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AI Chef: Generative AI for Personalised Recipe Creation and Nutrition Planning

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Abstract - This paper presents an intelligent recipe generation system designed to support users in everyday meal planning. It recommends recipes based on the availability of ingredients and individual food preferences, addressing common challenges faced by users when time is limited or ingredient choices are restricted. To overcome these difficulties, artificial intelligence is employed through practical and user-friendly methods suitable for real-world cooking scenarios. The system monitors daily nutritional objectives, including caloric intake, protein, carbohydrates, and fat consumption, while also tracking water intake. Recipe recommendations dynamically adapt to user preferences, reducing monotony and simplifying daily cooking routines. In addition to creativity, the system emphasizes health-conscious meal suggestions. Users begin by entering ingredient details and meal type, which are processed by a backend server connected to an AI model responsible for generating appropriate recipes. The output is presented in a clear textual format to ensure accessibility for non-technical users. The Groq Cloud API is utilized to access the LLaMA 3.18B large language model developed by Meta, enabling rapid and efficient recipe generation. Generated recipes are displayed interactively, allowing users to review and analyze the dish. Extensive testing was conducted using various ingredient combinations, and Server-Sent Events (SSE) were implemented to enhance real-time interactivity. User feedback collected through a digital survey using google form indicates that the web application is effective and suitable for everyday use. The findings highlight the role of an online AI-based chef in supporting diverse user needs. The system also contributes to food waste reduction by encouraging the use of leftover ingredients instead of discarding them. Additionally, the application supports step-by-step recipe generation, enabling users to observe the formation process, thereby improving transparency and engagement. Integrated nutrition planning features track daily intake of calories and macronutrients, making the system more engaging and informative. Unlike traditional cooking applications that rely on static recipes without nutritional monitoring, the proposed system actively generates recipes while tracking dietary intake. By combining personalization, real-time interaction, and nutrition-aware recommendations, the AI Chef framework demonstrates how smart systems can effectively support daily cooking and meal planning in an accessible manner. The application is designed for ease of use and is suitable for a broad audience, including students, families, and working professionals, illustrating the applicability of artificial intelligence to routine household activities.

Keywords – Sustainable Development Goal 3, Nutrition Planning, Personalised Meal Planning, Rule-Based Recommendation System, Food Waste Reduction, Smart Cooking Systems

1. INTRODUCTION

Food plays a fundamental role in human life due to its close association with daily routines, cultural traditions, health, and societal practices. Culinary habits vary across regions, influenced by factors such as climate, history, and cultural identity. In Indian households, meal preparation commonly focuses on balancing essential nutrients, including proteins, carbohydrates, and fats. In recent years, artificial intelligence (AI) has become increasingly prevalent across multiple domains, including chatbots, autonomous systems, and recommendation technologies. Online platforms such as YouTube and Instagram have further amplified interest in cooking and recipe exploration, while urban populations show growing awareness of nutrition planning and health management. As digital technologies continue to advance, the food industry is gradually undergoing transformation. Conventional cooking methods are increasingly replaced by modern approaches that offer convenience, efficiency, and enhanced engagement. Traditional techniques often require considerable effort and may no longer appeal to individuals seeking faster solutions. Daily meal planning remains a challenging task, and a significant quantity of edible food is wasted worldwide, making food waste a persistent global concern. These challenges emphasize the need for innovative solutions that reshape how individuals approach cooking and food selection.

This study focuses on promoting creativity in cooking by encouraging users to generate new recipes rather than repeatedly preparing familiar dishes. Artificial intelligence enables experimentation with diverse ingredient combinations, supporting personalized decision-making tailored to user preferences. Smart kitchen technologies are increasingly integrated into households, yet existing research often provides rigid solutions with limited consideration of health-focused outcomes. In particular, the creative modification of traditional cuisines, such as Indian food, remains underexplored. The proposed Auto Chef system addresses this gap by emphasizing balanced dietary planning while fostering innovation in recipe creation. Health-related

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concerns further underline the importance of such systems. According to the ICMR-INDIAB study, more than 101 million individuals in India are affected by diabetes, and over 315 million suffer from hypertension, highlighting the critical need for improved dietary management. Although AI is widely adopted in food production environments and kitchen appliances, its application in creative and nutrition-aware home cooking remains limited. General-purpose chatbots often provide incomplete or generic responses when users seek cooking suggestions based on available ingredients. In contrast, the proposed system is specifically designed for cooking and nutritional planning, enabling users to explore new dishes while efficiently utilizing available ingredients.

