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A Digital Framework for Efficient Food Donation Management

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Abstract: ***Food wastage and inefficient distribution of surplus food continue to be major social challenges, especially in developing countries, where large quantities of edible food are discarded while many people face food insecurity. To address this gap, this paper proposes a AI Integrated digital framework for efficient food donation management using the MERN stack. The proposed system provides a centralized web-based platform that connects food donors such as restaurants, event organizers, and households with verified NGOs and volunteers in real time. Using the MERN stack (MongoDB, Express.js, React.js, and Node.js) and Gen AI, the framework ensures scalability, secure data handling, and responsive user interaction. Key features include donor and receiver registration by admin that ensures user safety check , real-time food request and acceptance, location-based matching, status tracking, and administrative monitoring to ensure transparency, authenticity and accountability. Unlike traditional manual or semi-automated donation systems, the proposed framework minimizes delays, reduces food spoilage, and improves coordination among stakeholders. The system also supports data analytics for tracking donation patterns and measuring social impact. Overall, this digital framework aims to reduce food waste, enhance operational efficiency in food donation processes, and contribute to sustainable social welfare through modern web technologies.***

Keywords: Food Donation Management System, Food Waste Reduction, Digital Platform,AI integrated MERN Stack, Web Application, Surplus Food Redistribution, NGO Coordination, Sustainable Development, Real-Time Monitoring, Social Welfare Technology.

I. INTRODUCTION

Food wastage is a major global challenge with serious social, economic, and environmental consequences. Large quantities of edible food are wasted daily at households, restaurants, social events, and food service industries, while a significant portion of the population continues to suffer from hunger and food insecurity, especially in developing countries. Traditional food donation practices are mostly manual and fragmented, relying on informal communication and limited coordination among donors, non-governmental organizations (NGOs), and volunteers. Due to the absence of real-time tracking, transparency, and centralized management, these methods often lead to delays in food distribution and increased food spoilage.The rapid advancement of digital technologies has created new opportunities to improve food donation and surplus food redistribution. Digital platforms can effectively connect donors and receivers, enable real-time communication, and enhance accountability in donation processes. However, many existing systems lack scalability, seamless integration, and user-friendly interfaces, limiting their practical impact. To address these challenges, modern full-stack web technologies provide a reliable foundation for developing efficient and scalable solutions.

This paper proposes a digital framework for efficient food donation management using the MERN stack with AI Integration, which offers a centralized and transparent platform for managing food donations. The proposed system enables donors to share surplus food information, allows NGOs and receivers to accept donations in real time, and supports volunteers in coordinating food delivery. By leveraging the MERN stack, the framework ensures scalability, secure data handling, and responsive user interaction, ultimately reducing food waste and contributing to sustainable social welfare.

II. LITERATURE SURVEY

Food Wastage Reduction Through Donation (2018) by Jethwa et al. [1] presented a web-based food donation portal that connects restaurants and institutions with charitable organizations to reduce surplus food wastage. The system allowed donors to post food donation requests online, but it lacked real-time location tracking and automated coordination, resulting in limited efficiency.

Re-Food: Digital Platform-based Innovation Solutions for National Food Waste Problems (2021) by Pramana et al. [2] proposed a digital platform focusing on social enterprise and public awareness to address large-scale food waste issues.

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While the study highlighted the importance of digital platforms in food waste management, it primarily emphasized business models rather than real-time operational management.

Seva: A Food Donation App for Smart Living (2021) by Varghese et al. [3] introduced a mobile application that enables users to visualize available food resources within their local communities. The system incorporated location and time constraints to maintain food freshness, but it lacked centralized monitoring and scalability for large user bases.

Development of Leftover Food Management System Using Efficient Hunger Search Techniques (2021) by Naveen Kumar et al. [4] proposed a location-based system to match food donors and receivers efficiently. The hunger search algorithm improved response time and reduced food waste; however, the system required further integration and scalability enhancements.

