustainable Technology

1. INTRODUCTION

Food waste and food insecurity are two major global challenges that continue to coexist despite advancements in technology and supply chain systems. In urban areas, large quantities of edible food are discarded daily by households, restaurants, and events, while a significant portion of the population struggles to access sufficient and nutritious meals. Traditional food donation practices are largely informal, relying on manual communication, unstructured coordination, and the absence of standardized safety protocols. These limitations often result in delayed food collection, inefficient distribution, and potential health risks due to the absence of proper food quality assessment. Additionally, the lack of a unified digital platform restricts real-time collaboration between donors, Non-Governmental Organizations (NGOs), and administrative authorities, further reducing the effectiveness of food rescue efforts.

To address these challenges, *Annabachao – Intelligent Food Rescue and Logistics Platform* is proposed as a mobile-first, technology-driven solution that digitizes and streamlines the entire food donation and redistribution process. The platform establishes a centralized ecosystem connecting donors, NGOs, and administrators through an integrated interface, enabling seamless communication and coordination. Donors can register and provide details about available food, including preparation time and location, while participating organizations can identify suitable collection opportunities based on proximity and operational capacity. By centralizing these interactions within a single system, the platform reduces dependency on manual coordination and improves the overall responsiveness of food rescue operations.

A key innovation of the Annabachao platform is the integration of an algorithm-driven food safety

mechanism, known as the Spoilage Detection Algorithm. Unlike traditional systems that rely on subjective judgment, this approach evaluates food safety using scientific parameters such as temperature exposure, humidity levels, and time elapsed since cooking. By generating a hazard index score, the system determines whether the food is safe for consumption or should be discarded.

Furthermore, the platform ensures secure data handling and role-based access control through modern authentication mechanisms. Administrators can monitor system activities, track donations, and manage operational workflows via dedicated dashboards, while cloud-based infrastructure enables real-time data accessibility across multiple users. Through the combination of digital coordination, safety validation, and location-aware decision-making, the proposed system aims to improve the reliability and effectiveness of food redistribution initiatives while addressing both waste reduction and social need.

2. PROBLEM STATEMENT

1. Unstructured Food Donation Practices:

Current food donation activities are largely informal and lack a standardized system for coordination. Donors and service organizations often rely on personal contacts or social media, resulting in inconsistent communication and missed opportunities for timely food redistribution.

2. Delays in Collection and Distribution:

The absence of an organized mechanism to match donors with nearby NGOs leads to delays in food pickup. Since most surplus food is perishable, even minor delays can render it unfit for consumption, increasing overall waste.

3. Lack of Food Safety Assessment:

Existing systems do not incorporate any scientific or structured method to evaluate food quality before distribution. Decisions are often based on subjective judgment, which can pose health risks to recipients.

4. Inefficient Coordination Between Stakeholders:

There is limited real-time interaction between

donors, NGOs, and administrators. This lack of synchronization results in poor visibility of available resources and operational status, reducing the efficiency of food rescue efforts.

5. Absence of Location-Based Optimization:

Many donation processes do not utilize geospatial data to assign the nearest or most suitable NGO for collection. This leads to increased travel time, higher logistical costs, and a greater risk of food spoilage during transit.

6. Limited Transparency and Tracking:

Donors often have no visibility into whether their contributions are successfully collected and distributed. Similarly, NGOs lack a centralized system to track ongoing and completed operations, affecting accountability.

7. Data Management and Security Concerns:

Without a centralized digital platform, maintaining accurate records of donations, users, and activities becomes difficult. This can lead to data inconsistencies, duplication, and potential misuse of sensitive information.

3. LITERATURE REVIEW

1. IoT-Based Smart Garbage System for Efficient Food Waste Management (IJERT, 2023)

Ramani P et al. developed an IoT-based system that monitors waste levels and environmental conditions using smart sensors. The system improves waste collection efficiency by providing real-time data on garbage status and optimizing disposal processes. Their approach highlights the importance of integrating sensor-based monitoring with digital platforms to manage food waste effectively.

2. IoT-Based Food Spoilage Detection and Waste Management System (IJERT, 2024)

Dr. S.V.R.K. Rao et al. proposed a system that uses IoT sensors to detect food spoilage by analyzing environmental parameters such as temperature and storage conditions. The system helps in identifying unsafe food before consumption, reducing health risks and wastage. This work strongly supports the concept of automated spoilage detection mechanisms in food redistribution systems.

