Department of Computer Science and Engineering

23CS1512 Socially Relevant MiniProject.

Zerobite: A Real-Time Food Donation and Waste Management System

SDG Goals

SDG 2: Zero Hunger

SDG 12: Responsible Consumption and Production

SDG 13: Climate Action

BATCH NUMBER : A9

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Date :   31/10/2025

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AGENDA

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3. Objective
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ABSTRACT

- Food wastage and hunger continue to be major global problems, with large amounts of edible food discarded while millions remain undernourished.
- The lack of a centralized and automated platform leads to delays, inefficiency, and increased food spoilage.
- The ZeroBite system aims to bridge this gap by providing a real-time web-based food redistribution platform.
- It facilitates digital coordination between food donors, NGOs, and beneficiaries for faster and safer food collection.
- The system is built using HTML, SCSS, and JavaScript for the frontend and Django REST Framework with MySQL for the backend.
- Donors can easily post food details, including expiry time, quantity, and location, through the web interface.
- An integrated live map helps NGOs locate nearby donations, while the expiry module automatically removes expired items.
- By promoting transparency, automation, and sustainability, ZeroBite reduces food waste and supports community welfare.

INTRODUCTION

- Food wastage and hunger are two deeply interconnected problems that persist globally despite abundant food resources.
- Every day, tons of edible food from restaurants, events, and households are discarded instead of being redistributed.
- This unused food could potentially feed millions of undernourished people suffering from hunger and malnutrition.
- Improper food management systems and lack of coordination between donors and NGOs worsen the issue.
- Food waste also impacts the environment, contributing to greenhouse gas emissions and resource wastage.
- According to global studies, nearly one-third of all food produced is wasted before consumption.
- The imbalance between food availability and food access highlights the need for a better redistribution system.
- Current donation practices are manual, unstructured, and time-consuming, leading to inefficiency.

INTRODUCTION

- Traditional methods depend on phone calls, emails, or social media messages for coordination.
- These methods often result in communication gaps and delayed pickups, causing food spoilage.
- Many existing food donation systems lack automation and require constant human intervention.
- There is no standard mechanism for tracking food expiry times or verifying freshness.
- Geolocation or route optimization is rarely implemented, making it hard to match nearby donors and NGOs.
- As a result, valuable time is lost in locating and collecting food before it expires.
- The absence of real-time data updates reduces system transparency and trust among users.
- A digital, centralized platform can eliminate manual inefficiencies and connect all stakeholders instantly.
- Such a system should include features like real-time tracking, expiry validation, automated notifications, and secure data management.
- By integrating modern web technologies and automation, food redistribution can become faster, safer, and more reliable.

OBJECTIVE

- To develop a real-time web-based platform that connects food donors, NGOs, and volunteers, enabling efficient food redistribution through a single centralized system.
- To reduce food wastage by ensuring that surplus edible food from restaurants and events is collected and delivered to the needy before expiry.
- To implement a secure and role-based authentication system that categorizes users as Donors, NGOs, or Admins for organized access and data management.
- To design an automatic expiry detection feature that continuously monitors donations and removes expired items to ensure food safety.
- To integrate a live location map that helps NGOs identify nearby food donations and plan quick pickups through real-time navigation.
- To ensure seamless data synchronization between frontend and backend using Django REST Framework and MySQL for instant updates and reliability.
- To establish a transparent donation tracking mechanism that verifies each transaction from posting to pickup, ensuring accountability and trust.
- To incorporate data analytics and reporting tools for monitoring donation patterns, expiry rates, and system performance metrics.
- To contribute to social welfare and sustainability goals by aligning with UN SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption).

LITERATURE REVIEW

[1] Helping Hand: An Interactive Mobile Application Featuring Underprivileged People Assistance With Donation and Beneficiary Selection Facilities (2023)

Aspect	Details
Author	Chowdhury, Mahfuzulhoq and Ahmad, Alve.
Summary	Developed a digital platform connecting donors with beneficiaries through real-time interaction and food listing features.
Relevance	Demonstrates the importance of technology-based solutions for donation coordination.
Gaps	Lacks expiry management, live location tracking, and admin monitoring.
Impact	Serves as a base for ZeroBite's automation, expiry validation, and geolocation features.

LITERATURE REVIEW

[2] Food Waste Management System in the Midst of a Food Crisis (2023)

| Aspect	Details
Author	Kruthika V., Lavanya H.R., Mahalakshmi, Ranju P.S.R., Priyanka H.L., and Sindhu K.S.
Summary	Proposed a web platform to manage food donations during crisis situations.
Relevance	Shares the same goal of connecting donors and NGOs.
Gaps	Lacks live map tracking and automatic expiry validation.
Impact	Strengthens the concept behind ZeroBite's real-time tracking and expiry control.

LITERATURE REVIEW

[3] **Recent Advances on Physical Technologies for Pretreatment of Food Waste** (2023)

| Aspect	Details
Author	Gallego-García, María, et al.
Summary	Reviewed advanced methods for sustainable waste reuse and pretreatment technologies.
Relevance	Supports the role of automation and smart systems in food management.
Gaps	Focused on industrial waste processing rather than redistribution.
Impact	Encourages using technology-driven automation as integrated in ZeroBite.