Understanding Food Waste-Reducing Platforms: A Mini-Review (2022) by Oroski and da Silva [5] reviewed various digital platforms aimed at food waste reduction. The study identified key challenges such as stakeholder coordination, trust, and scalability, emphasizing the need for integrated and user-friendly digital solutions.

AI-FEED: Prototyping an AI-Powered Platform for the Food Charity Ecosystem (2024) by Sammer et al. [6] proposed an advanced platform integrating artificial intelligence and blockchain technologies to enhance transparency and decision-making in food donation systems. Despite its effectiveness, the complexity and higher implementation cost limited its adoption for small-scale organizations.

III. PROPOSED SYSTEMS

The proposed system, “Digital Framework for Efficient Food Donation Management using MERN Stack with AI integration”, provides a centralized web-based platform to manage surplus food donations efficiently. The system integrates a Retrieval-Augmented Generation (RAG) framework using Gemini Flash 2.5 as the Large Language Model and Pinecone as the vector database for semantic retrieval and intelligent response generation.The system connects food donors such as restaurants, households, and event organizers with NGOs and volunteers to ensure timely food redistribution. By replacing manualcoordination with a digital solution, the framework reduces delays and minimizes food wastage. The system is developed using the MERN stack and Gen AI, where React.js handles the user interface, Node.js and Express.js manage server-side operations, and MongoDB stores user and donation data and an LLM model is used to build chatbot that can help and assist the users and answer the queries about the food safety. Donors can post surplus food details, NGOs can accept requests, volunteers assist in food delivery, and administrators monitor and manage system activities. The platform supports real-time updates and role-based access to ensure transparency and smooth coordination.

