Survey of Development of ZeroWasteEats: Optimizing Every Bite for a Greener Future using Flutter and AI

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Abstract - Globally, an estimated 1.3 billion tons of food are wasted every year, leading to environmental and food security concerns. This waste significantly impacts food security and contributes to environmental problems such as greenhouse gas emissions and excessive resource consumption. "ZeroWasteEats" is an innovative mobile application designed to streamline food redistribution by connecting food donors, including restaurants, grocery stores, and households, with NGOs and communities in need. The app incorporates advanced features such as real-time inventory tracking, AI-powered expiration alerts, and optimized delivery routes to ensure timely and efficient food distribution. This study explores the app's design, development methodology, and anticipated impact on minimizing food waste and promoting sustainable consumption habits.

Keywords— *Food waste, NGOs, Sustainable consumption, Food donation, Redistribution, Artificial Intelligence, Mobile App, Logistics Optimization.*

INTRODUCTION

The global food system faces two paradoxical challenges: widespread hunger and excessive food waste. According to the Food and Agriculture Organization (FAO), nearly one-third of all food produced globally is wasted, leading to significant economic and environmental repercussions. An estimated 8–10% of global greenhouse gas emissions stem from food waste, significantly impacting climate change, making it a major factor in climate change. At the same time, millions of people struggle with food insecurity and malnutrition.

To address this challenge, "ZeroWasteEats" offers a technology-driven solution that enables real-time coordination between food donors and NGOs. This digital platform ensures surplus food is efficiently managed and redistributed before spoilage. By leveraging AI for predictive analysis and optimized logistics, "ZeroWasteEats" enhances efficiency in food distribution, minimizes waste, and fosters a culture of responsible food consumption.

LITERATURE REVIEW

A. Food Waste and Its Impact

Food waste not only exacerbates hunger but also depletes natural resources. Studies reveal that wasted food accounts for approximately 25% of freshwater consumption and occupies nearly 30% of agricultural land worldwide. Additionally, food waste in landfills releases methane, a potent greenhouse gas. Beyond environmental concerns, food waste contributes to financial losses exceeding $1 trillion annually.

B. Role of NGOs in Food Redistribution

NGOs play a vital role in food recovery and redistribution. Organizations such as Feeding America and the United Nations World Food Programme work tirelessly to collect and distribute surplus food to underserved communities. However, challenges such as inefficient tracking, coordination issues, and logistical constraints hinder their efforts. The implementation of digital platforms like "ZeroWasteEats" can address these inefficiencies, allowing NGOs to manage food donations more effectively.

C. Technology in Food Waste Management

Recent technological advancements have paved the way for AI-driven food inventory management, blockchain-based donation tracking, and mobile applications that facilitate food redistribution. While many existing solutions focus on

individual food waste reduction, few provide a holistic approach for large-scale redistribution involving NGOs, businesses, and food donors. "ZeroWasteEats" fills this gap by integrating AI, real-time inventory tracking, and optimized logistics.

RESEARCH GAP

Despite numerous efforts to tackle food waste, existing solutions lack a holistic approach tailored for large-scale NGO-driven food redistribution. Most mobile applications focus on individual household food tracking or commercial waste reduction, leaving a gap in real-time, AI-driven food donation management.

Key challenges include inefficient inventory tracking, lack of coordination between donors and NGOs, and suboptimal food delivery logistics. Current platforms fail to integrate AI-based expiration alerts and GPS-optimized distribution routes.

ZeroWasteEats fills this gap by providing a scalable, technology-driven solution that ensures efficient, data-backed food redistribution, reducing waste while improving food security for underprivileged communities.

STATEMENT OF THE PROBLEM

NGOs face significant challenges in food distribution, including:

- Lack of Real-Time Inventory Tracking: Many NGOs rely on manual record-keeping, leading to delays and inefficiencies.
- Inefficient Coordination: Donors and recipients struggle with communication and logistics, often leading to food waste.
- Inadequate Expiration Alerts: Without real-time expiration monitoring, donated food often spoils before redistribution.
- Logistical Barriers: Poorly optimized transportation and delivery routes hinder efficient food redistribution.

The challenge is to develop a mobile solution that addresses these issues effectively while ensuring minimal food waste and timely distribution to the needy.

OBJECTIVE OF THE STUDY

The primary objective of ZeroWasteEats is to develop a mobile application that optimizes food redistribution by connecting food donors, NGOs, and underprivileged communities. The app aims to:

- Reduce food waste by facilitating real-time tracking of surplus food.
- Implement AI-driven expiration alerts to ensure food is distributed before spoilage.
- Streamline donation matching by automatically connecting donors with nearby NGOs.
- Enhance logistics efficiency using Google Maps API for optimized delivery routes.
- Promote sustainable food consumption and raise awareness about food waste management.