PROBLEM STATEMENT

- Food wastage and hunger remain interconnected global problems, with large amounts of edible food wasted while millions suffer from hunger.
- Restaurants, events, and households discard surplus food daily, even as nearby communities face food insecurity.
- The absence of a centralized, automated platform leads to poor coordination and delayed redistribution.
- Manual processes such as phone calls or social media coordination are inefficient and prone to errors.
- Existing systems lack real-time tracking and automation, reducing speed and effectiveness in food collection.
- Expiry-time validation is often missing, leading to potential distribution of unsafe or spoiled food.
- Environmental pollution increases as food waste contributes to methane emissions and resource wastage.
- A smart digital solution is essential to connect donors and NGOs in real time for faster, safer food redistribution.
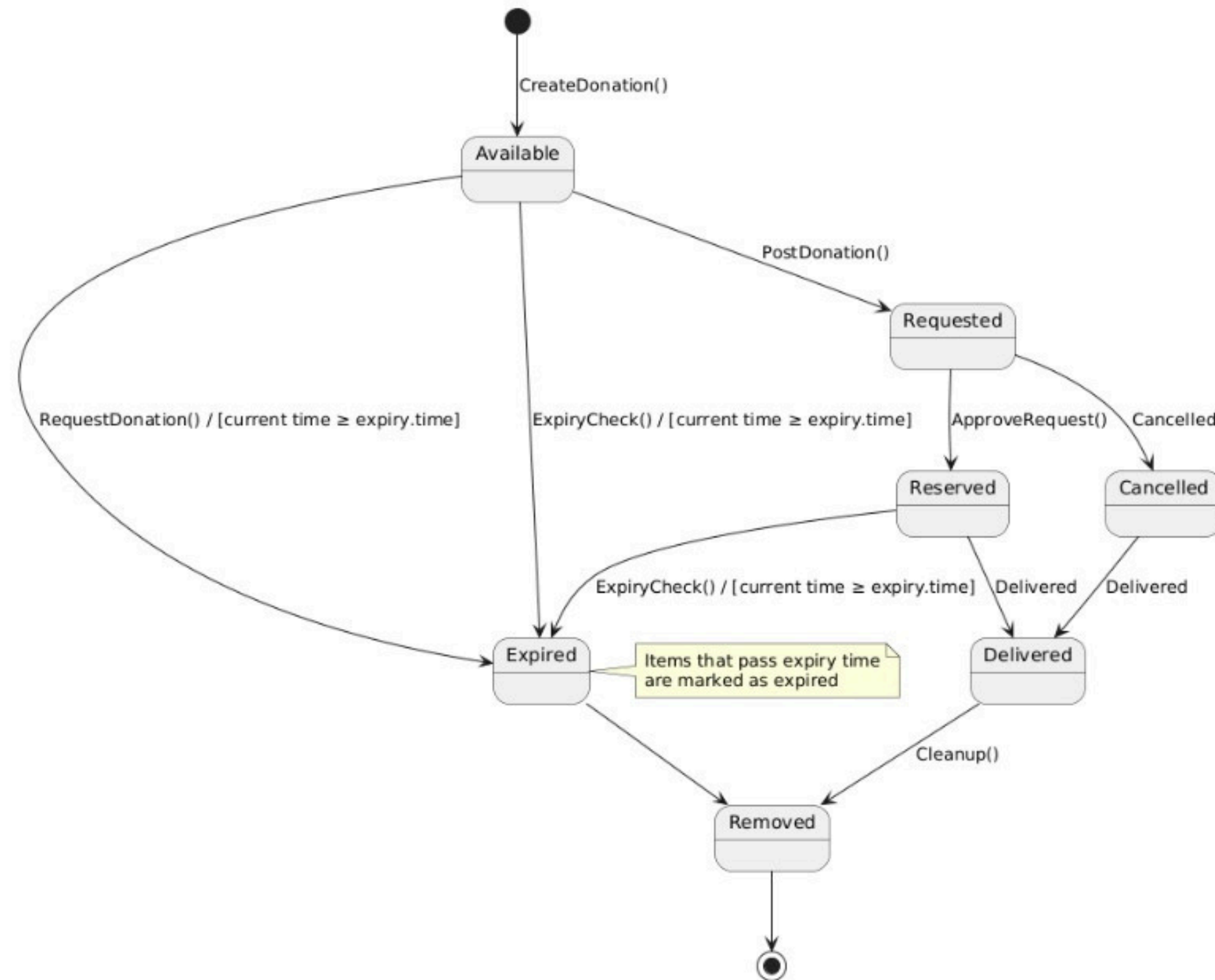
SYSTEM ARCHITECTURE DIAGRAM
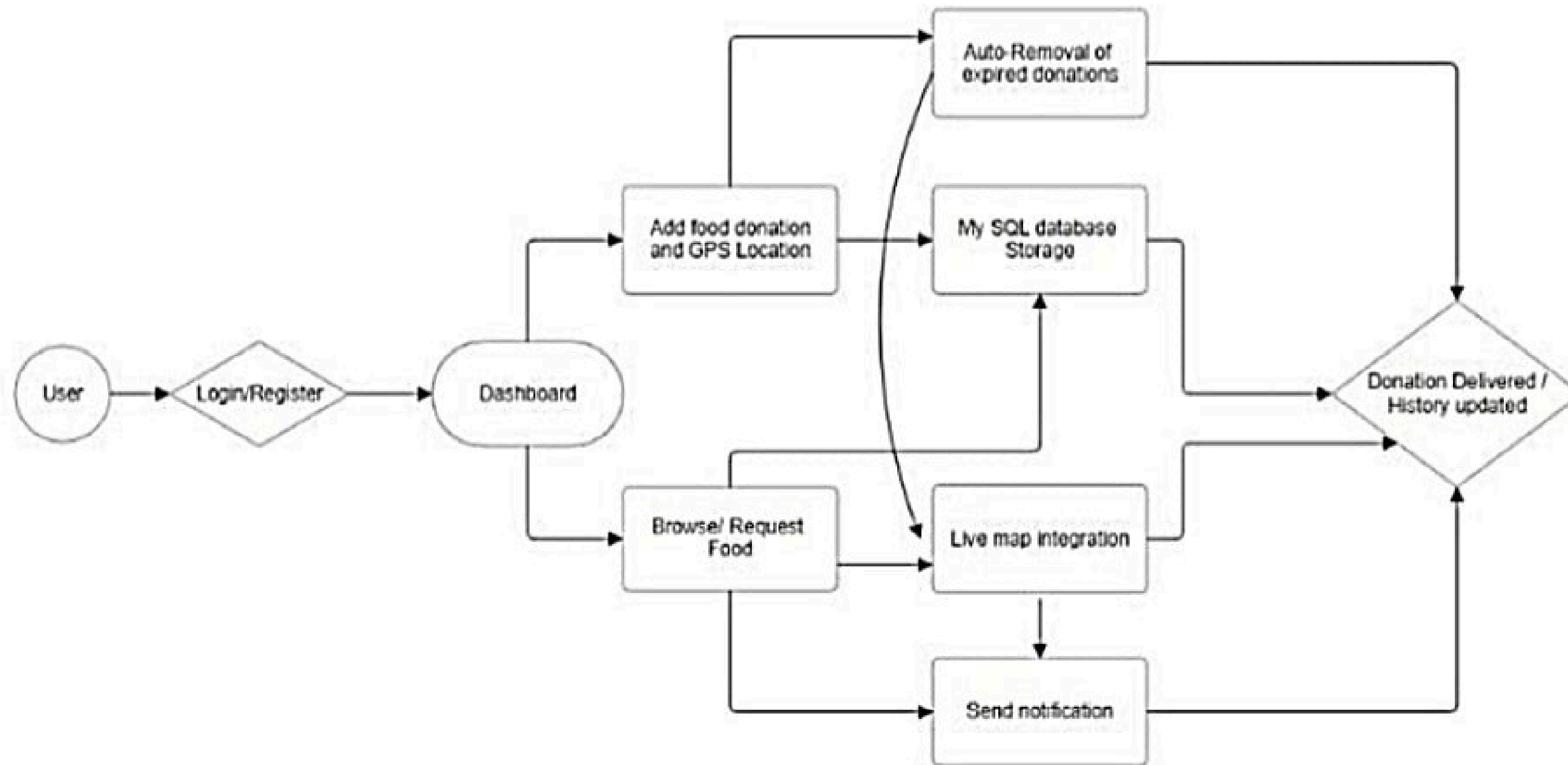
SEQUENCE DIAGRAM
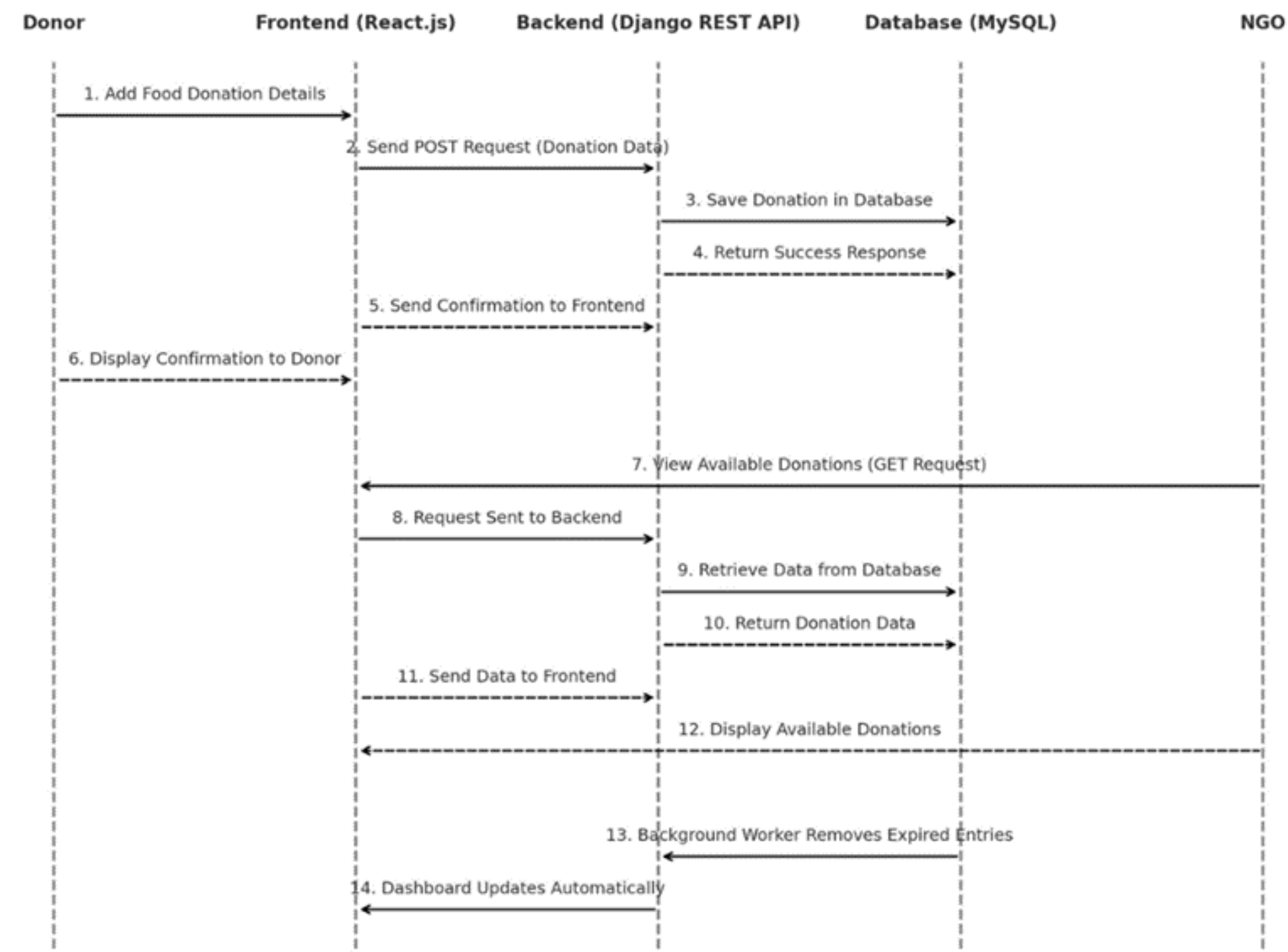
STATE DIAGRAM

