

Smart Serve-The New Era in the Food Waste Reduction System

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Abstract—

Food waste is one of the major challenges faced by the food service industry, leading to financial loss, environmental impact, and inefficient use of resources. Restaurants, hotels, and catering services often experience waste due to excess preparation, poor stock monitoring, and inaccurate prediction of customer demand. To overcome these issues, this paper introduces Smart Serve, an advanced system developed to reduce food waste through intelligent monitoring and management. The proposed model uses real-time data collection, inventory tracking, and predictive analysis to estimate food requirements and identify surplus items. By integrating machine learning techniques and smart sensors, the system improves decision-making in food preparation and storage processes. In addition, Smart Serve enables the redistribution of safe surplus food to charities and food donation centers through automated alerts and notifications. The implementation of the system helps minimize wastage, reduce operational expenses, and improve overall efficiency in food service management. Results demonstrate that Smart Serve can support sustainable practices and modernize conventional waste management methods. The proposed solution provides a reliable and scalable approach for building smarter and more eco-friendly food service operations.

Food waste has become a serious issue in today's world, affecting the economy, environment, and efficient use of available resources. Large amounts of food are wasted every day in restaurants, hotels, cafeterias, and catering services due to overproduction, poor inventory management, and incorrect estimation of customer demand. Reducing this waste is essential for building a more sustainable and responsible food service system. To address this challenge, this paper presents Smart Serve, an innovative solution designed to minimize food wastage through smart monitoring and efficient management techniques.

Keywords—Food Waste, Smart Serve, Inventory Tracking, Predictive Analysis, Machine Learning, Smart Sensors, Waste Management, Sustainable Food Service

1. INTRODUCTION

Food waste has become one of the major global challenges, affecting economic growth, environmental sustainability, and social welfare. Large quantities of edible food are wasted daily during production, transportation, storage, and consumption, while millions of people continue to face hunger and food insecurity. This imbalance highlights the inefficiency of current food distribution systems. Food wastage also leads to the loss of valuable resources such as water, energy, labor, and raw materials used in food production. In addition, discarded food in landfills produces methane gas, which contributes significantly to climate change and environmental pollution. Therefore, reducing food waste has become both a social responsibility and an environmental necessity.

To address this issue, this paper presents **Smart Serve**, a web-based food donation platform developed to connect food donors, non-governmental organizations (NGOs), and delivery personnel through a centralized digital system. The platform enables users to share information, coordinate donation activities, and manage food redistribution in an efficient and organized manner. Smart Serve is developed using the Django framework based on the Model View Template (MVT) architecture, which ensures scalability, maintainability, and clear separation of system components.

The system provides several important features such as secure user registration, role-based access control, OTP verification, and real-time donation tracking. Donors can register surplus food details, NGOs can request available food items, and delivery personnel can manage transportation activities.

1.1 Motivation

The development of the **Smart Serve** system is inspired by the increasing need to reduce food wastage and improve the management of surplus food distribution. Every day, a large amount of edible food is discarded from restaurants, hotels, events, and households, while many people continue to struggle with hunger and lack of access to nutritious meals. This imbalance highlights the need for an efficient and organized solution that can connect available food resources with communities in need.

Traditional food donation methods often face problems such as poor communication, lack of coordination, delayed transportation, and absence of a centralized system. As a result, much of the surplus food remains unused or gets spoiled before reaching the right beneficiaries. Modern digital technologies provide an opportunity to solve these challenges through smart and user-friendly platforms.

The Smart Serve system is motivated by the goal of creating a reliable web-based platform that connects donors, NGOs, and delivery personnel in a structured manner. It aims to improve coordination, ensure timely food delivery, minimize spoilage, and promote sustainable use of resources. The project also encourages social responsibility and creates awareness about the importance of food donation practices. By using technology for a meaningful cause, Smart Serve contributes toward building a more efficient and hunger-free society.

1.2 Objectives

The main objective of the **Smart Serve** system is to reduce food wastage by redistributing surplus edible food efficiently to people who need it. The project is designed to provide a centralized and technology-driven platform that simplifies the process of food donation and delivery management.

