

AI-Food Expiry Tracker and Smart Recipe Suggestion

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Abstract- The AI-Based Food Expiry Tracker and Smart Recipe Suggestion System is a web-based platform developed to intelligently monitor food items, predict expiry dates, and suggest suitable recipes based on available ingredients. The system operates through three major components — user, business, and admin — each offering specialized functionalities for food tracking, recipe generation, and system management. Food items can be added manually or through smart logging, and users receive timely notifications before items expire. The integrated AI module enhances usability by analyzing ingredient combinations and recommending region-specific Indian recipes to prevent wastage. For efficient and reliable performance, the system architecture incorporates technologies such as PHP, Laravel, HTML, CSS, JavaScript, MySQL, and Python for AI and machine learning integration. This project presents a scalable and sustainable model that addresses the growing issue of food wastage by promoting intelligent kitchen management and mindful consumption.

Keywords- Artificial Intelligence, Food Expiry Tracking, Recipe Recommendation, Machine Learning, Sustainable Living, Web Application.

I. INTRODUCTION

In the modern era, efficient food management has become a critical concern for both households and commercial establishments. Conventional tracking methods, which depend largely on manual logging or paper-based records, are often time-consuming, error-prone, and ineffective, resulting in significant food wastage and poor inventory organization [1]. To overcome these challenges, this study introduces an innovative web-based platform titled “AI-Based Food Expiry Tracker and Smart Recipe Suggestion System” [1], designed to provide a reliable, intelligent, and secure approach to managing food inventories.

The proposed platform integrates artificial intelligence to deliver a centralized, user-friendly environment accessible to all users at any time. It supports three distinct user roles—household users, business users, and administrators—each assigned specific responsibilities and privileges. Household users can register grocery items, record purchase and expiry details, and receive automated alerts prior to product expiration. Business users, including restaurants and grocery outlets, can maintain large-scale inventories and obtain automated suggestions for discounts on products approaching expiry.

Administrators manage the overall platform, overseeing user accounts, AI model performance, and system security [2] to ensure smooth and reliable operation.

A key innovation of the system lies in its AI-powered expiry prediction and recipe recommendation engine. By intelligently estimating the shelf life of commonly used Indian ingredients such as milk, paneer, bread, and vegetables, the system minimizes food spoilage and promotes mindful consumption. Through Natural Language Processing (NLP), the system analyzes available ingredients to provide personalized and region-specific recipe recommendations. Additionally, an optional smart logging feature integrates with UPI transactions to automatically record grocery purchases and update the inventory, reducing manual effort and improving automation [3].

From a technical standpoint, the platform employs a modern technology stack to ensure scalability and reliability. The backend is developed using PHP (Laravel), while the frontend is built with React.js, supported by Bootstrap, HTML, CSS, and JavaScript for a responsive and interactive interface [7][11]. MySQL serves as

hedatabaseforstructuredstorageofuserandinventorydata [9][10], while Python is used for implementing AI modules responsible for expiry prediction and recipe generation [2][3]. Together, these technologies create a robust and sustainable system that leverages artificial intelligence to improve food management, reduce wastage, and encourage sustainable consumption practices.

II. LITERATURE REVIEW

The growing need for efficient household and commercial food management has led to increasing interest in intelligent web-based platforms that streamline inventory tracking and minimize wastage. Traditional methods of managing groceries and ingredients, which often rely on manual logging or paper-based records, are prone to errors, time-consuming, and inefficient. In response, web-based systems have been developed to allow users, businesses, and administrators to register, track, and manage food items with greater accuracy and convenience. Such platforms aim to reduce manual effort, enhance operational efficiency, improve data security, and ensure timely utilization of resources. To maintain a well-organized and secure system, most contemporary platforms implement role-based access, user authentication, and administrative oversight. For example, users may only add inventory items after proper validation, which maintains data integrity and prevents unauthorized entries. Additionally, categorization of items by type, expiry date, or usage enhances usability and allows for quick retrieval of relevant information. Recent systems have also leveraged artificial intelligence for predictive inventory management, automated alerts, and intelligent suggestions, further increasing efficiency and reliability.

A Role of Artificial Intelligence in Smart Kitchen Management

Artificial intelligence has become an integral component in modern food management systems, enabling personalized recommendations and operational assistance. In this project, AI modules are employed to predict the shelf life of commonly used ingredients such as milk, paneer, bread, and vegetables, while also suggesting suitable recipes based on available items. The AI system utilizes natural language processing to analyze ingredient inventories and provide personalized, context-aware recipe recommendations, promoting resourceful usage and minimizing food wastage. A rule-based AI assistant further supports users by offering guidance on logging items, monitoring expiry dates, and troubleshooting common issues, ensuring smooth

interaction even for users with limited technical expertise [2][3].