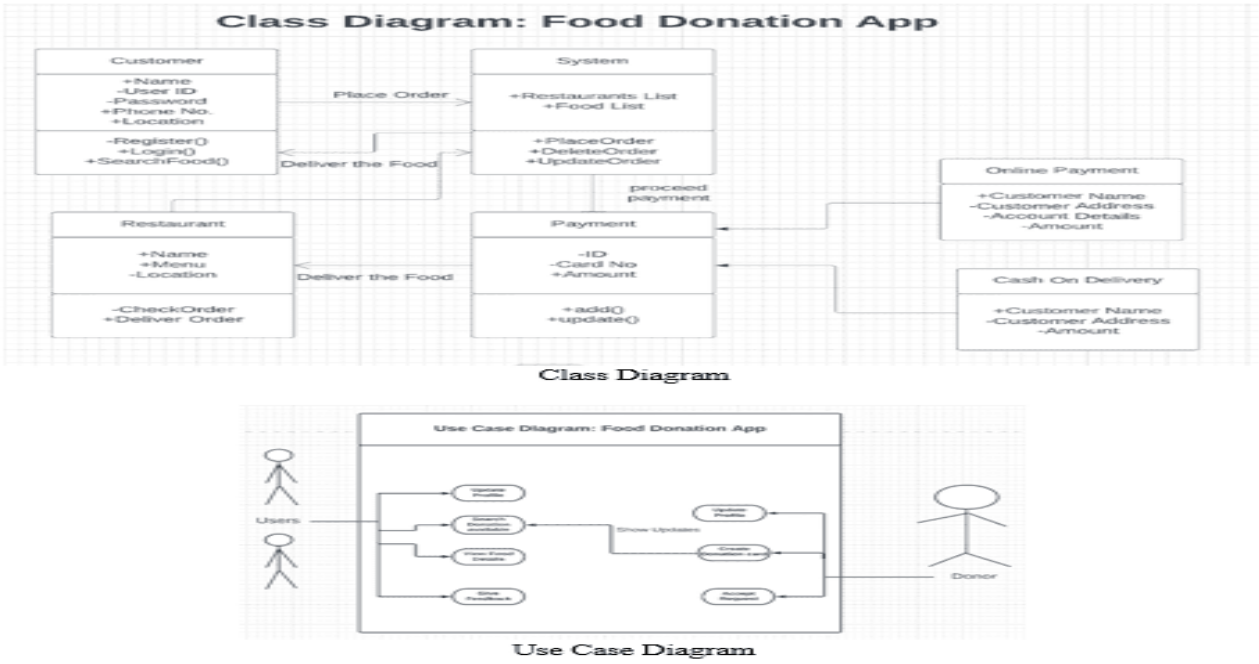
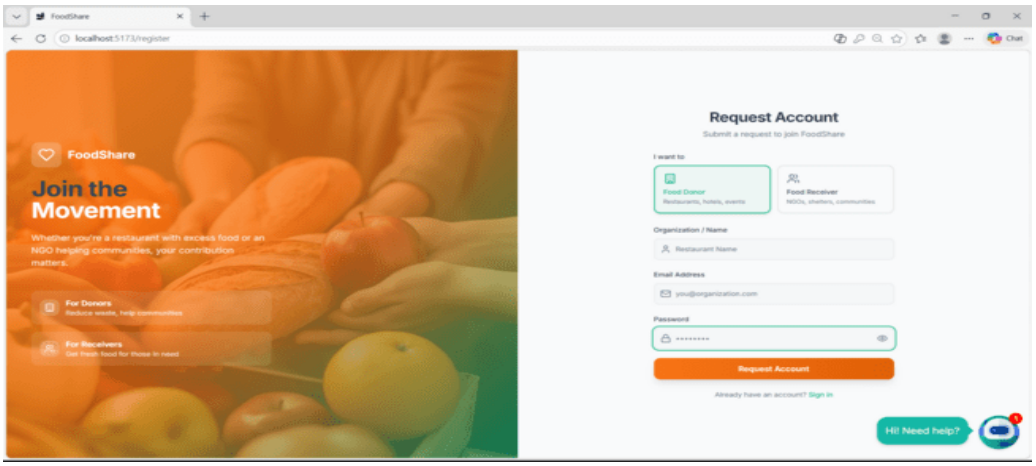
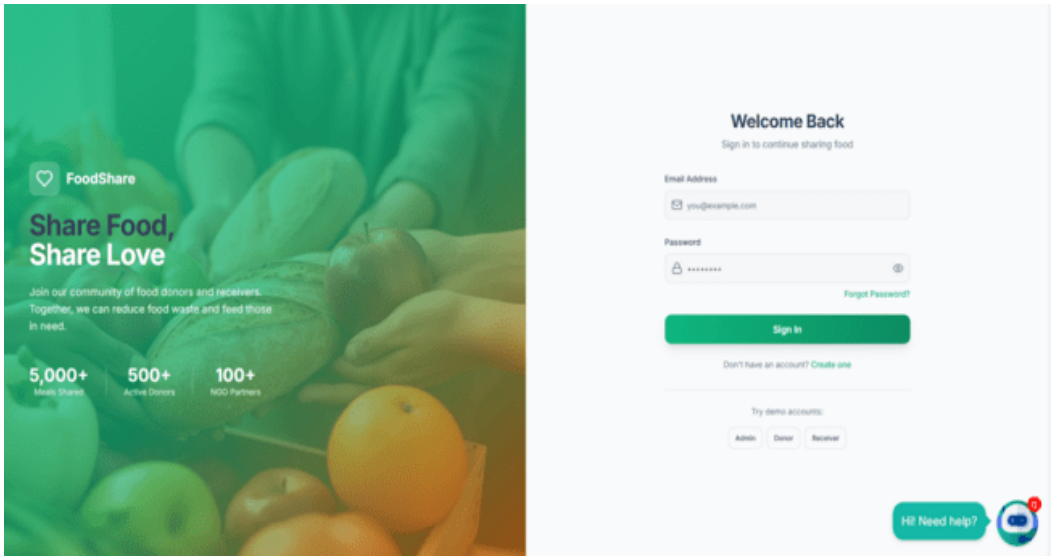
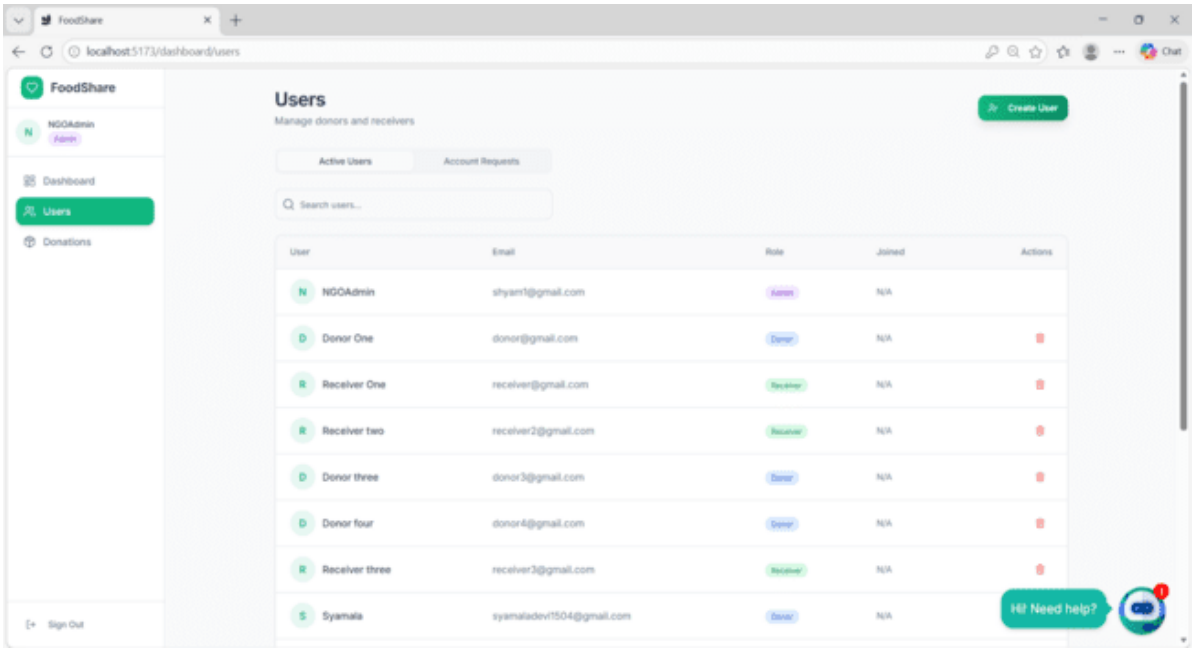