Ultimately, the project seeks to improve food security and reduce environmental impact through technology-driven solutions.

SCOPE AND LIMITATIONS

A. Scope

The ZeroWasteEats project aims to create a mobile application that optimizes food redistribution by connecting food donors, NGOs, and recipients in need. The app will provide:

- Real-time Inventory Tracking: Donors can list surplus food, and NGOs can track available supplies.
- AI-Driven Expiration Alerts: AI algorithms will monitor food expiration dates to prevent wastage.
- Donation Matching System: The app will automatically match food donors with nearby NGOs or individuals.
- Optimized Delivery Routes: Google Maps API will ensure efficient logistics and food distribution.
- User Roles & Authentication: Separate portals for NGOs, donors, and volunteers to streamline operations.
- Data Analytics & Reporting: Insights on food donations, waste reduction, and impact assessment.
- Scalability: Initially targeting NGOs and restaurants, with potential expansion to government food programs and corporate CSR initiatives.

B. Limitations

- User Engagement: The success of the app depends on active participation from food donors and NGOs. Low adoption rates could affect efficiency.
- Technological Accessibility: Some NGOs may lack the necessary technology or training to use the app effectively.
- Data Accuracy: AI-based expiration alerts and donation matching rely on accurate user input; incorrect data entry may impact food distribution.
- Internet Dependency: The app requires a stable internet connection for real-time updates, which may not be available in some rural areas.
- Initial Adoption Barriers: Restaurants and donors may be hesitant to use a new system without incentives or government support.

METHODOLOGY

The development of ZeroWasteEats follows a structured methodology to ensure a well-researched and effective solution for food waste management.

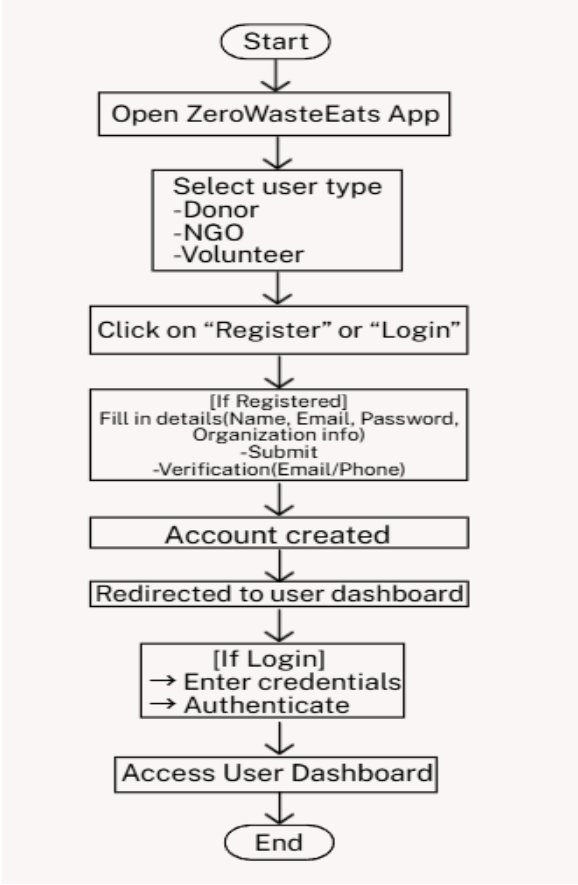
1. Research and Requirement Analysis

- Conduct a literature review on food waste, existing redistribution models, and challenges faced by NGOs.
- Gather data through surveys and interviews with NGOs, restaurants, and food donors to understand their needs.
- Identify key technological solutions such as AI for expiration tracking and GPS for optimized delivery routes.

2. Design and Development

- UI/UX design will be created using Figma to ensure user-friendly navigation.

Figure 1: User Registration Flow



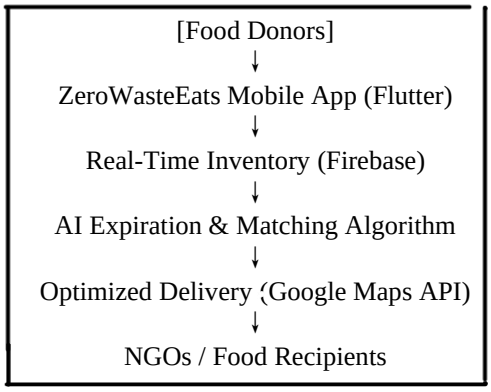
- The mobile app will be developed using Flutter, with Dart as the primary programming language.
- Firebase will be used for real-time data synchronization and inventory tracking.
- AI algorithms will be integrated for food expiration prediction and donation matching.
- Google Maps API will enable location tracking and route optimization for deliveries.