The specific objectives of the system include developing a platform that connects food donors, NGOs, and delivery personnel through a single interface. It aims to allow donors to easily register and upload details of available food items, while NGOs can browse, request, and manage donations effectively. The system also focuses on implementing real-time tracking features to monitor donation and delivery status for better transparency and accountability.

Another important objective is to automate delivery assignment for faster logistics management and timely transportation of food. The platform includes secure authentication and role-based access control to ensure safe and authorized access for different users. In addition, the project seeks to improve communication and coordination among all stakeholders involved in the donation process.

The system is designed to be scalable so that future enhancements such as mobile applications, route optimization, analytics, and machine learning can be integrated easily.

2. LITERATURE SURVEY

The reduction of food waste has become an important research topic due to its impact on society, the economy, and the environment. In recent years, researchers have developed several digital solutions to improve the redistribution of surplus food and ensure that edible food reaches people in need instead of being discarded. Many of these systems use web technologies, automation, and database management to connect donors, NGOs, volunteers, and delivery personnel through a common platform. These solutions aim to reduce manual effort, improve communication, and increase transparency in donation activities. This section reviews major research contributions in the field of food redistribution systems and highlights their benefits and limitations.

Early studies mainly focused on basic web-based donation platforms where donors could register food availability and NGOs could request resources. These systems provided a simple communication channel between stakeholders and reduced dependency on manual coordination. However, many early systems lacked real-time tracking, automated allocation, and secure access control. As a result, delays in food collection and incomplete coordination were common issues.

Later research introduced structured frameworks such as Django and MVC/MVT architectures to improve scalability, maintainability, and system organization. These platforms separated business logic, database management, and user interfaces, making the systems easier to develop and expand. Researchers found that such architectures improved workflow management, reduced errors, and provided faster handling of donation records. However, some systems still depended heavily on manual approval processes and limited intelligent decision-making features.

Several studies also explored secure food redistribution portals with authentication mechanisms and role-based access control. These systems ensured that donors, NGOs, administrators, and delivery personnel could access only authorized features. Security-focused designs improved trust among users and reduced misuse of the platform. Even with these improvements, some solutions required more advanced security measures such as encryption, audit logs, and stronger verification methods.

Recent advancements have focused on integrating real-time tracking and logistics management into food redistribution systems. These platforms allow stakeholders to monitor food donation status, delivery progress, and final completion updates. Real-time monitoring increases accountability, reduces spoilage, and improves overall coordination. Some systems also automate volunteer or delivery assignment to reduce delays. However, implementation complexity and dependency on internet connectivity remain common challenges.

Researchers have also introduced data-driven and intelligent allocation systems that analyze historical donation data, NGO demand, location, and urgency levels. These approaches improve matching accuracy between food availability and actual requirements. Analytics-based systems help reduce mismatch, optimize resource usage, and support faster decision-making. Some studies recommend the future use of machine learning techniques for demand prediction and route optimization.

Another major trend is the use of full-stack development and REST API-based architectures. These systems provide better flexibility, smoother communication between modules, and easier integration with mobile applications or external services. API-based designs improve scalability and allow future expansion with advanced features. However, some platforms still face issues related to user adoption, mobile accessibility, and large-scale deployment. From the analysis of existing literature, it is clear that digital food redistribution systems have significantly improved coordination among donors, NGOs, and delivery teams. Frameworks such as Django and structured architectures like MVC/MVT provide reliable development support, while security modules and intelligent workflows enhance efficiency. Despite these advancements, many systems still lack complete automation, advanced analytics, and seamless mobile support.

The proposed **Smart Serve** system aims to overcome these limitations by combining secure authentication, real-time tracking, intelligent food allocation, and scalable web architecture into a single platform. It focuses on reducing food waste, improving operational efficiency, and creating a practical solution for sustainable food redistribution. By addressing the gaps identified in previous studies, Smart Serve contributes toward the development of a more effective and socially beneficial food donation ecosystem.