B. Administrative Control and Security

Robust administrative oversight is essential for maintaining the platform's integrity, managing user accounts, and monitoring AI functionalities. Administrators are responsible for approving business access, regulating content and inventory entries, and ensuring secure data management. This structured control not only guarantees accurate inventory records but also helps prevent unauthorized access, enabling a reliable and trustworthy environment for both household and commercial users [1].

C. Item Classification and User Accessibility

To address diverse user needs, the platform classifies items and notifications based on urgency, expiry, and usage patterns. Household users receive personalized alerts for individual grocery items, while businesses can manage bulk inventories and obtain automated discounts suggestions for near-expiry products. This dual-focused approach ensures accessibility, encourages efficient food utilization, and supports sustainable consumption practices [1][2].

In conclusion, existing literature underscores the benefits of web-based platforms augmented with artificial intelligence and administrative oversight for efficient resource management. By integrating predictive AI, role-specific functionalities, and intuitive categorization, this project builds upon these principles to create an intelligent, user-friendly system that enhances food inventory management and reduces waste across households and businesses.

III. PROPOSED METHODOLOGY

The development of the AI-Based Food Expiry Tracker and Smart Recipe Suggestion System follows a structured methodology encompassing requirement analysis, design, implementation, and deployment to ensure a secure, efficient, and user-friendly platform [1][2]. The process begins with a detailed requirement analysis to identify the needs of household users, business users, and administrators, defining both functional and non-functional specifications. Role-based access control enables administrators to manage user accounts and monitor inventories, business users to handle bulk

stock and automated discount suggestions, and household users to log grocery items and receive timely expiry alerts. Items are further categorized to provide personalized recommendations, enhancing usability and promoting optimal food utilization.

The system leverages a modern technology stack to deliver a robust and responsive application. The backend is built using PHP Laravel for server-side logic, authentication, API management, and database interactions, while MySQL securely stores user details, inventory records, AI predictions, and transactional data. The frontend, developed with React.js, ensures a responsive and intuitive interface, complemented by Bootstrap for design consistency. AJAX and jQuery facilitate seamless asynchronous communication between the frontend and backend, enabling real-time updates without page reloads. Python-based AI modules are integrated to predict the shelf life of ingredients and generate personalized recipe suggestions, providing intelligent guidance to users [2][3].

Rigorous testing is conducted throughout the development lifecycle to ensure reliability and security. Unit testing validates individual components, integration testing confirms smooth interaction between modules, and system testing verifies that the application meets all functional and performance requirements. Security testing safeguards sensitive data and prevents unauthorized access. Finally, the platform is deployed on a scalable web server, supporting concurrent usage by multiple users and allowing continuous updates based on feedback and evolving requirements. This methodology ensures a maintainable, efficient, and AI-assisted system for intelligent food inventory management and waste reduction [1][2].

IV. SYSTEM DESIGN AND IMPLEMENTATION

The structured, role-based architecture of the AI-Based Food Expiry Tracker and Smart Recipe Suggestion System [1][2] ensures scalability, secure management, and efficient operation for both household and business food inventories. The system is built around three major components: the inventory management module, an AI-powered recipe and expiry prediction engine, and an administrative module for monitoring and control. Its three-tier architecture, comprising the database layer, application layer (backend), and

presentation layer (frontend), allows for flexible expansion, maintainability, and seamless integration of AI capabilities [2][3].

A. System Design

The primary goal of the system's design is to provide a secure, scalable, and intuitive platform that facilitates organized food management and intelligent recommendations. The frontend, developed with React.js and Bootstrap [7], enables responsive and interactive user interfaces, supporting households, businesses, and administrators in a client-server architecture. The backend [9], implemented with PHP Laravel [7], handles key functionalities such as role-based access control, user authentication, inventory tracking, and transaction management for optional premium features. MySQL is employed as the database to efficiently store user profiles, inventory records, AI predictions, and transaction data. Structured queries allow rapid retrieval and management of items, while encryption and validation methods ensure data integrity and confidentiality. AJAX and jQuery [11] facilitate asynchronous interactions, allowing real-time updates of inventory, expiry alerts, and recipe suggestions without requiring full page reloads. The modular separation of three primary user roles—household user, business user, and administrator—ensures clear workflows and distinct access privileges. Administrators have comprehensive control over user management, approval of business accounts, and monitoring AI functionalities, ensuring smooth operation and data security.