MODULES

1. USER AUTHENTICATION MODULE

- Ensures only verified users (Donors or NGOs) can securely access and interact with the ZeroBite platform.
- It is built using Django REST Framework (DRF) with JSON Web Tokens (JWT) for secure, stateless authentication.
- This supports role-based access control (RBAC) to limit actions based on user type (Donor or NGO).

Registration Process:
- Collects user details — name, email, password, and role.
- Validates all inputs for accuracy and security.
- Passwords are encrypted using Django's PBKDF2 hashing algorithm before storage.
- Verified user information is stored in the MySQL database, and a success response is sent to the frontend.

Login and Token Handling:
- User logs in with email and password; backend verifies credentials.
- If valid, the system generates JWT access and refresh tokens.
- The frontend stores tokens securely and includes them in each request for authorization.
- Expired tokens are refreshed using the refresh token to maintain secure sessions.

Role-Based Access:
- Donors: Can add and manage their own food donation posts.
- NGOs: Can browse, request, and confirm available donations.
- Any unauthorized action outside a user's role is denied automatically by the backend.

MODULES

2. FOOD DONATION MANAGEMENT MODULE

- The Food Donation Management Module is the core component of the ZeroBite System, responsible for managing the complete donation lifecycle — from creation and storage to viewing and confirmation.
- It seamlessly integrates the React.js frontend with the Django REST Framework backend, ensuring smooth data flow and communication between users and the server.
- All donation records are securely stored in a MySQL database, maintaining data integrity, accuracy, and real-time accessibility for both donors and NGOs.