Figure 1:Class & Use Case Diagram


FoodShare
Join the Movement
Request Account
Submit a request to join FoodShare
Request Account
Hi! Need help?


FoodShare
Share Food, Share Love
5,000+
500+
100+
Welcome Back
Sign in to continue sharing food
Sign In
Hi! Need help?


FoodShare
Users
Manage donors and receivers
Create User
Dashboard
Users
Donations
Hi! Need help?

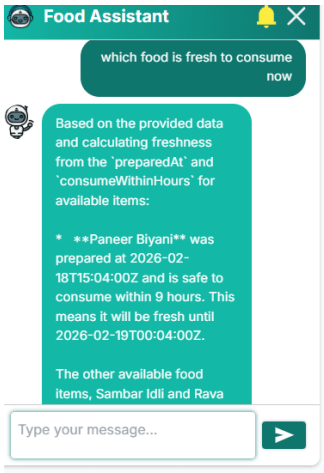


Figure 2: Implementation

IV. WORKFLOW STEPS

1) Users (donors, NGOs, volunteers) register and log in to the system.
2) Donors upload surplus food details through the web application.
3) The system displays available donations to nearby NGOs or receivers.
4) NGOs accept suitable food donations.
5) Volunteers collect and deliver the food.
6) Donation status is updated in real time and monitored by the admin.
7) Fully digital and centralized process
8) Real-time coordination using MERN stack
9) Reduced manual effort and food wastage
10) Transparent and efficient food donation management.