3. METHODOLOGY

The **Smart Serve** system is developed using a structured methodology based on the MVT (Model–View–Template) architecture. This approach ensures proper separation of data, business logic, and user interface. The first stage is requirement analysis, where user needs and system features are identified. The second stage is system design, where database structure, workflows, and interface layouts are planned. The development stage is carried out using the Django framework to implement modules such as donation

management, request handling, and tracking. The testing stage verifies the performance, accuracy, and security of the system. After successful testing, the system is deployed in a server environment for practical use. During operation, users can donate food, request resources, and track deliveries. The system also generates reports, notifications, and status updates. This structured methodology helps in building an efficient, scalable, and reliable food donation platform.

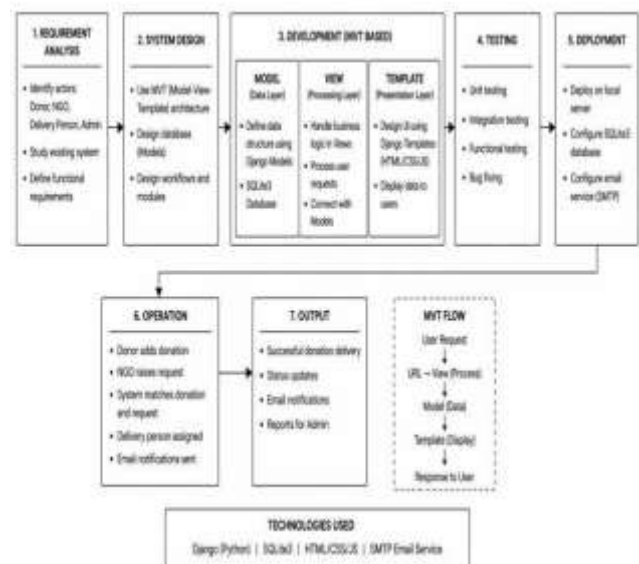


Fig 3.1: Methodology (MVT based approach)

The above figure represents the overall methodology followed in the development of the Smart Serve system using the MVT (Model– View–Template) approach. It illustrates the complete workflow starting from requirement analysis, system design, and development, followed by testing, deployment, operation, and final output. The diagram also highlights the interaction between different layers such as model, view, and template, which together handle data processing, business logic, and user interface. This structured approach ensures efficient system development, better coordination, and smooth execution of food redistribution processes.

3.1 Requirement Analysis

In this phase, the requirements of the Smart Serve system are identified by studying user needs and existing food donation challenges. The main users considered are Donor, NGO, Delivery Person, and Admin. Functional requirements such as donation management, request handling, tracking, and notifications are defined. This phase ensures the system is designed according to real- world needs.

3.2 System Design

The system design phase focuses on planning the structure of the application. The Smart Serve platform follows the MVT (Model– View–Template) architecture. Database tables, workflows, and module interactions are planned in this stage. Proper design helps in smooth system operation and future scalability.

3.3 Development (MVT Based)

The development phase is carried out using Django. The **Model** layer defines database structure using Django models with SQLite3. The **View** layer handles business logic, processes requests, and connects with models. The **Template** layer creates the user interface using HTML, CSS, and JavaScript. This structured approach improves maintainability and efficiency.

3.4 Testing

Testing is performed to verify the reliability and performance of the system. Unit testing, integration testing, and functional testing are carried out. Errors are identified and corrected during this stage. It ensures the platform works accurately and securely.

3.5 Deployment

After testing, the system is deployed with required configurations. The application is executed on a local server environment. SQLite3 database and SMTP email services are configured properly. This stage makes the system ready for real-time use.

3.6 Operation

During operation, donors add food donations and NGOs raise requests. The system matches available food with requests and assigns delivery personnel. Email notifications are sent to all users for updates. This process improves coordination and reduces delays.

3.7 Output

The system generates outputs such as successful food delivery records, donation status updates, notifications, and admin reports. These outputs improve transparency and monitoring.

3.8 MVT Workflow

The workflow of MVT architecture follows this sequence:

User Request → URL → View → Model → Template → Response to User.

3.9 Technologies Used

The technologies used in Smart Serve are Django, Python, SQLite, HTML, CSS, JavaScript, and SMTP Email Service. The Smart Serve system is developed using a structured MVT methodology that ensures clear separation of data, logic, and presentation. This process supports efficient food donation management, real-time tracking, and reliable redistribution among all stakeholders.