By generating recipes based on user-provided inputs, the system reduces food waste and improves meal planning efficiency. It is designed to be accessible to users without technical expertise, requiring only ingredient information and personal preferences. The system then delivers easy-to-follow recipes that account for essential nutritional requirements. Through this approach, AI Chef aims to promote healthier eating habits, support efficient meal planning, and demonstrate the potential of artificial intelligence in addressing everyday challenges related to cooking and nutrition.

2. LITERATURE SURVEY

With the rapid advancement of technology, artificial intelligence (AI) has gained significant attention in the domains of cooking and food recommendation systems. Numerous researchers have investigated how AI techniques can be effectively applied within the food industry to enhance efficiency and improve user experience. The primary objective of these studies is to leverage modern technology to reduce the time and effort involved in cooking while making the overall process more convenient. As lifestyles continue to evolve, individuals increasingly seek intelligent and efficient solutions for everyday tasks, among which cooking remains a common and time-consuming activity. Existing research in this area spans multiple directions, including automated recipe creation, recipe recommendation systems, personalized diet planning, and food image-based recipe generation. Karkera et al. [1], Chaudhary et al. [2], and Halaye et al. [4] proposed AI-based smart cooking systems that function as virtual cooking assistants. These systems assist users in selecting recipes, managing cooking procedures, and performing basic personalization using machine learning or rule-based approaches. However, these models primarily rely on predefined recipe databases, which limits their ability to provide deep personalization. Consequently, they exhibit restricted creativity in recipe generation and are unable to dynamically create new recipes beyond the stored dataset.

Similarly, Kumar et al. [3] explored AI-driven smart cooking solutions aimed at simplifying recipe selection, saving time, and enhancing the overall cooking experience. Despite these benefits, the proposed system remains dependent on static recipe repositories and offers limited adaptability to diverse user requirements. It does not sufficiently modify recipes based on individual constraints such as dietary goals, time availability, or taste preferences. Halaye et al. and Somnath et al. [5] focused on AI-based recipe generation; however, their work places minimal emphasis on nutritional planning or user health objectives. While their studies demonstrate the feasibility of AI-assisted recipe generation, the lack of health-oriented considerations restricts their applicability, particularly given the growing demand for nutritious meal options.Several researchers have also investigated food recognition using images combined with recipe generation. Kawano and Yanai [6], Salvador et al. [7], and Chhikara et al. [20] employed deep learning and computer vision techniques to identify food items from images, enabling food classification and recipe generation based on visual input. Although these approaches are effective for food detection and image-based analysis, they are highly dependent on image quality and require substantial computational resources. Moreover, such systems are less suitable for daily home cooking scenarios, as they fail to support text-based inputs and do not address personalized dietary planning. In cases where food images are unavailable, the usefulness of these systems is significantly reduced.

Other studies have concentrated on ingredient-based and preference-driven food recommendation systems. Marin et al. [8] proposed a method that recommends recipes by analyzing ingredient similarity and user preferences, where input data is compared against a stored database to identify the closest match. Min et al. [9] conducted a comprehensive study of food recommendation systems, highlighting key challenges and limitations. While their work provides valuable theoretical insights, it lacks implementation as a fully functional system accessible to end users. Singla et al. [10] developed FoodAI, a personalized nutrition planning system with a strong focus on health and dietary guidance. However, the system prioritizes nutritional recommendations over practical cooking assistance and offers limited interaction, while also overlooking regional food diversity and creative recipe formulation.Chen and Yang [11] applied natural language processing and deep learning techniques to automatically generate recipes, whereas Kodama and Nemoto [15] demonstrated the use of generative methods, inverse TF-IDF, and NLP for text-based recipe creation. Despite these advancements, their systems exhibit limited user interaction, lack comprehensive meal planning features, and show minimal real-world deployment. Li et al. [12] presented a survey on AI-based diet and personalized meal planning systems, with a primary focus on nutrition-oriented recommendation frameworks. While informative, this work does not propose an end-to-end solution for daily cooking assistance.Salvador et al. [13] introduced Recipe1M+, a large-scale dataset designed to support cooking-related AI research. Although the dataset is valuable for model training and experimentation, it does not function as a practical application for everyday users. Agrawal and Jain [14] developed cooking assistants using a combination of rule-based logic and AI techniques. While effective for basic cooking guidance, rule-based approaches remain constrained by

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predefined rules and lack the flexibility to generate innovative recipes. Happy et al. [16] reviewed AI-based food systems and explained the mechanisms behind recipe recommendation and generation; however, their study does not result in a deployable system. Venkataramanan et al. [17] proposed a generative model that learns cooking actions from recipes, primarily serving research purposes rather than practical daily use.