3. Food Waste Management System (IJARIIE, 2023)

Molak Mansi Anil et al. designed a web-based platform that allows users to donate surplus food from events and restaurants to needy individuals. The system enables admin-controlled monitoring and distribution of food resources. Their research emphasizes the role of centralized platforms in reducing food waste and improving accessibility for beneficiaries.

4. Smart Food Waste Reduction System Using a Web-Based Donation Platform (IJERT, 2026)

Sandhiya C et al. developed a web-based donation platform that connects food donors with organizations to minimize food wastage. The system focuses on improving communication, simplifying donation processes, and enabling efficient redistribution of surplus food. This research demonstrates the effectiveness of digital platforms in streamlining food donation workflows.

5. The Smart Food Waste Management System (IJITCE, 2025)

Irfan Mohiuddin et al. proposed a comprehensive system that connects donors, NGOs, and delivery personnel through a web and mobile-based application. The platform includes real-time tracking, task management, and chatbot support to improve user interaction and coordination. Their work highlights the importance of integrated systems and real-time communication in enhancing food redistribution efficiency.

4. OBJECTIVE

1. To design and develop an intelligent, mobile-first platform that digitizes the process of surplus food donation and redistribution, thereby reducing reliance on informal communication and improving overall operational efficiency.
2. To implement a structured and algorithm-based food safety evaluation mechanism that analyzes environmental factors such as temperature, humidity, and time to determine food quality, ensuring that only safe and consumable food is distributed.

3. To enhance coordination between donors, Non-Governmental Organizations (NGOs), and administrators through a centralized system that enables seamless communication, task management, and real-time status tracking.

4. To optimize the allocation and collection process using geospatial analysis, ensuring that food donations are assigned to the nearest and most suitable NGOs, thereby reducing delays and minimizing food wastage.

5. To improve transparency and accountability within the system by providing clear tracking of donation activities, from submission to final distribution, allowing stakeholders to monitor outcomes effectively.

6. To ensure secure handling and storage of user and operational data through role-based access control and reliable digital infrastructure, maintaining data integrity and user trust.

5. METHODOLOGY

The proposed system follows a structured and modular approach to ensure efficient food redistribution while maintaining safety and reliability. The methodology is designed around data flow, decision-making processes, and real-time coordination between system components. Initially, users interact with the platform through a mobile application where donors register and provide details of surplus food, including quantity, preparation time, and location. The system captures this information and stores it in a centralized database, enabling further processing and coordination. Location data is converted into geographical coordinates, which forms the basis for spatial analysis and efficient allocation.

Once a donation request is submitted, the system initiates a validation process. A rule-based spoilage detection mechanism evaluates the quality of food by analyzing key environmental and temporal factors. Parameters such as estimated temperature exposure, humidity levels, and the time elapsed since preparation are processed to compute a hazard score. Based on predefined thresholds, the system determines whether the food is suitable for distribution. This step acts as a filtering layer, ensuring that unsafe

or expired food does not proceed further in the pipeline.

After validation, the system performs a geospatial matching process to identify suitable Non-Governmental Organizations (NGOs) for collection. Distance calculations are carried out using location-based algorithms to prioritize nearby organizations. Additional factors such as NGO capacity and current operational load may also be considered to improve allocation efficiency. The selected NGO is notified in real time, allowing them to accept or decline the task based on availability.

Upon acceptance, the donation enters the execution phase, where collection and delivery activities are coordinated. The platform maintains continuous status updates, enabling both donors and NGOs to track the progress of each request. Background synchronization mechanisms ensure that data remains consistent across users without requiring manual refresh actions.

The system also incorporates administrative oversight, where authorized users can monitor activities, manage user roles, and maintain system integrity. All actions, including submissions, approvals, and cancellations, are recorded for traceability and analysis.

Overall, the methodology integrates data collection, algorithmic validation, geospatial decision-making, and real-time communication into a unified workflow. This structured approach not only improves the efficiency of food redistribution but also ensures safety, transparency, and accountability throughout the process.

6. PROCESS OF SYSTEM : FLOWCHART

The workflow of the Annabachao system begins when a user accesses the application and proceeds to authentication, where login credentials are verified to determine authorized access. Based on successful authentication, the user is directed to a role-specific dashboard that acts as the primary interface for interaction. The system supports multiple roles, including donors, Non-Governmental Organizations (NGOs), and administrators, each with distinct functionalities and access privileges.