4. SYSTEM DESIGN

The system design of the Smart Serve platform defines the overall architecture and interaction between various components of the application. It explains how users such as Donors, NGOs, Delivery Personnel, and Administrators communicate with both the frontend and backend of the system. The design follows a structured approach based on the Django framework and MVT architecture, where data handling, business logic, and user interface are separated efficiently. This improves system organization, maintainability, and scalability. Through this design, food donation requests, delivery assignments, tracking, and notifications are managed smoothly. The structured system design ensures reliable communication and effective food redistribution among all stakeholders.



Fig 4.1: System Architecture of Smart serve Donation Platform

The above figure represents the system architecture of the **Smart Serve** platform. It illustrates the interaction between different users such as Donors, NGOs, Delivery Personnel, and Admin with the frontend and backend components of the system. The frontend is developed using Django templates with HTML, CSS, and JavaScript, while the backend manages URL routing, views, authentication, and business logic. The architecture also includes major modules such as user management, donation management, request

management, matching system, delivery management, notification system, and analytics. All system data is stored in an SQLite database through Django ORM, and SMTP email service is used for notifications. The design ensures efficient communication and smooth food donation processing.

- A centralized Django application handles URL routing, authentication, and request processing.
- Modules include User Management, Donation Management, Request Management, Matching, Delivery, Notifications, and Reports.
- Django ORM is used for secure database storage and retrieval.
- Web interface is built using HTML, CSS, and JavaScript.
- SMTP email service is used for alerts and communication.

4.1 Actors in the System

The Smart Serve platform consists of four main actors. The Donor adds surplus food details for donation. The NGO requests available food and manages received donations. The Delivery Person handles food pickup and delivery operations. The Admin monitors system activities and manages users. Each actor interacts with the platform according to assigned roles.

4.2 System Architecture

The Smart Serve system follows a layered architecture for better organization and scalability. The Frontend Layer is developed using Django templates, HTML, CSS, and JavaScript to provide a user-friendly interface. The Backend Layer handles URL routing, authentication, authorization, and business logic using Django. The Database Layer uses SQLite to store user, donation, and delivery data. The Email Service Layer uses SMTP to send notifications and updates.

4.3 Core Modules

The platform is divided into important modules such as User Management, Donation Management, Request Management, Matching System, Delivery Management, Notification Management, and Analytics & Reports. These modules help in managing all system functions efficiently.

4.4 Workflow

The system follows two main workflows. In the first workflow, Donor adds food donation details, the system matches requests, Delivery Person collects food, and NGO receives it. In the second workflow, NGO places a request, the system performs matching, delivery is assigned, and the request is fulfilled successfully.

The system design of Smart Serve provides a structured architecture that integrates frontend, backend, database, and communication services into a single platform. It ensures secure access, smooth data flow, and efficient coordination among all users. Overall, the design supports reliable and scalable food redistribution operations.

5. RESULTS AND DISCUSSION

5.1 System Output Screens

The system output screens present the practical results of the **Smart Serve** platform and demonstrate the functionality of different modules. These screens show how users such as Donors, NGOs, Delivery Personnel, and Administrators interact with the system to complete their tasks efficiently. Each interface is designed to provide simple navigation, smooth workflow execution, and accurate data handling. The outputs confirm that the system successfully implements important features such as user authentication, food donation management, request processing, delivery coordination, and tracking.

The following screens represent the real implementation of the Smart Serve platform. They highlight how different modules are integrated to create a user-friendly and organized experience. Each screen reflects the main operations of the system and validates the working of the application.

Signup Page: This page is used for new user registration. Users can enter details such as name, phone number, email address, location, and password to create an account. The registration process helps ensure that only authorized and valid users can access the platform. It acts as the first step for joining the Smart Serve system.



The image displays two side-by-side screenshots of the Smart Serve web application. The left screenshot, titled 'Food Donate - Sign Up', shows a registration form with fields for Name, Phone, Email, Location, Password, and Confirm Password, followed by a 'Sign Up' button. The right screenshot, titled 'Verify Your Email', shows a confirmation screen with a message 'OTP sent to your email. Please verify to complete registration.', an input field for the OTP, a 'Verify OTP' button, and a 'Back to Signup' link.