Research on smart kitchen systems has also gained attention. The Smart Chef survey [18] reviewed various AI-powered kitchen assistants, noting that many rely on fixed datasets and exhibit limited adaptability to individual user preferences. Ter et al. [19] developed a generative AI-based meal recommender that provides meal suggestions but lacks strong integration with health-oriented planning. Another study [22] introduced a flexible meal planner that considers user health conditions and scheduling preferences; however, its functionality is largely restricted to recipe planning. Hannon et al. [23] explored the use of generative AI and ChatGPT for sustainable cooking, emphasizing nutrition and food waste reduction. Although their work aligns closely with the present study, its primary focus differs in terms of objectives. Agrawal et al. [24] reviewed the applications of AI in food and nutrition and discussed future research directions, yet did not implement a complete, user-ready system.

Overall, existing studies address isolated aspects such as recipe recommendation, food image recognition, or nutritional advice, each with inherent limitations. Many systems rely heavily on static databases, restricting creativity and personalization. Additionally, limited emphasis is placed on real-time user interaction, transparency in recipe generation, and practical usability for everyday cooking. These gaps highlight the need for a comprehensive and adaptive AI-driven cooking system.In contrast to prior work, the proposed system adopts a generative AI approach to dynamically create new recipes rather than selecting from predefined datasets. The system generates recipes in real time based on user-provided inputs, including ingredient availability, preferences, dislikes, and health objectives. This enables personalized recipe generation, where identical ingredients can result in different outputs for different users. Furthermore, the system incorporates basic nutritional analysis to support healthier food choices. Real-time interaction allows users to observe the recipe generation process, enhancing transparency and engagement. Implemented as a web-based application, the system is designed to be lightweight, scalable, and easily accessible. By integrating generative AI with practical cooking and health considerations, the proposed approach aims to simplify daily meal preparation while promoting healthier and more organized lifestyles.

Ref	Model / System Name	Main Technique Used	Purpose / Task	Input Data	Output	Year
[1]	AI Chef (Karkera et al.)	Deep Learning	Intelligent cooking assistant	Ingredients, user input	Recipes & cooking steps	2024
[2]	AI Chef (Chaudhary et al.)	AI-based assistant	Cooking guidance	Ingredients, preferences	Recipe suggestions	2022
[3]	Smart Cooking Solutions	AI-enabled generation	Recipe creation	Ingredients, user needs	Generated recipes	2025
[4]	Smart Cooking & Recommendation	AI + Recommendation	Recipe recommendation	Ingredients, user choice	Suggested recipes	2024
[5]	Food Recipe Generation	AI models	Recipe generation	Ingredients	New recipes	2025
[6]	Food Image Recognition	CNN (Deep Learning)	Recognize food from images	Food images	Food labels	2014
[7]	Inverse Cooking	Computer Vision + DL	Recipe from image	Food images	Ingredients + recipe	2019
[8]	Ingredient Similarity Recommender	Similarity-based ML	Recipe recommendation	Ingredients, preferences	Relevant recipes	2020
[9]	Food Recommendation Survey	Review-based	Analysis of systems	Research papers	Survey report	2020
[10]	FoodAI	Recommender System	Nutrition planning	User profile, diet data	Personalized meal plan	2021
[11]	Auto Recipe Generation	NLP + Deep Learning	Generate recipes	Text data	Recipes	2021
[12]	Diet Recommendation	Review-based	Nutrition systems	Research data	Survey	2022