Once logged in, donors can initiate the process by submitting details of surplus food, including type, quantity, preparation time, and location. This information is recorded in the system and triggers the next stage of processing. Upon submission, the system activates the validation layer, where the spoilage detection mechanism evaluates the safety of the food using predefined parameters such as time elapsed, environmental exposure, and estimated storage conditions. If the food does not meet safety thresholds, the system restricts further progression and marks the request accordingly. However, if the food is deemed safe, the workflow continues to the allocation phase.

In the allocation stage, the system performs location-based matching to identify the most suitable NGO for collection. This is achieved by analyzing geographical proximity and operational feasibility. Once a potential match is found, the NGO receives a notification and can either accept or decline the request. If no NGO is available, the system may hold the request temporarily or notify the donor regarding the unavailability of service.

Upon acceptance by an NGO, the process moves into the execution phase, where pickup is scheduled and coordinated. The system continuously updates the status of the donation, allowing both donors and NGOs to track progress in real time. After successful collection and distribution, the process is marked as complete, and the record is stored for future reference and analysis.

In parallel, administrative users can monitor all ongoing activities, manage users, and intervene when necessary to ensure smooth operation. At any stage, users have the option to exit the system, resulting in secure logout and session termination. In cases of failed authentication, access is denied, and the user is redirected appropriately.

This structured workflow ensures that every stage—from user authentication to final food distribution—is handled in a systematic, transparent, and efficient manner, minimizing delays while maintaining safety and accountability throughout the process.

7. SYSTEM ARCHITECTURE

The Annabachao platform is designed using a multi-tier architecture that integrates mobile interfaces, backend services, and a centralized database to ensure scalability, reliability, and real-time coordination. The system follows a client-server model where the frontend application communicates with backend APIs to process requests and manage data efficiently.

At the client layer, the system is implemented as a mobile application developed using a cross-platform framework. This layer provides role-based user interfaces for donors, Non-Governmental Organizations (NGOs), and administrators. Users interact with the system through intuitive dashboards that allow them to perform actions such as submitting food donations, managing collection tasks, and monitoring system activities. The client layer is responsible for capturing user inputs and displaying real-time updates received from the server.

The application layer consists of a backend server built using a modular architecture. It handles all core functionalities, including authentication, request processing, data validation, and communication between system components. Secure access is maintained through token-based authentication, ensuring that only authorized users can perform specific operations. The backend also implements role-based access control, allowing different levels of permissions for donors, NGOs, and administrators.

A key component within the application layer is the decision-making module, which includes the spoilage detection mechanism and geospatial processing logic. The spoilage detection module evaluates food quality using environmental and temporal parameters, generating a risk score that determines whether a donation is safe for distribution.

Simultaneously, the geospatial module processes location data to identify the most suitable NGO for food collection by calculating distances and optimizing allocation. The data layer is managed using a NoSQL database, which stores user information, donation records, activity logs, and system states in a structured yet flexible format. This allows efficient handling of dynamic data

and supports scalability as the number of users and transactions increases. All interactions between the application layer and the database are handled through well-defined models and queries, ensuring data consistency and integrity.

Additionally, the system incorporates real-time synchronization mechanisms that enable continuous updates across users. Background processes periodically fetch and update data, ensuring that all stakeholders have access to the latest information without manual intervention. The architecture also supports integration with external services, such as weather APIs, to enhance decision-making capabilities.

Overall, the system architecture is designed to provide a seamless integration of user interaction, intelligent processing, and data management. This layered approach ensures that the platform remains efficient, secure, and scalable while supporting the complex requirements of food redistribution and safety validation.

8. SYSTEM MODULES

The Annabachao platform is structured into three primary modules, namely **Admin**, **Donor**, and **NGO (Service Provider/User)**. Each module is designed with specific functionalities to ensure smooth coordination, efficient management, and secure operation of the food redistribution process.

8.1 ADMIN MODULE

1. **Dashboard:**

The admin dashboard provides a comprehensive overview of system activities, including total registered donors, NGOs, active food donations, pending requests, completed distributions, and rejected or expired entries. It acts as the central monitoring interface.

2. **User Management:**

The admin can manage all registered users, including donors and NGOs. This includes viewing details, verifying accounts, and controlling access when necessary.

3. **Donation Monitoring:**

In this section, the admin can view all listed food donations along with their status, such as pending, accepted, rejected, or completed. It ensures transparency and system-wide visibility.