Donation Process:
- Donors log in and create donation entries with food type, quantity, expiry time, and pickup location.
- Frontend validates inputs and sends data to the backend via POST API.
- Backend verifies the donor, stores details in the Donation Table, and returns a success response.

Viewing and Access:
- NGOs can view available, non-expired donations through the dashboard using GET API calls.
- New donations appear instantly without page refresh, ensuring real-time updates.

Management and Tracking:
- Donors can update or withdraw donations; expired ones can't be edited.
- All donation actions are logged for transparency and accountability.
- Follows RESTful design for fast performance and accurate data handling.

MODULES

3. AUTOMATIC EXPIRY REMOVAL MODULE

- The Automatic Expiry Removal Module automatically detects and removes expired food donations to ensure food safety and reliability within the ZeroBite system.
- It operates silently in the background, checking expiry times at regular intervals without requiring any manual action.
- When donors add a donation, they are required to specify an expiry time (T_e), which is stored in the MySQL database.
- The system continuously compares the current time (T_n) with the expiry time (T_e) to determine whether a donation remains valid or needs to be marked as expired.

EXPIRY TIME LOGIC

Condition for expiry:
If $T_n \geq T_e$, the donation is considered Expired.
Remaining time before expiry:
$\Delta T = T_e - T_n$
If $\Delta T \leq 0$, the donation is marked as Expired automatically.

MODULE

4. LIVE MAP INTEGRATION MODULE

- The Live Map Integration Module in the ZeroBite system enables real-time connectivity between donors and NGOs through an interactive map interface.
- It visualizes donation locations, tracks routes, and ensures quick, efficient food collection.
- By integrating location and mapping technologies, this module plays a key role in reducing food wastage and improving coordination.

- Automatically captures latitude and longitude of donor locations using the Geolocation API.
- Displays all active donations as interactive map markers via the Google Maps API.
- Each marker shows important details such as donor name, food type, quantity, and expiry time.
- NGOs can click on a marker to view the shortest route for pickup, saving time and preserving food freshness.
- The map updates dynamically as new donations are added or old ones expire.
- Ensures real-time data accuracy and smooth donor–NGO coordination.
- Promotes faster response, efficient logistics, and reduced food wastage across multiple locations.

METHODOLOGY

- The proposed system implements secure user authentication and role-based access control to manage user permissions effectively.
- Each user is assigned a specific role — Restaurant, NGO, or Volunteer — which determines their access level and functionalities.
- Restaurants and event organizers can create and post detailed food donations.
- NGOs can browse, filter, and request available food items from nearby donors.
- Volunteers play a support role by assisting in collection, transportation, and delivery of food to recipients.
- When a donation is created, all essential details such as food name, quantity, expiry time, location coordinates (latitude & longitude), and donor info are stored in the MySQL database.
- The system includes a freshness monitoring mechanism that uses a countdown timer to track the remaining valid time for each donation.
- The remaining time before expiry is dynamically calculated using the formula:
- **Remaining Seconds = max(0, (ExpiryTime − CurrentTime) / 1000)**
- Once the remaining time reaches zero, the donation is automatically flagged as expired and removed from the active donation list.
- This feature ensures food safety and hygiene, allowing NGOs to access only safe, non-expired food items, while improving efficiency and trust in the redistribution process.

TESTING

- Functional Testing: Conducted to verify the operation of each core module including login, donation posting, expiry removal, and live map tracking.
- Usability Testing: Focused on ensuring the interface is simple, responsive, and easily navigable for both donors and NGOs with minimal training.
- Performance Testing: Measured how efficiently the system responds under multiple concurrent user requests and database operations.
- Security Testing: Validated JWT authentication, encrypted passwords, and secure API communication to prevent unauthorized data access.
- Integration Testing: Checked the seamless interaction between frontend, backend, and database layers for error-free synchronization.
- Compatibility Testing: Ensured smooth functioning across different browsers and devices, including mobile and desktop platforms.
- Load Testing: Evaluated system stability when multiple donations and NGO requests were processed simultaneously.
- API Testing: Performed using Postman to verify all REST endpoints return correct data and handle edge cases properly.
- Validation Testing: Confirmed that user inputs, expiry checks, and food listings meet all functional and safety requirements.

VALIDATION TEST CASES

Test Case	Input Description	Expected Output	Actual Result
Login Function	Valid username & password	User redirected to dashboard	Pass
Add Donation	Valid donation details entered	Donation saved successfully	Pass
Expiry Check	Expired food entry detected	Automatically removed from list	Pass
Map View	Valid coordinates provided	Live markers displayed on map	Pass
Token Authentication	Expired token used	Access denied with error message	Pass
Role Restriction	NGO tries to add donation	Action blocked by system	Pass

PERFORMANCE ANALYSIS

- The system achieved an average response time of under 2 seconds for all major actions such as login, posting, and map updates.
- Data synchronization accuracy reached nearly 100%, ensuring all users view updated food listings without delay.
- Expiry validation efficiency was recorded at 98%, with automatic removal of expired items verified during testing.
- The live map module updated within 1 second, maintaining real-time accuracy of donor and NGO locations.
- System uptime measured at 99%, confirming high availability and reliability under normal operating conditions.
- Database query performance remained consistent even with large data volumes, ensuring scalability for future expansion.
- Error rate was minimal, with most detected issues resolved during early test iterations.
- Overall, the system proved to be stable, secure, and responsive, meeting all functional and non-functional requirements.