3**. Testing and Deployment**

- Beta testing will be conducted with selected NGOs to gather feedback.
- Performance evaluation will focus on reducing food waste, improving logistics, and user satisfaction.
- After refining based on feedback, the app will be deployed and monitored for future improvements.

This methodology ensures an efficient, scalable, and impactful food redistribution platform.

Figure 2: System Architecture for ZeroWasteEats



TOOLS AND TECHNIQUES

To develop **ZeroWasteEats**, we will utilize various tools and technologies for efficient design, development, and deployment:

- **Flutter:** A cross-platform framework for building a user-friendly mobile application compatible with Android and iOS.
- **Firebase:** A cloud-based real-time database for storing and managing food donations, user data, and transaction history.
- **Dart:** The programming language for writing clean and maintainable Flutter code.
- **Figma:** A UI/UX design tool for wireframing and prototyping the app's interface.
- **AI Algorithms:** Used for food expiration tracking and donation matching to reduce waste.
- **Google Maps API:** Enables GPS-based tracking and optimized routing for food deliveries.
- **Node.js & Express.js:** Backend technologies for managing API requests and database interactions.
- **Git & GitHub:** Version control system for collaborative development.
- **JIRA/Trello:** Project management tools for tracking progress and assigning tasks.
- **Postman:** API testing tool to ensure seamless integration of backend services.

These tools will ensure an efficient, scalable, and well-optimized food redistribution platform.

WORK PLAN

The development of **ZeroWasteEats** will be completed within six months, progressing through research, design, and implementation phases.

- **Month 1:** Conduct research on food waste management and analyze existing solutions.
- **Month 2:** Gather requirements, finalize features, and design the UI/UX using Figma.
- **Month 3:** Begin app development using Flutter and integrate Firebase for database management.
- **Month 4:** Implement AI-driven food expiration alerts and optimize logistics with GPS tracking.
- **Month 5:** Conduct beta testing with NGOs and refine the application based on feedback.
- **Month 6:** Finalize development, deploy the app, and evaluate its effectiveness.

IMPLICATIONS

The "ZeroWasteEats" platform has significant social, environmental, and economic implications. By addressing food waste through technology-driven food redistribution, the app creates a structured and efficient system that benefits multiple stakeholders.

-Social Implications

The platform empowers NGOs, food donors, and communities, ensuring that surplus food reaches those in need. By facilitating real-time tracking and optimized logistics, it enhances food security and reduces hunger. The app fosters a culture of responsible consumption and encourages businesses to contribute actively to food donation initiatives.

-Environmental Implications

Food waste contributes to landfill overflow and greenhouse gas emissions, accelerating climate change. By reducing food waste, ZeroWasteEats helps lower methane emissions, conserve resources like water and energy, and decrease the overall environmental footprint of food production.

-Economic Implications

Businesses and NGOs can save money by optimizing food usage and reducing disposal costs. Additionally, restaurants, grocery stores, and food suppliers can benefit from tax incentives and reduced waste management expenses. The app also creates potential job opportunities in logistics and food distribution.

Overall, ZeroWasteEats is a scalable and impactful solution that contributes to global sustainability goals, aligning with the UN's Sustainable Development Goals (SDGs).

EXPECTED CONCLUSIONS

The "ZeroWasteEats" project presents an innovative approach to tackling the critical issue of food waste through technology-driven solutions. By integrating Flutter for cross-platform compatibility, AI for expiration tracking, and GPS for optimized logistics, the application ensures that surplus food is efficiently redistributed to those in need. The app bridges the gap between food donors, NGOs, and recipients, addressing major challenges such as lack of real-time inventory tracking, inefficient coordination, and logistical barriers.

This study highlights the significance of leveraging digital tools to enhance food donation processes, minimize spoilage, and promote sustainable consumption. The implementation of AI-driven expiration alerts and optimized delivery routes will not only reduce food waste but also create a more structured and effective redistribution network. By conducting beta testing with NGOs and food providers, the platform's impact on reducing food insecurity and environmental waste can be measured.

In the future, the integration of blockchain for improved traceability and expansion to government-supported food programs could further enhance the platform's reach. Ultimately, ZeroWasteEats serves as a scalable, efficient, and impactful solution in the fight against food waste, contributing to global sustainability goals and fostering responsible food consumption habits.

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