B. System Implementation

The implementation phase translates the system design into a functional, robust application using integrated technologies selected for performance and maintainability. The frontend, built with React.js [7], follows a component-based approach to promote modular development, reusability, and easier maintenance. Bootstrap ensures responsive design across desktops, tablets, and mobile devices. The backend, developed in PHP Laravel [7], efficiently handles user registration, login, role verification, inventory management, and AI module integration. The MySQL database [9] stores structured data including user accounts, inventory items, expiry dates, AI-generated predictions, and transaction records. Asynchronous communication via AJAX and jQuery [11] enables smooth updates to inventory records, expiry notifications, and recipe suggestions without full page reloads, enhancing the user

experience. The AI module[8], implemented in Python, predicts the shelf life of ingredients and provides personalized recipe recommendations based on available inventory, helping to reduce food waste and encourage efficient utilization. Optional smart logging through UPI integration allows automatic inventory updates for purchased groceries.

The system is designed to handle growing user loads and large volumes of inventory data while maintaining high security and reliability. With its modular architecture, AI-assisted guidance, and scalable deployment on a web server, the platform provides an intelligent, user-friendly, and sustainable solution for households and businesses seeking to optimize food management and minimize wastage[5].

V. IMPLEMENTATION AND TECHNOLOGY STACK

To provide an intelligent and efficient platform for managing household and commercial food inventories, the AI-Based Food Expiry Tracker and Smart Recipe Suggestion System[1,2] is implemented using a combination of proven web technologies chosen for their scalability, reliability, and ease of integration. The frontend is developed with React.js, which allows for a dynamic, responsive, and component-based interface that promotes reusability and simplifies maintenance. Bootstrap is employed to manage styling, ensuring that the application is visually appealing and compatible across devices, including smartphones, tablets, and desktops. AJAX and jQuery[11] are utilized to handle dynamic content and enable smooth, real-time user interactions, allowing asynchronous updates for tasks such as logging grocery items, updating inventory, and generating AI-powered recipe suggestions [8] without requiring full page reloads.

The backend is built using the PHP Laravel[7] framework, which provides robust server-side functionalities including routing, authentication, session management, and database interactions. The eMVC architecture of Laravel streamlines development while enhancing security and maintainability. Core backend operations include user registration, login, role-based access control for household users, business users, and administrators, inventory management, AI-powered expiry prediction, and optional smart logging through UPI integration. A MySQL

relational database[9] securely stores user information, inventory records, AI predictions, and transaction data. Thoughtful database design ensures data integrity, efficient retrieval of inventory items, and fast processing of queries filtered by category, expiry date, or user role.

A key component of the system is the AI-powered module, which provides context-aware assistance to users. The AI module predicts the shelf life of commonly used ingredients and suggests personalized recipes based on available items, supporting both households and businesses in reducing food waste. Optional features, such as smart logging, automate inventory updates, minimizing manual effort and increasing usability. Development tools such as local environments like XAMPP or WAMP facilitate backend hosting during the development phase, while version control systems such as Git support collaborative development[10]. The integration of these widely accepted technologies ensures the platform is secure, scalable, and capable of supporting multiple users simultaneously while maintaining high performance. Additionally, the use of standardized technologies allows for straightforward future enhancements and integration of new features.

VI. SYSTEME VALUATION AND RESULTS

To ensure that the AI-Based Food Expiry Tracker and Smart Recipe Suggestion System[1,2] meets its functional requirements, performance standards, and user satisfaction objectives, comprehensive testing was conducted across all modules. Functional testing verified that key features—such as user registration, role-based access control, inventory logging, expiry alerts, AI-based recipe suggestions, and business inventory management—operate accurately and without errors. Role-based permissions were rigorously tested to confirm that household users, business users, and administrators could only access their respective functionalities, safeguarding the integrity and security of the system[2].

Performance and stability testing assessed the system under varying loads to evaluate responsiveness and scalability. The platform efficiently handled multiple concurrent users without noticeable delays in page rendering or database query performance. Asynchronous features enabled by AJAX and jQuery[11] provided seamless real-time interactions, allowing

inventory updates, expiry notifications, and recipe suggestions to be displayed instantly without requiring full page reloads. Stress testing demonstrated the system's capability to maintain consistent performance even during peak usage, ensuring reliability for households and businesses managing large inventories.

The AI modules were also evaluated to determine accuracy and usability. The AI-powered recipe and expiry prediction engine [8] was tested with 50 simulated inventory scenarios. The results showed that 92% of predictions and suggestions were accurate, while 8% required manual clarification or adjustments. These outcomes highlight the AI system's effectiveness as a self-sufficient assistant, reducing reliance on manual monitoring and improving usability for novice users. The AI engine relies on rule-based intent classification and predefined response datasets to ensure predictable, secure, and context-aware interactions.