4. **Request Management:**

The admin can track all food requests initiated

by NGOs, monitor their progress, and intervene if required to maintain operational efficiency.

5. **Location Management:**

The system allows the admin to manage geographical data such as service regions, cities, or operational zones to improve allocation and filtering processes.

6. **Reports and Analytics:**

The admin can generate reports based on time periods, including total food donated, number of successful distributions, and system usage statistics, supporting decision-making and performance evaluation.

7. **Enquiry and Support:**

This module allows the admin to view and respond to user queries or feedback submitted through the platform.

8. **Profile and Security Settings:**

The admin can update profile details, manage passwords, and maintain account security through controlled authentication mechanisms.

8.2 DONOR MODULE

1. **Dashboard:**

Donors can view a summary of their activities, including total food donations submitted, accepted requests, and completed pickups.

2. **Add Food Donation:**

Donors can list surplus food by providing details such as food type, quantity, preparation time, and location. This initiates the redistribution process.

3. **Donation Status Tracking:**

Donors can monitor the status of their submitted donations, including whether they are pending, accepted, rejected, or completed.

4. **Request Interaction:**

Donors can view which NGO has accepted their donation and track the progress of collection and distribution.

5. **Search and History:**

This section allows donors to search past donations and review historical records for reference.

6. **Profile Management:**

Donors can update personal details, change passwords, and manage account settings securely.

8.3 NGO MODULE (SERVICE PROVIDER)

1. **Dashboard:**

NGOs can view available food donations, accepted tasks, completed pickups, and current operational load.

2. **Available Donations:**

This section displays nearby food donation requests filtered based on location and availability, enabling NGOs to identify suitable collection opportunities.

3. **Task Management:**

NGOs can accept or decline donation requests. Once accepted, they can manage pickup operations and update the status accordingly.

4. **Spoilage Verification:**

Before confirming pickup, NGOs must pass through the system's spoilage detection mechanism, ensuring that only safe food is collected.

5. **Real-Time Tracking:**

NGOs can track ongoing tasks and receive updates regarding new donation requests or changes in status.

6. **Search and Records:**

NGOs can search donation records and maintain logs of completed and pending activities.

7. **Profile and Security:**

NGOs can manage their account details, update information, and ensure secure access through authentication controls.

9. CONCLUSION

The Annabachao platform presents a structured and technology-driven approach to addressing the persistent issues of food wastage and inefficient redistribution. By introducing a centralized digital system, the platform reduces dependence on informal coordination methods and enables a more organized interaction between donors and service organizations. The integration of mobile accessibility ensures that users can participate in the process conveniently, thereby increasing engagement and system reach.

A significant contribution of the proposed system lies in its emphasis on food safety through a rule-based evaluation mechanism. By considering environmental and time-based factors, the platform introduces a consistent method for assessing food quality before distribution. This not only minimizes potential health risks but also strengthens trust among stakeholders involved in the redistribution process.

Furthermore, the use of location-based processing enhances logistical efficiency by connecting

donors with nearby organizations, reducing delays and preventing unnecessary spoilage. The inclusion of real-time updates and tracking mechanisms improves transparency and allows all participants to remain informed throughout the lifecycle of a donation.

The system also ensures secure handling of user data and operational records through controlled access and structured data management. This contributes to maintaining reliability, accountability, and scalability as the platform grows. Overall, Annabachao demonstrates how the integration of digital technologies, algorithmic validation, and efficient coordination can transform traditional food donation practices into a more reliable and impactful system.

11. FUTURE SCOPE

1. **Integration of Computer Vision for Food Quality Assessment:**

Future versions of the system can incorporate image-based analysis using machine learning models to automatically detect spoilage, contamination, or quality degradation from uploaded food images.

2. **Predictive Analytics for Demand and Supply:**

By analyzing historical data, the system can predict areas with high food surplus or demand, allowing better planning and proactive resource allocation.

3. **Integration with Government and NGO Networks:**

Collaboration with government bodies and registered NGOs can enhance credibility, improve reach, and support large-scale implementation of food rescue initiatives.

4. **User Incentive and Reward System:**

Introducing reward points, recognition badges, or incentives for donors can encourage active participation and consistent contribution.

5. **Multilingual Support and Accessibility Enhancements:**

To increase usability across diverse populations, the system can include multiple language options and improved accessibility features.

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