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Ref	Model / System Name	Main Technique Used	Purpose / Task	Input Data	Output	Year
	Survey		study			
[13]	Recipe1M+ Dataset	Multimodal Dataset	Dataset for cooking AI	Images + text	Benchmark dataset	2021
[14]	Smart Cooking Assistants	Rule-based + AI	Household cooking help	User inputs	Cooking guidance	2022
[15]	Inverse TF-IDF + GenAI	NLP + Generative AI	Recipe generation	Text + ingredients	New recipes	2025
[16]	Survey on Recipe Systems	Review-based	Survey study	Research papers	Survey	2025
[17]	Cook-Gen	Generative Model	Cooking action modeling	Recipes text	Cooking steps	2023
[18]	Smart Chef Survey	Review-based	Kitchen assistant systems	Research data	Survey	2025
[19]	GenAI Meal Recommender	Generative AI	Meal recommendation	User profile, diet	Meal plans	2025
[20]	FIRE	CV + DL	Image to recipe	Food images	Full recipe	2023
[21]	Intelligent Diet System	AI System	Nutrition recommendation	Health & diet data	Diet plans	2025
[22]	Flexible Meal Planning	System design	Diet planning	User health data	Meal schedules	2023
[23]	Smart Cuisine	Generative AI + ChatGPT	Sustainable cooking	Ingredients, user needs	Recipes + nutrition help	2024
[24]	AI in Nutrition Review	Review-based	Nutrition & food AI	Research data	Review	2025

Table 1: Comparison of Existing AI-Based Recipe and Nutrition Systems

This study evaluates cooking recipe generation based on criteria including accuracy, originality, and innovation. It introduces Auto Chef, an algorithm that leverages existing culinary knowledge to iteratively generate novel and valid recipes. To support dietary adherence, the system incorporates a nutritional assessment module that estimates caloric values and nutrient composition for generated meals. Recipe inspiration is derived from publicly available online culinary content, which is analyzed to produce creative and palatable dishes. Modern culinary systems extend beyond basic information retrieval by employing advanced techniques to infer nutritional properties. Nutrient estimation is particularly valuable for newly generated recipes, where precise ingredient quantities may be uncertain. Nevertheless, such systems may exhibit reduced accuracy due to the broad scope of nutritional coverage they attempt to provide.

In addition to research-based systems, several AI-driven cooking applications have been developed. Yum AI is a subscription-based platform designed for meal planning and dietary tracking. RecipeGenie and Dishify focus on generating recipes from available ingredients, thereby contributing to food waste reduction; however, these applications have not been evaluated using large-scale datasets. RecipifyAI specializes in diet-specific recipe generation but offers limited support for detailed cooking procedures. Similarly, existing Android-based AI recipe generator applications provide only basic functionality and minimal customization options. Although these applications demonstrate the potential of AI in culinary assistance, they also highlight existing limitations related to scalability, adaptability to diverse user requirements, and comprehensive system validation.

3. RESEARCH GAP

- This research addresses the development of an AI-based system aimed at simplifying daily cooking decisions while supporting healthy eating practices. Many individuals experience difficulty in planning meals due to limited ingredient availability, time constraints, or specific health requirements. To understand this challenge, existing cooking and food recommendation systems were examined.
- The review of prior studies indicates that most existing systems either rely on fixed recipe databases or concentrate primarily on nutritional analysis. A majority of these systems do not support dynamic recipe creation and instead select recipes from pre-existing collections. Furthermore, limited attention is given to real-time interaction and responsive user engagement. As a result, current solutions often fail to provide a comprehensive cooking experience that combines personalization, creativity, and immediacy.

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- This observation reveals a clear research gap: there is a lack of integrated platforms capable of generating new recipes based on user inputs, delivering rapid responses, and simultaneously considering health-related factors. Only a small number of system attempt to combine recipe generation, personalization, and real-time interaction within a single framework.
- To address this gap, a web-based AI Chef system has been proposed. The system allows users to input available ingredients, food preferences, and health objectives. These inputs are transmitted to a backend server, which communicates with an AI model through an application programming interface (API) to generate customized recipes along with basic nutritional guidance. The generated output is presented to users in a clear and accessible format.
- The system was implemented using Node.js and Express for backend development, with MongoDB employed for storing user information and recipe history. The frontend interface was developed using React and Tailwind CSS to ensure simplicity and usability. The Groq Cloud API was utilized to access the LLaMA 3.1 – 8B Instant model for recipe generation. The system was evaluated using diverse user inputs, including ingredients only, dietary goals only, and a combination of both. User feedback was collected through a Google Forms survey, which indicated that most participants found the system practical, intuitive, and effective. Overall, this research demonstrates that the integration of generative AI into cooking applications can enhance personalization, promote healthier eating, and improve the overall cooking experience.