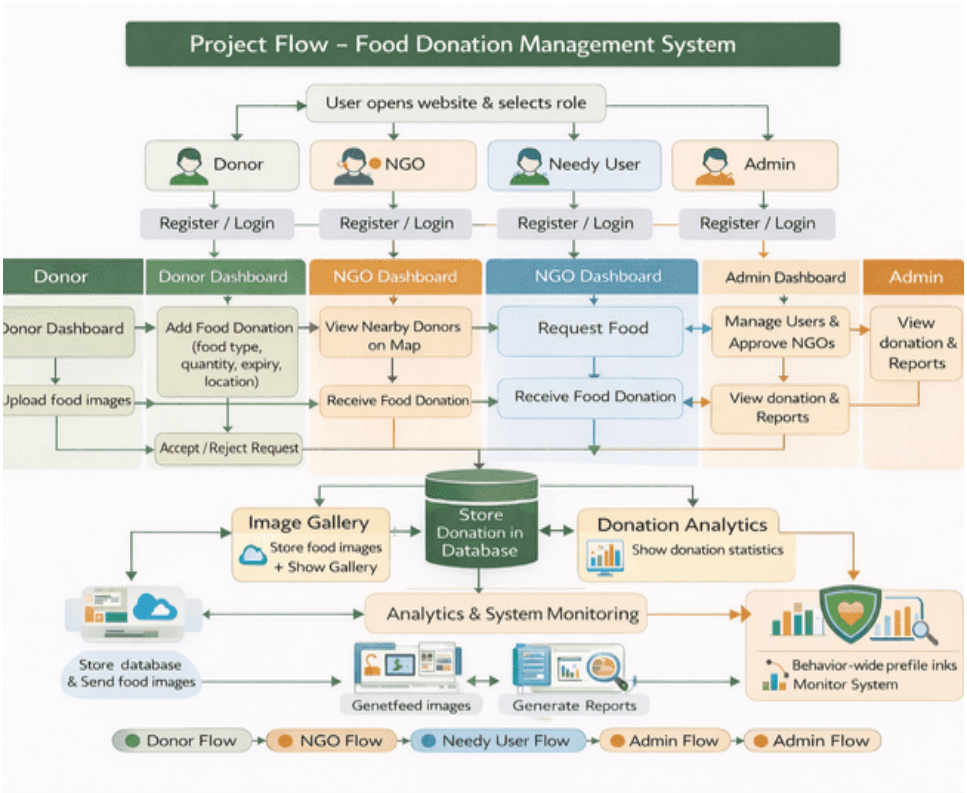


Figure 3: Project Workflow

V. RESULTS & DISCUSSIONS

1) The proposed AI-integrated food donation system was tested using multiple donation scenarios to evaluate its performance and reliability.
2) Different types of donation inputs, including small, medium, and bulk quantities, were provided to analyze system scalability and response behavior.
3) To ensure system security and authenticity, only the administrator was authorized to create donor and receiver accounts after conducting proper verification and safety checks.
4) When donors uploaded food details, the AI-powered chatbot enhanced user experience by answering queries related to food freshness, safety status, and real-time availability of donations. This reduced ambiguity and improved communication between donors and NGOs.
5) Overall, the system demonstrated enhanced efficiency, transparency, and reliability compared to traditional coordination methods.