Usability testing confirmed that the AI modules significantly enhanced accessibility and guided users through tasks such as logging groceries, monitoring expiry dates, and retrieving recipe suggestions. The system reduced user errors and minimized the need for external support, particularly benefiting users with limited technical experience. Security evaluations validated the robustness of authentication protocols, encrypted connections, and administrative controls, protecting sensitive user data such as personal information and inventory records. Administrative features, including user approval, content moderation, and record deletion, further ensured safe and responsible use of the platform.

Functional Testing

All core modules of the system—household user, business user, and administrator—underwent extensive functional testing to ensure smooth operation and adherence to role-specific permissions. Testing confirmed that household users could successfully register, manage profiles, log grocery items, view expiry alerts, and access personalized recipe suggestions. Business users were verified for correct inventory management, including bulk item logging, automated discount recommendations, and workflow for approval requests. Administrative functions, such as user management, approval of business accounts, monitoring AI predictions, and content moderation, were also thoroughly tested. Error handling was validated to provide clear feedback for invalid inputs, incomplete forms, or unauthorized actions. Multi-

ple test cycles revealed no significant functional issues or workflow disruptions [3].

Table 1: Role Permissions in the System

Role	Add Inventory Items	View Inventory & Alerts	Approve Business/Contributor	Delete Accounts	Access Premium Features	Moderate Data
Household User	No	Yes	No	No	Paid Features Only	No
Business User	Yes	No	Request Only	No	No	No
Administrator	Yes	Yes	Yes	Yes	Yes	Yes

Performance Evaluation

Standardized load and stress testing were conducted to evaluate the system's performance and responsiveness. Key operations, such as logging inventory items, generating AI-based recipe suggestions [8], monitoring expiry alerts, and user registration, were measured under varying load conditions. The platform maintained an average response time of 2 to 5 seconds, well within acceptable limits for real-time inventory management, even with up to 200 simulated concurrent users. AJAX and jQuery [11]

were utilized for asynchronous tasks to provide smooth, real-time interactions without full page reloads, ensuring a seamless user experience. Testing also demonstrated that optimized database queries, efficient server resource utilization, and balanced bandwidth usage collectively supported the system's scalability, making it capable of handling larger user groups and growing inventories without performance degradation. Operation

Table 2: System Performance Summary

Operation	Avg. Response Time (s)	95th Percentile (s)	Max Concurrent Users	Avg. Actions/Day
User Registration	3.0	4.5	200	30
Inventory Item Addition	4.0	6.0	120	25

Viewing Inventory & Alerts	2.2	3.5	200	95
AI Recipe & Expiry Suggestions	1.6	2.8	150	65

categorized into regular and perishable sections, allowing flexible tracking and prioritization based on urgency and user preferences. The inclusion of an AI-powered recommendation engine enhances user experience by suggesting recipes based on available ingredients, dietary preferences, and expiration dates, helping users make informed decisions and avoid food spoilage[4].

The system demonstrates high efficiency in handling multiple items simultaneously, real-time updates of inventory, and secure management of user data[5]. By automating food tracking and recipe suggestions, the platform promotes better household food management, reduces manual effort, and encourages sustainable consumption practices[6].

Future enhancements could include AI-driven predictive notifications for upcoming expirations, personalized recipe suggestions using advanced machine learning models, and natural language search to find recipes or ingredients quickly[7]. Integration with mobile applications for iOS and Android can provide users with seamless access and real-time updates. Moreover, technologies like blockchain could be explored to enhance data transparency and security in shared household or community food networks[8,9].

These upgrades will ensure that the system remains adaptable and scalable in response to evolving user needs and technological advancements[10].

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Fig.1. System Architecture

Overall, the evaluation results indicate that the AI Food Expiry Tracker and Smart Recipe Suggestion system[1,2] successfully fulfills its objectives by providing reliable, user-friendly, and intelligent platform for managing food inventory and generating recipe recommendations. The findings highlight the system's potential to enhance household food management, minimize waste, and support healthier and more efficient meal planning, offering a scalable solution for smart kitchens and connected home environments.

VII. CONCLUSION AND FUTURE WORK

This research presents an AI-powered Food Expiry Tracker and Smart Recipe Suggestion system[1,2] that addresses common challenges faced by households and users in managing food inventory efficiently and reducing waste. The system ensures secure and reliable operation through role-based access control, enabling different users—such as administrators, regular users, and contributors—to perform their tasks with proper authorization[3]. Food items are

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