EXPERIMENTAL RESULTS

Registration Page

Login Page

EXPERIMENTAL RESULTS
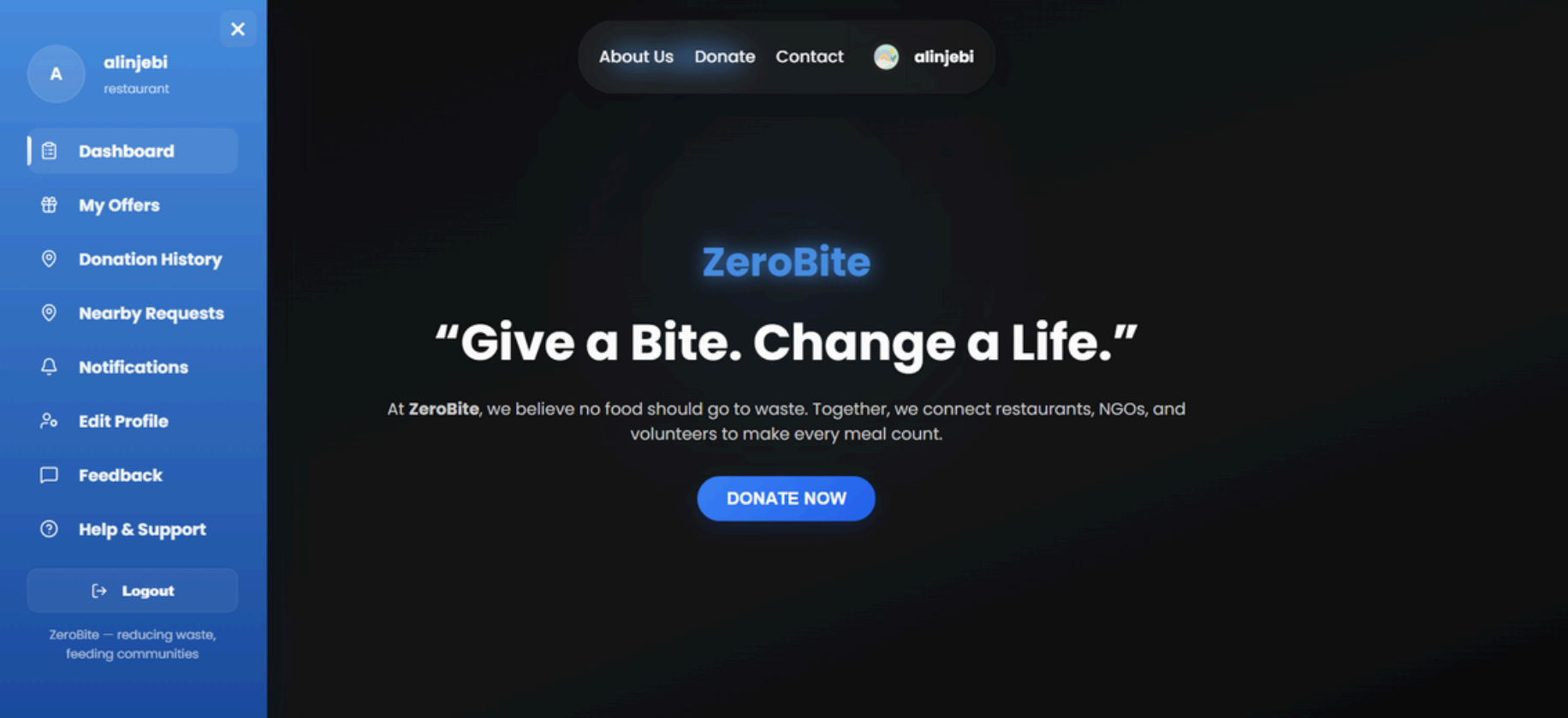
Dashboard
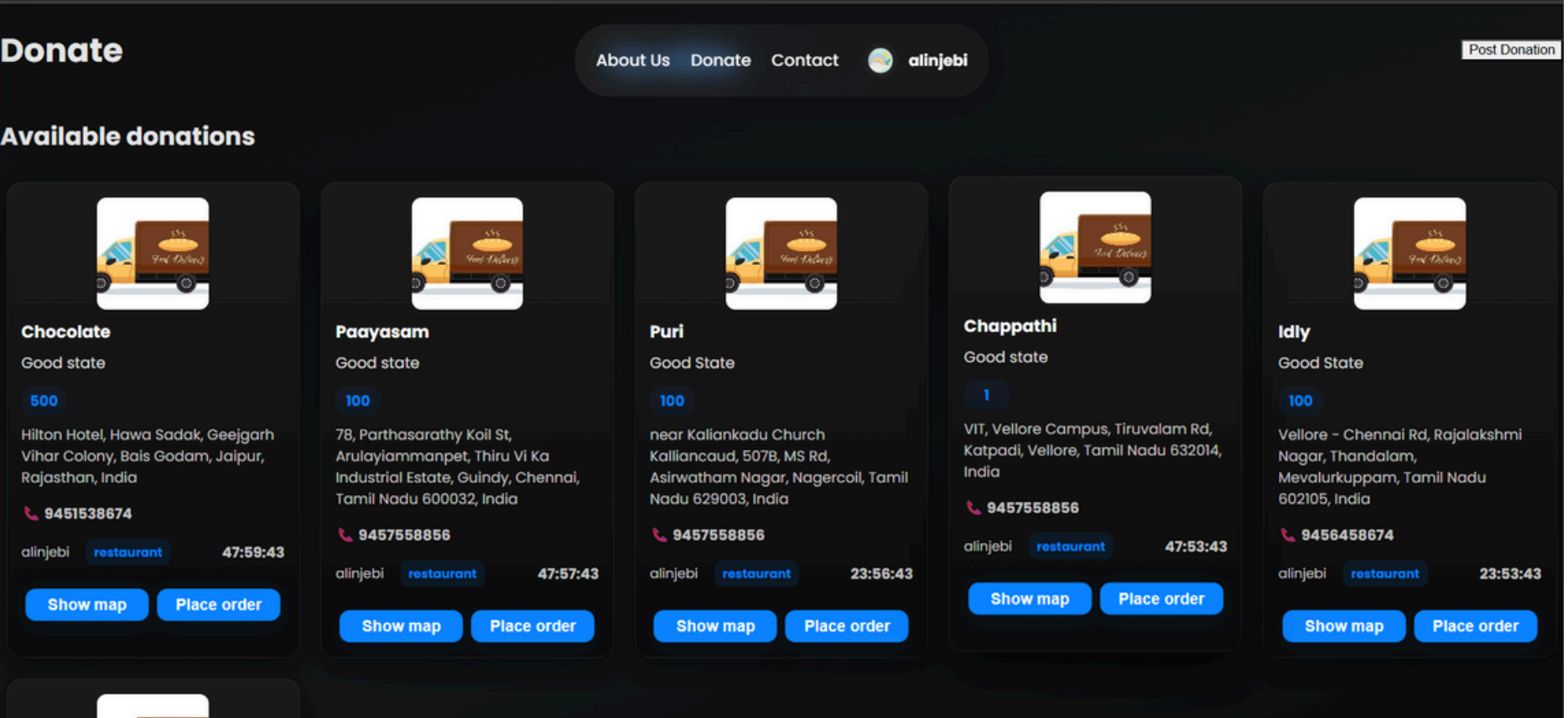
Donation Page