4. OBJECTIVE

Based on the analysis of existing research and the identification of their limitations through the literature review, the following objectives were established for this study:

- To develop a system capable of generating recipes based on user preferences and available ingredients.
- To utilize the LLaMA 3.1 – 8B Instant model for personalized recipe generation.
- To integrate basic nutrition planning alongside recipe recommendations.
- To design a user-friendly system that is accessible to individuals with varying technical backgrounds.
- To minimize daily cooking-related decision-making effort and save user time.
- To promote healthier eating habits through AI-driven recommendations.

These objectives guided the design and implementation of the proposed AI Chef system.

5. METHODOLOGY

The proposed AI Chef system is developed using a modular architecture consisting of three main layers: the frontend, the backend, and the database. This layered design supports scalability, maintainability, and efficient communication between system components. The overall methodology includes data collection and preprocessing, system design, model interaction, implementation, and evaluation.

- The system follows a client–server architecture. Users interact with the application through a web-based frontend, while all processing and logic are handled by the backend server. Persistent data storage is managed using a NoSQL database. Communication between the frontend and backend is achieved through RESTful APIs, ensuring secure and efficient data exchange.
- The frontend is developed using React.js to provide a responsive and interactive user interface. Pages such as Home, Login, Signup, Dashboard, and Recipe Generator are used to collect user inputs and display generated results. The interface design prioritizes simplicity, allowing users to easily enter ingredients, dietary preferences, and health-related requirements.
  Tailwind CSS is used to enhance the visual appearance while maintaining consistency and usability. Navigation between pages is handled using centralized routing within the application.
- The backend is implemented using Node.js and Express.js, which handle application logic, user requests, and communication with external services. The server initializes through a central file and establishes a secure connection with the database. User inputs received from the frontend are validated and formatted before further processing.
- RESTful API endpoints are created to manage core functionalities. User-related operations such as registration, authentication, and profile management are handled through dedicated user routes, while recipe generation and recipe history storage are managed through separate recipe routes. All sensitive configuration information, including database connection

The codebase follows a structured and modular folder organization to ensure clarity and ease of maintenance.

- The backend directory contains the core logic of the system, including models, routes, and the main server configuration.

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- The models module defines database schemas. The User model stores user-related information such as email and login credentials, while the Recipe model stores ingredient lists, cooking steps, and generated outputs.
- The routes module manages application endpoints. The user route handles authentication and profile-related actions, whereas the recipe route manages recipe generation requests and history storage.
- The server file integrates database connections, API routes, and AI model communication.

On the frontend side, reusable components are employed to reduce redundancy. Page-level components manage layout and user interaction, while routing logic controls navigation across different views. This modular structure improves scalability and simplifies future enhancements. User inputs collected from the frontend are converted into structured prompts by the backend. These prompts are sent to the Groq Cloud API, which provides access to the LLaMA 3.1 – 8B Instant language model. The model analyzes ingredient availability, dietary preferences, and nutritional constraints to generate suitable recipes in textual format. To enhance user engagement, the AI-generated output is streamed in real time from the API to the backend and subsequently forwarded to the frontend using Server-Sent Events (SSE)**.** This allows users to observe the recipe generation process step by step.

The system utilizes both structured and semi-structured data related to food ingredients, nutritional values, dietary categories, and user preferences. Data is collected from existing sources as well as user inputs. During preprocessing, incomplete records, duplicate entries, and irrelevant information are removed to improve data quality. Feature extraction is then applied to identify essential attributes such as calorie limits, ingredient type, dietary classification, and macronutrient composition.

System evaluation was performed using multiple test scenarios, including inputs containing only ingredients, only dietary preferences, and a combination of both. Generated recipes were assessed for clarity, usefulness, and correctness. A rule-based filtering mechanism was also applied to ensure that nutritional constraints and dietary categories were satisfied. User feedback was collected through a digital survey conducted using Google Forms. The results indicated that the system was easy to use and provided practical and meaningful recipe suggestions. The application was developed and tested in a local environment to ensure smooth interaction between the frontend and backend. Version control was maintained using Git throughout the development process. The proposed methodology integrates frontend usability, backend efficiency, structured code organization, and real-time AI interaction to deliver a practical and scalable cooking assistance system. By combining generative AI with rule-based logic and nutritional planning, the AI Chef system demonstrates an effective approach to personalized and health-aware recipe generation.