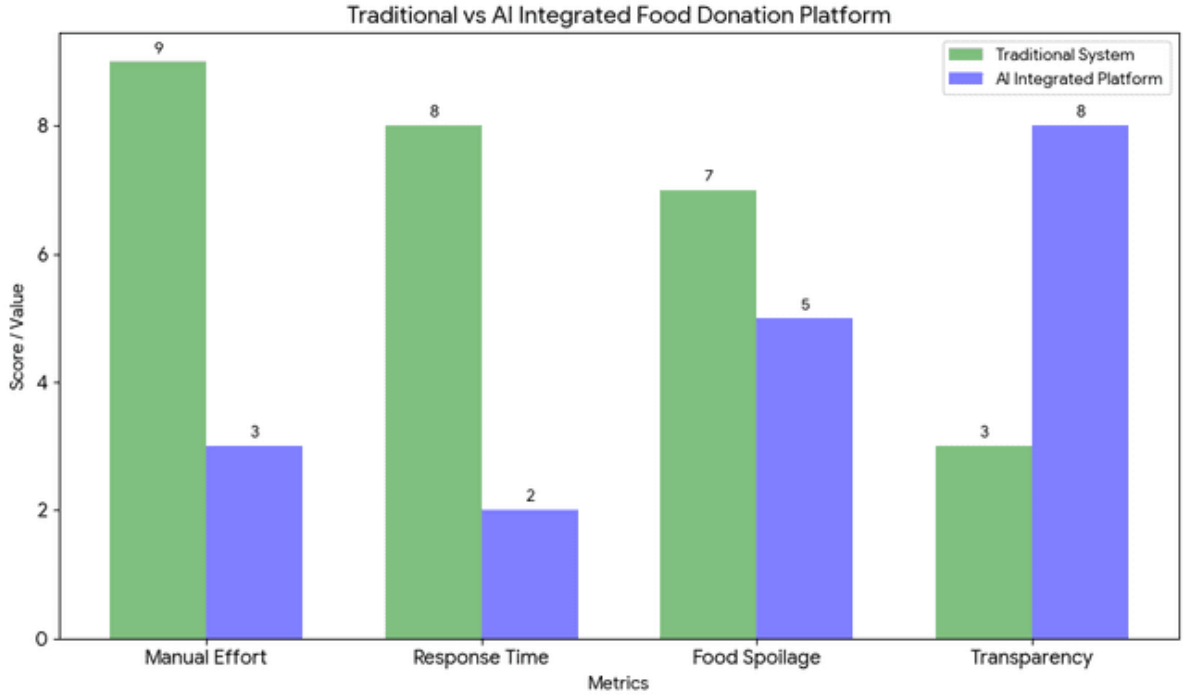


Figure 4: Graphical Representation

VI. GRAPH INTERPRETATION

1) Lower values in response time, food spoilage, and manual effort indicate improved efficiency of the AI-integrated system compared to the traditional approach.
2) Higher transparency reflects better monitoring, accountability, and trust in the proposed food donation platform.

VII. FUTURE INSIGHTS

1) The proposed AI-integrated food donation system can be further enhanced by incorporating advanced technologies such as microservices architecture using Go or Python-based AI modules for improved performance and scalability.
2) In addition to the web-based platform, the system can also be extended into a dedicated mobile application so that users can directly access the platform from their smartphones.
3) This will improve accessibility and allow donors and NGOs to post and accept food donations in real time from anywhere.
4) Integration of computer vision techniques can enable automated food quality assessment, while blockchain technology can improve transparency and trust in donation tracking.
5) Additionally, IoT-based temperature monitoring systems can ensure food safety during storage and transportation.

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6) These advancements can transform the current framework into a scalable, intelligent, and fully automated food redistribution ecosystem, contributing more effectively to sustainable development goals.