EXPERIMENTAL RESULTS

Donation Form Page

Location being visible

EXPERIMENTAL RESULTS
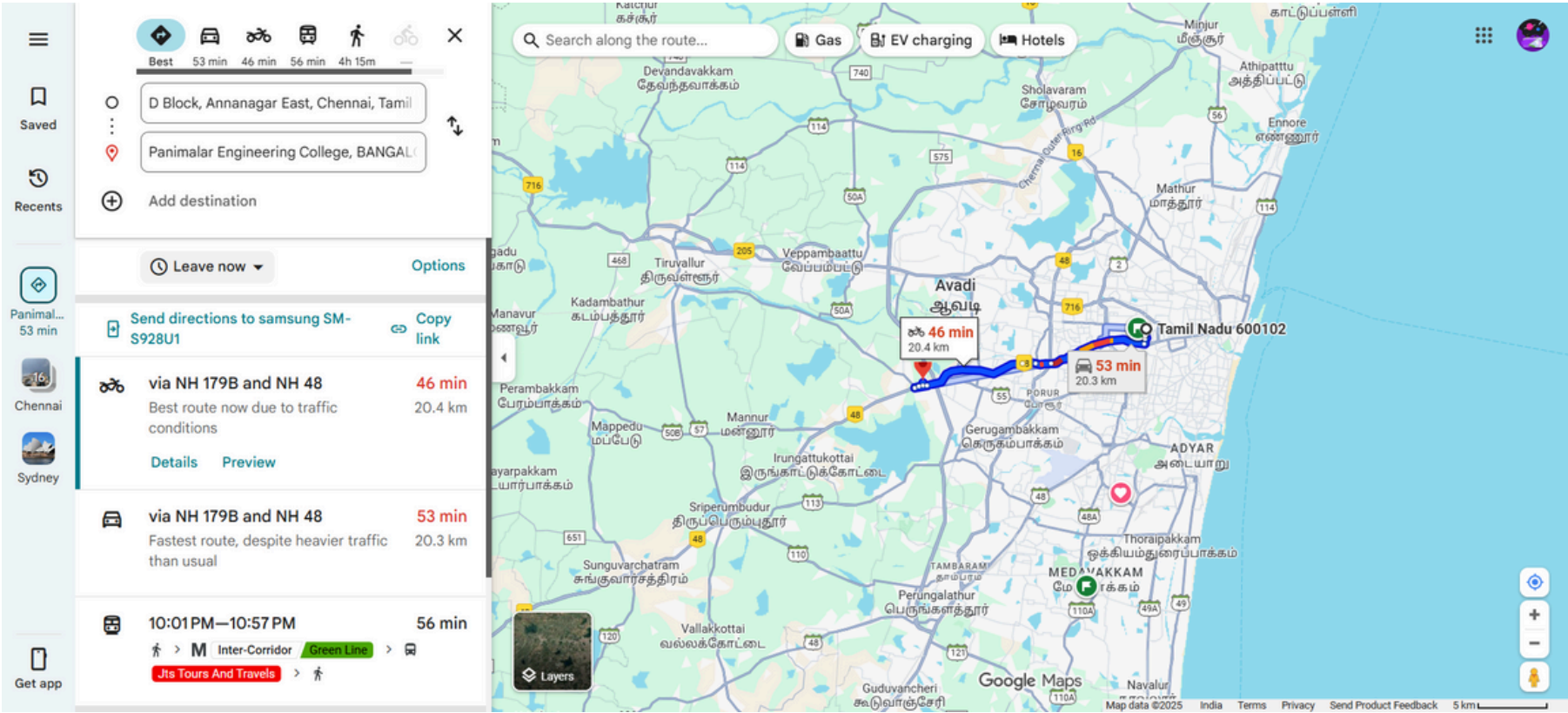
Track Donation Using Google Map
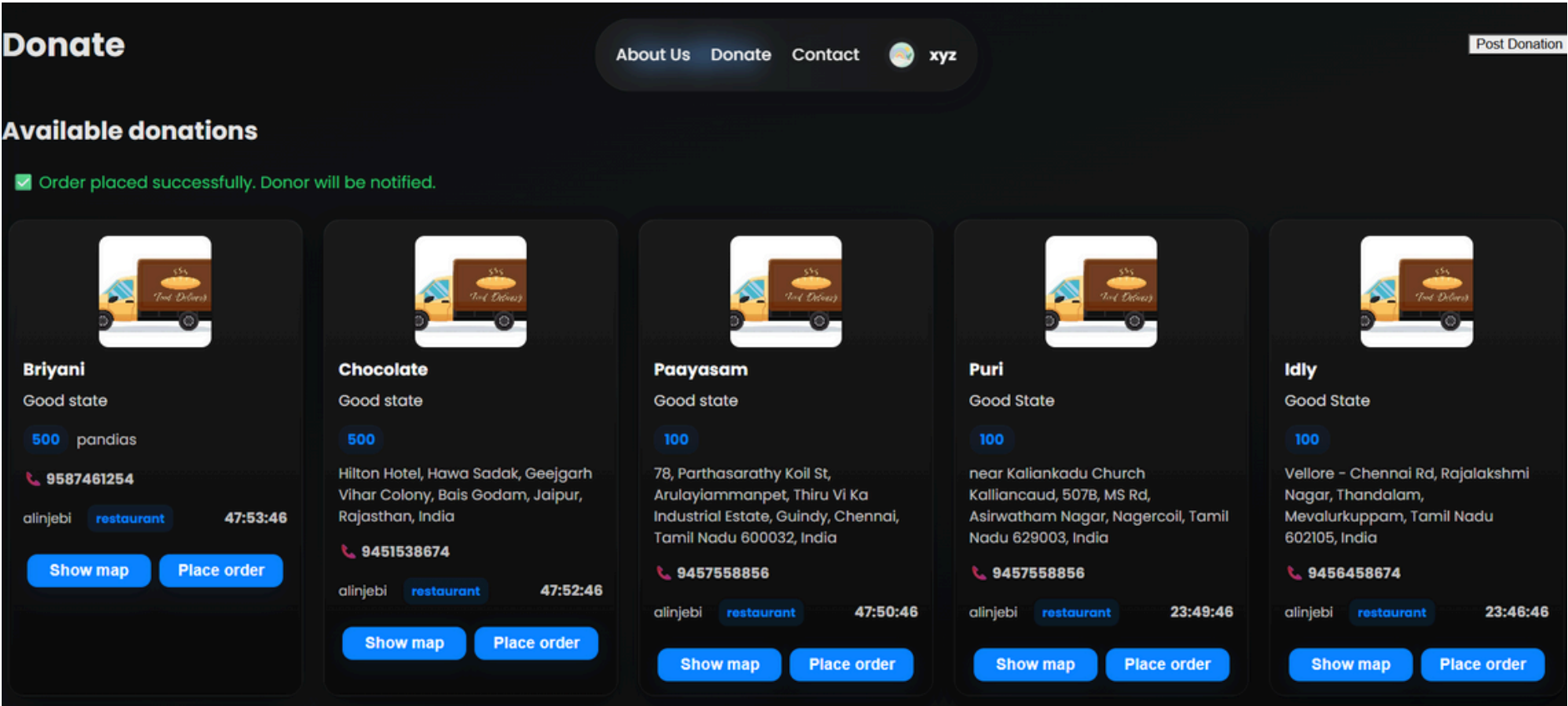
Order Placed