Fig 5.1: Registration Page

Login Page: The login page provides secure access for registered users of the Smart Serve platform. It verifies user credentials such as username or email and password before granting access. After successful authentication, users are directed to their respective dashboards based on assigned roles such as Donor, NGO, Delivery Personnel, or Admin. This page ensures safe and role-based access to system

functionalities.



The login form is titled "Food Donate - Login". It contains two input fields: "Email" and "Password". Below these fields is a green "Login" button. At the bottom, there is a link that says "Don't have an account? Sign up here".

Fig 5.2: Login Page

Donor Dashboard: The donor dashboard serves as the main interface for donors after successful login. It provides easy navigation to different features and displays the purpose of the Smart Serve platform. The dashboard includes a "Donate Food" option that allows donors to add surplus food details and begin the donation process. It is designed to offer a simple and user-friendly experience for managing donations efficiently.

the system. All sensor data collected from the input layer is transmitted to this microcontroller, where it is processed in real time. The system uses predefined logic combined with basic artificial intelligence concepts to analyze the data and determine the baby's condition. The microcontroller also manages communication between different modules and ensures synchronized operation of the entire system.

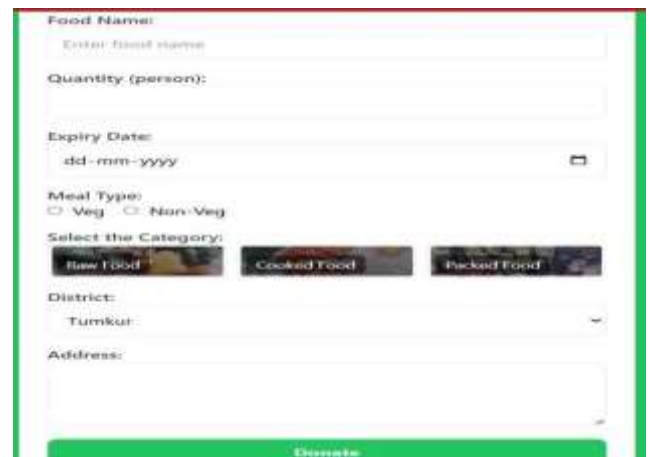


The dashboard features a header with navigation links: Home, Profile, Contact, About, Support. The main content area has a large image of children with a "Donate Food" button. Below the image is a green banner with the text: "Collecting food waste is a vital and easy way of saving money, helping to feed the world and protect the planet." At the bottom, there is a section titled "Our mission".

Fig 5.3: Donar Dashboard for Smart serve Platform

Food Donation Form: This interface allows donors to submit details of available food items for donation. Users can enter information such as food name, quantity, expiry date, category, and pickup address. The form helps in proper classification of food items and supports accurate matching with NGO requests. It ensures organized data entry and

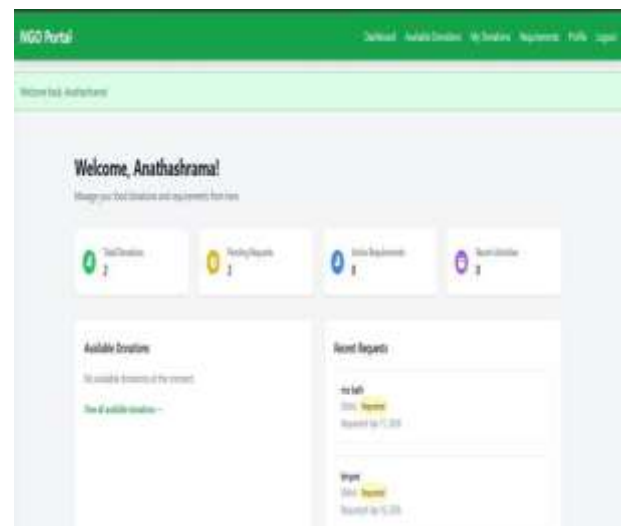
smooth processing of donations within the Smart Serve platform.