6. WORKING MECHANISM

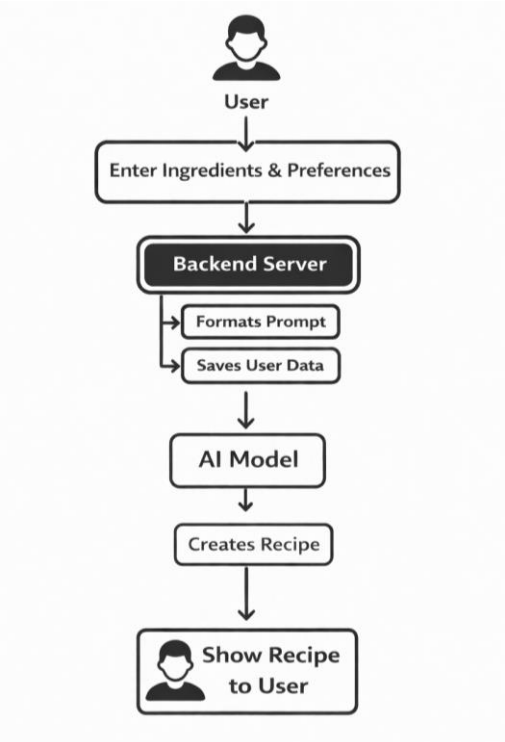

Fig1: Working Mechanism

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- The operation of the AI Chef system begins with users accessing the web application and providing details about available ingredients and individual food preferences. These inputs are transmitted from the frontend interface to the backend server for processing.
- Upon receipt, the backend converts the user data into a structured prompt interpretable by the AI model and concurrently stores relevant user information for subsequent use.
- The prompt is then sent to the Groq Cloud API, which leverages the LLaMA 3.1–8B Instant model to analyze the provided ingredients and preferences. The AI generates a recipe in real time, streaming the output incrementally rather than delivering the complete recipe at once.
- The backend receives this streamed data and relays it to the frontend, allowing users to observe the stepwise formation of the recipe. Once completed, the full recipe is presented in a clear and structured format. This approach ensures a responsive and interactive user experience while maintaining system efficiency.

7. RESULT AND DISCUSSION

The AI Chef system was successfully implemented using the LLaMA 3.1–8B Instant model through the Groq Cloud API, demonstrating the capacity to generate recipes in real time based on diverse user inputs, including ingredients, dietary preferences, and cooking requirements. When only ingredients were provided, the system produced viable recipes using the available items. When dietary preferences—such as protein, carbohydrates, fats—were specified, the generated recipes were adjusted accordingly. Combining both ingredients and preferences yielded highly personalized and contextually appropriate outputs. The live streaming feature allowed users to follow the recipe generation process step by step, enhancing the system's interactivity. Most recipes were generated within seconds, indicating robust performance of both the Groq Cloud API and the LLaMA model. User evaluations revealed that the interface was intuitive and accessible even for individuals with minimal technical experience. Generated recipes were clear, with well-organized ingredient lists, preparation steps, and, in some cases, nutritional guidance.

The backend and database integration functioned effectively, as evidenced by the successful storage of user details and generated recipes. Users were able to log in, generate multiple recipes, and access historical outputs without difficulty. A structured user survey conducted via Google Forms, distributed among students and general users, indicated high levels of satisfaction. Participants reported that recipes were practical, time-saving, and aligned with available ingredients.Overall, the results demonstrate that integrating the LLaMA 3.1–8B Instant model with the Groq Cloud API provides an efficient, real-time, and personalized cooking assistant. The system performed consistently well regarding speed, accuracy, and user satisfaction.

8. CONCLUSION

The AI Chef system was developed and tested to support users in meal planning by providing recipe suggestions and basic nutrition guidance. The system addresses common challenges such as food waste, repetitive meal preparation, and lack of personalized nutritional information by generating recipes tailored to user preferences, available ingredients, and dietary needs. Feedback from users indicated that the system produces clear, practical, and useful recipes, aiding efficient utilization of ingredients and promoting healthier food choices.The system demonstrated reliable performance in generating recipes quickly, supporting diverse users, and offering an intuitive interface suitable for students, working professionals, and families. Leveraging open-source tools and free-tier platforms ensured affordability and ease of development, while the interactive website design facilitated a seamless user experience.

By enabling rapid generation of meal ideas and enhancing creativity in daily cooking, the system improves meal planning efficiency and reduces repetitive cooking patterns. Future enhancements could include expanding the recipe database, offering more detailed nutritional analysis, and refining recommendation logic to further enhance personalization and user satisfaction.

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