CONCULSION

- The ZeroBite system connects restaurants, event organizers, and NGOs to enable efficient redistribution of surplus food.
- It ensures that excess edible food reaches those in need safely and promptly.
- The platform allows donors to share precise pickup locations for easy coordination and faster collection.
- Expiry time tracking ensures all redistributed food remains fresh and safe for consumption.
- The system enhances efficiency and transparency in the food donation and collection process.
- Its simple and reliable design makes it easy for users to operate during time-critical situations.
- ZeroBite minimizes food wastage by redirecting surplus food to underprivileged communities.
- It actively supports hunger relief efforts and strengthens community engagement.
- The project encourages social responsibility and sustainability through technology.
- Overall, ZeroBite transforms food surplus into a social good, reducing both hunger and environmental impact.

FUTURE STEPS

- **Mobile Application Development**: Expand ZeroBite into mobile platforms for easy access and real-time food management.
- **AI-Based Expiry Prediction**: Use AI to predict food shelf life based on type, temperature, and storage conditions.
- **Real-Time Notification System**: Send instant alerts to donors and NGOs about new donations, approvals, or expiry reminders.
- **Blockchain for Transparency**: Track donation records securely to enhance trust and accountability in the redistribution process.
- **Multilingual and Accessibility Support**: Add multiple languages and accessibility features to make the system inclusive for all users.

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[2] Lagorio, A. et al. (2018) Food Waste Reduction in School Canteens: Evidence from an Italian Case, Journal of Cleaner Production.

[3] Food and Agriculture Organization (FAO). (2020) Technical Platform on Food Loss and Waste Measurement & Reduction.

[4] Kruthika, V. et al. (2023) Food Waste Management System in the Midst of a Food Crisis, IRJMETS Journal.

[5] Gallego-García, M. et al. (2023) Advances in Pretreatment of Food Waste and Lignocellulosic Residues, Bioresource Technology, 369.

[6] Panchal, V., Kuchekar, K., & Tambe, S. (2021) Availability of Food for NGO through Mobile Application: Food for All, IRJET Journal.

[7] Nawab, N.A. & Malik, H.R. (2022) Solving Food Wastage Issues Through BYOD Application, IEEE NCCC 2022.

[8] Raras, B. (2022) Household Food Waste Contribution in Indonesia, GoodStats Research Report.

[9] Mathisen, T. & Johansen, F. (2022) Impact of Smartphone Apps on Food Waste and Eating Habits, JMIR Formative Research.

[10] Närvänen, E., Mattila, M., & Mesiranta, N. (2021) Start-ups' Role in Circular Economy for Food Waste Reduction, Industrial Marketing Management.

REFERENCES

[11] Amicarelli, V. & Bux, C. (2021) Food Waste Measurement Toward a Fair and Sustainable System, British Food Journal.

[12] Mazzucchelli, A. et al. (2021) How to Fight Against Food Waste in the Digital Era, Journal of Business Research.

[13] Aierzhati, A. et al. (2021) Mobile Hydrothermal Liquefaction Reactor for Food Waste Conversion, Energy Conversion and Management: X.

[14] Ciccullo, F., Pero, M., Caridi, M., & Gosling, J. (2021) Circular Economy in Agri-Food Chains: Waste Prevention Tech., Resources, Conservation and Recycling.

[15] Annosi, M.C., Brunetta, F., & Barlattani, M. (2021) Digitalization Within Food Supply Chains to Prevent Waste, Industrial Marketing Management.

[16] Bajželj, B. et al. (2020) Reducing Food Waste for Resilient Food Systems, Ecosystem Services Journal.

[17] Read, Q.D. et al. (2020) Environmental Impacts of Halving Food Waste, Science of the Total Environment.

[18] Harvey, J., Smith, S., & Golightly, D. (2020) Food Sharing and Waste Reduction via Mobile Apps, Industrial Marketing Management.

[19] Kruthika, V. et al. (2023) Food Waste Management System in the Midst of a Food Crisis, IRJMETS Journal.

[20] Johnson, S.G.B. & Park, S.Y. (2022) Moral Signalling Through Donations of Money and Time, Behavioral Science Review.

Thank You

LITERATURE REVIEW

[1] Food Waste Reduction in School Canteens: Evidence from an Italian Case (2018)

Aspect	Details
Author	Lagorio, Alexandra, et al.
Summary	Investigated waste management in school canteens through monitoring and awareness strategies.
Relevance	Highlights the importance of tracking and feedback systems to reduce food waste.
Gaps	No digital or automated data tracking mechanisms.
Impact	Inspires use of data-driven tools for automation as implemented in ZeroBite.

LITERATURE REVIEW

[2] **Technical Platform on the Measurement and Reduction of Food Loss and Waste** (**2020**)

Aspect	Details
Author	Food and Agriculture Organization of the United Nations (FAO).
Summary	Focused on global strategies for measuring and preventing food loss and waste.
Relevance	Provides a theoretical foundation for digital redistribution systems.
Gaps	Lacks a practical web or app-based implementation.
Impact	Supports the creation of web-based platforms like ZeroBite for effective food management.