The form is titled "Food Donation Form". It includes the following fields: "Food Name:" (text input), "Quantity (person):" (text input), "Expiry Date:" (date picker), "Meal Type:" (radio buttons for Veg and Non-Veg), "Select the Category:" (three buttons: Raw Food, Cooked Food, Packaged Food), "District:" (dropdown menu with "Tumkur" selected), and "Address:" (text input). A green "Donate" button is at the bottom.

Fig 5.4: Food Donation Form

NGO Dashboard: This page displays all available food donations along with their current status for NGO users. Detailed food information is also shared through email notifications to keep users updated. The dashboard allows NGOs to view donation requests, check availability, and monitor whether a donation has been accepted or processed. It provides an organized interface for managing food collection activities efficiently.



The dashboard is titled "NGO Portal" and includes a navigation bar with links: Dashboard, Available Donations, My Donations, Requests, Profile, Logout. The main content area shows a welcome message "Welcome, Ananthashrama!" and a sub-header "Manage your food donations and requests from here". There are four status cards: "Total Donations" (3), "Pending Requests" (1), "Active Requests" (1), and "New Donations" (3). Below these are two sections: "Available Donations" (showing "No available donations at the moment") and "Recent Requests" (showing two requests with details like "Newly", "Status: Request", "Received on: 11/11/2024", and "Import", "Status: Request", "Received on: 11/11/2024").

Fig 5.5: NGO'S Dashboard

E-mail Notification Bar: This feature is designed to instantly inform NGO users whenever a new food donation is added to the Smart Serve system. Once a donor submits food details, an automated email is sent containing important information such as the donor name, food type, quantity, expiry date, and pickup location. This helps NGOs quickly review available donations and take timely action to collect and distribute the food before it expires. The notification system improves communication, saves time,

and ensures that surplus food reaches those in need efficiently.

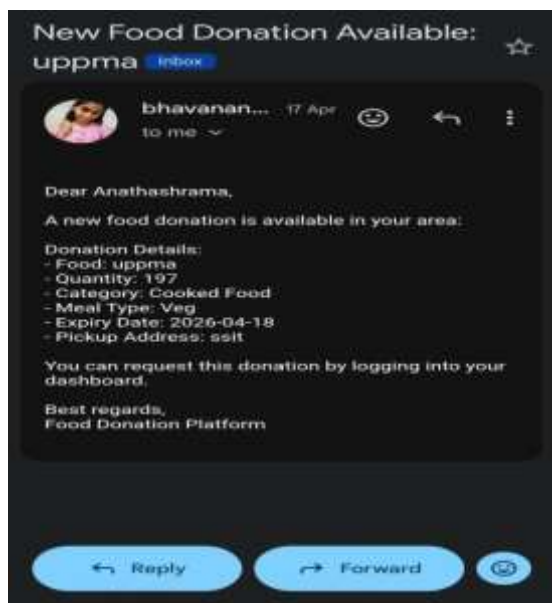


Fig 5.6: E-mail Notification for NGO

Tracked Food Details: This feature allows NGO users to view and manage all donated food items easily. It shows details such as the food name, quantity, category, meal type, expiry date, status, and donation date. With this information, users can keep track of available donations, know whether a request is pending or accepted, and distribute food on time. It helps in better organization, avoids confusion, and makes food management more efficient.

Your Food Donations

Food Name	Quantity	Category	Meal Type	Expiry Date	Status	Expiry At
Apple Pie	10000	Cooked Food	Veg	April 15, 2026	Pending NGO	2026-04-17 18:24
Apple Pie	197	Cooked Food	Veg	April 15, 2026	Pending NGO	2026-04-17 18:19
Apple Pie	197	Cooked Food	Veg	April 15, 2026	Pending NGO	2026-04-17 18:19
Apple Pie	10000	Cooked Food	Veg	April 15, 2026	Pending NGO	2026-04-17 18:19

Fig 5.7: Tracked Food Updates in Donar Dashboard

Delivery Dashboard: This interface allows delivery personnel to view assigned tasks and NGO requests in an organized manner. It helps ensure smooth coordination throughout the food pickup and delivery process. Delivery users can accept or reject assigned requests based on availability and confirm delivery completion after successful handover. This dashboard improves communication, task management, and overall workflow efficiency within the

Smart Serve platform.