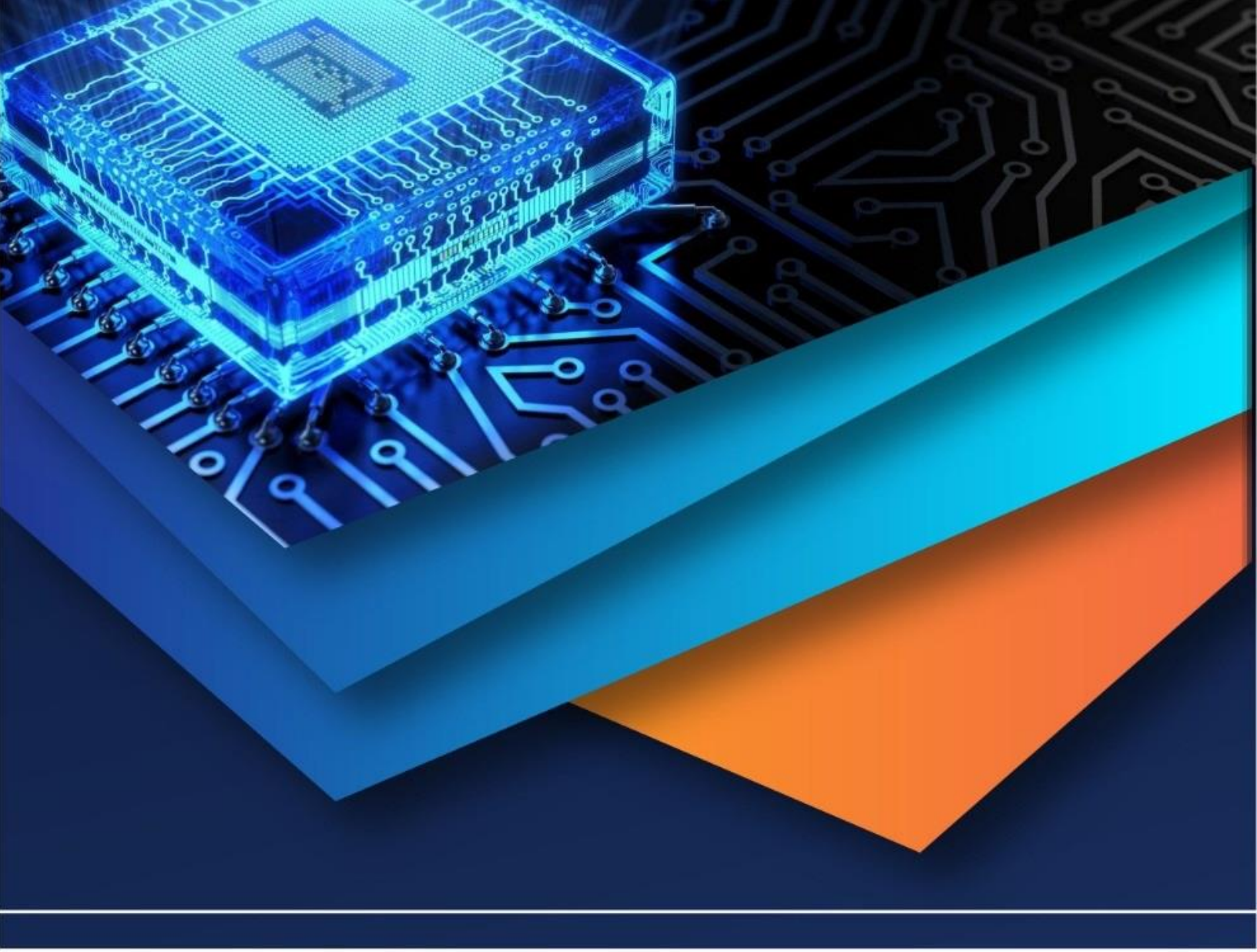
VIII. CONCLUSION

This project focuses on solving the problem of food wastage by providing a simple and effective digital solution for food donation management. By using anAI-Integrated MERN stack–based web application, the system makes it easy for donors to share surplus food, for NGOs to receive it on time, and for volunteers to help in delivery. The platform reduces manual effort, improves coordination, and ensures transparency in the donation process. Overall, the project shows how modern web technologies can be used practically to support social welfare and reduce food waste in an efficient and meaningful way.

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