LITERATURE REVIEW

[3] **Availability of Food for NGO through Mobile Application: Food for All** (2021)

Aspect	Details
Author	Panchal, V., Kuchekar, K., and Tambe, S.
Summary	Developed a mobile application enabling NGOs to locate and request food donations.
Relevance	Demonstrates how digital tools can bridge the donor–NGO gap.
Gaps	Lacks expiry tracking, notifications, and live map integration.
Impact	Inspires ZeroBite's real-time database and geolocation modules.

LITERATURE REVIEW

[4] Solving Food Wastage Issues through BYOD Application (2022)

Aspect	Details
Author	Nawab, Naeem A., and Malik, Hamid Raza.
Summary	Introduced a BYOD-based donation system allowing easy user access via personal devices.
Relevance	Highlights convenience and flexibility in digital donation management.
Gaps	No automation or expiry validation for food safety.
Impact	Motivates inclusion of expiry management and auto-updates in ZeroBite.

LITERATURE REVIEW

[5] **Household Food Waste in Indonesia (2022)**

Aspect	Details
Author	Raras, B.
Summary	Reported that household sectors contribute most to food waste in Indonesia.
Relevance	Emphasizes public need for awareness and redistribution systems.
Gaps	Lacks a structured technological solution.
Impact	Validates ZeroBite's goal of promoting digital awareness and redistribution.

LITERATURE REVIEW

[6] The Impact of Smartphone Apps Designed to Reduce Food Waste (2022)

Aspect	Details
Author	Mathisen, T., and Johansen, F.
Summary	Analyzed how mobile applications influence user behavior toward waste reduction.
Relevance	Supports use of technology to encourage sustainable food practices.
Gaps	Limited real-world scalability.
Impact	Reinforces ZeroBite's community-based real-time food sharing model.

LITERATURE REVIEW

[7] **Start-Ups' Role in Moving Towards a Circular Economy** (2021)

Aspect	Details
Author	Närvänen, Elina, Mattila, Malla, and Mesiranta, Nina.
Summary	Examined how startups use digital solutions to prevent food waste.
Relevance	Highlights innovation and entrepreneurship in waste reduction.
Gaps	No real-time application shown.
Impact	Supports ZeroBite's potential as a scalable social-impact platform.

LITERATURE REVIEW

[8] **Food Waste Measurement Toward a Fair and Sustainable System** (2021)

Aspect	Details
Author	Amicarelli, Vera, and Bux, Christian.
Summary	Reviewed global techniques for food waste measurement.
Relevance	Stresses importance of systematic tracking in waste reduction.
Gaps	No live or automated monitoring tools.
Impact	Inspires ZeroBite's real-time monitoring and MySQL-based tracking.

LITERATURE REVIEW

[9] **How to Fight Against Food Waste in the Digital Era** (2021)

Aspect	Details
Author	Mazzucchelli, Alice, et al.
Summary	Studied success factors for digital food sharing platforms.
Relevance	Emphasizes automation, trust, and transparency in redistribution.
Gaps	No expiry or location validation system.
Impact	Encourages transparent food sharing systems like ZeroBite.

LITERATURE REVIEW

[10] Development of a Mobile Hydrothermal Liquefaction Reactor (2021)

Aspect	Details
Author	Aierzhati, Aersi, et al.
Summary	Proposed a mobile system for food waste conversion into bioenergy.
Relevance	Shows innovation in sustainable waste utilization.
Gaps	Focused on waste reuse, not redistribution.
Impact	Supports sustainability-driven technological applications like ZeroBite.

LITERATURE REVIEW

[11] **Implementing the Circular Economy in Agri-Food Supply Chains** (2021)

Aspect	Details
Author	Ciccullo, Federica, et al.
Summary	Discussed applying circular economy practices to reduce waste.
Relevance	Promotes efficiency and recycling in food systems.
Gaps	Industrial-level model, not consumer-level.
Impact	Reinforces the circular logic adopted in ZeroBite's redistribution model.

LITERATURE REVIEW

[12] **Digitalization within Food Supply Chains to Prevent Waste** (2021)

Aspect	Details
Author	Annosi, Maria Carmela, et al.
Summary	Explored digital tools and collaboration for waste prevention.
Relevance	Highlights how technology can enhance efficiency in food systems.
Gaps	No automation or expiry features.
Impact	Supports ZeroBite's real-time coordination design.

LITERATURE REVIEW

[13] **Reducing Food Waste for Resilient Food Systems** (**2020**)

Aspect	Details
Author	Bajželj, Bojana, et al.
Summary	Linked food waste reduction with system resilience and sustainability.
Relevance	Underlines the social and environmental benefits of waste prevention.
Gaps	No technological implementation discussed.
Impact	Strengthens ZeroBite's purpose as a sustainable redistribution tool.

LITERATURE REVIEW

[14] Assessing Environmental Impacts of Halving Food Waste (2020)

Aspect	Details
Author	Read, Quentin D., et al.
Summary	Evaluated how waste reduction lowers emissions and resource use.
Relevance	Demonstrates environmental value of redistribution systems.
Gaps	No real-time implementation model.
Impact	Reinforces ZeroBite's eco-friendly and data-driven approach.

LITERATURE REVIEW

[15] **Food Sharing, Redistribution, and Waste Reduction via Mobile Apps** (2020)

Aspect	Details
Author	Harvey, John, et al.
Summary	Analyzed how social networks improve food sharing efficiency.
Relevance	Highlights community participation in digital redistribution.
Gaps	No automation or expiry validation system.
Impact	Supports ZeroBite's focus on user connectivity and real-time updates.

LITERATURE REVIEW

[16] **Food Waste Management System in the Midst of a Food Crisis** (2023)

Aspect	Details
Author	Kruthika V., Lavanya H.R., Mahalakshmi, Ranju P.S.R., Priyanka H.L., and Sindhu K.S.
Summary	Designed a system for managing food during emergencies.
Relevance	Focuses on digital redistribution under crisis conditions.
Gaps	Missing expiry and GPS modules.
Impact	Encourages ZeroBite's automated validation and map integration.

LITERATURE REVIEW

[17] **Moral Signalling Through Donations of Money and Time** (2022)

Aspect	Details
Author	Johnson, Samuel G.B. and Park, Seo Young.
Summary	Studied motivation and moral reasoning behind digital donations.
Relevance	Emphasizes the human and ethical side of donation systems.
Gaps	No technological aspect implemented.
Impact	Validates ZeroBite's transparent and socially responsible approach.