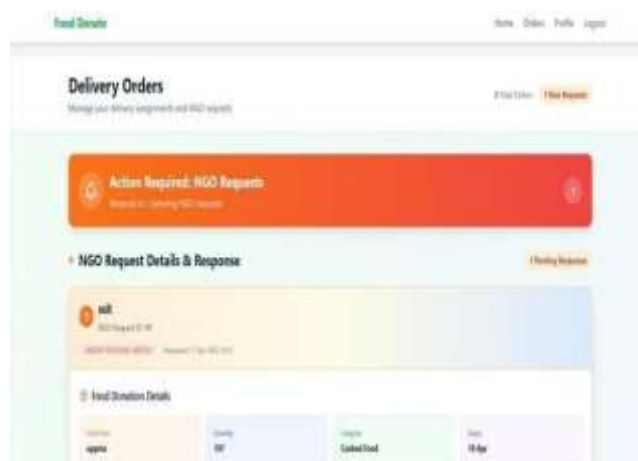


Fig 5.8: Delivery person's Dashboard

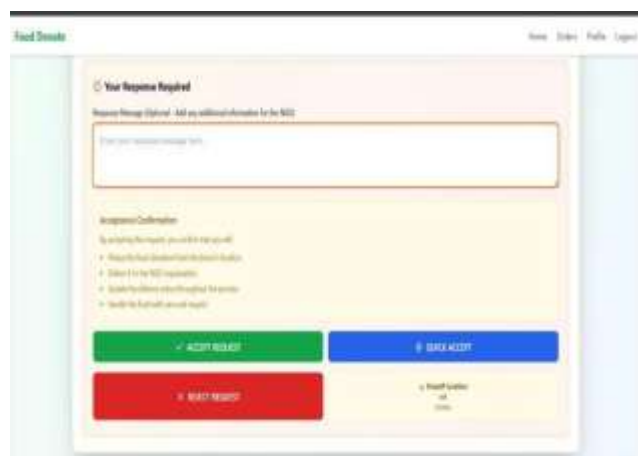


Fig 5.9: Delivery Response Interface

Admin Panel: The admin panel serves as the central control unit of the Smart Serve platform for managing all system activities. It allows the administrator to supervise users, monitor food donations, review requests, and track delivery operations efficiently. The panel helps maintain smooth workflow management, system security, and proper administration. It ensures effective monitoring and overall control of the platform.

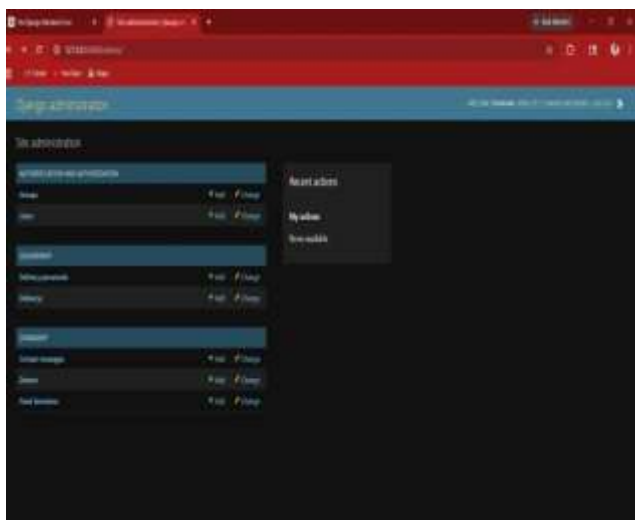


Fig 5.10: Admin Panel

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The results of the **Smart Serve** system show the successful implementation of all key functionalities, including secure user authentication, food donation management, request processing, and delivery coordination. The platform provides smooth interaction between Donors, NGOs, and Delivery Personnel through an easy-to-use interface. Real-time status updates and notifications enhance transparency, communication, and coordination among users. Overall, the system reduces manual effort and supports efficient food redistribution.

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