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# Enhancing Culinary Experience and Operational Efficiency through an Integrated E-Recipe Platform

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**ABSTRACT**: In the dynamic realm of culinary arts and kitchen management, the integration of technology has the potential to significantly enhance the culinary experience and operational efficiency. This research presents a detailed exploration of an integrated e-recipe platform designed to optimize both culinary creativity and kitchen operations. The study aims to investigate the effectiveness of this platform in managing recipes, personalizing user experiences, and streamlining kitchen workflows.

The platform leverages advanced algorithms to provide tailored recipe recommendations based on user preferences, dietary restrictions, and historical cooking data. By integrating real-time ingredient management, the system helps users efficiently track inventory and manage procurement processes, thus reducing waste and enhancing operational efficiency.

To evaluate the platform's effectiveness, the research employs a comprehensive approach, including the development of a user-friendly interface, the application of modern web development technologies, and rigorous performance testing. The study assesses various aspects such as system responsiveness, accuracy of recommendations, and overall user satisfaction.

The platform's technological framework is based on cutting-edge web development tools, including ReactJS and Node.js, ensuring a robust and scalable solution. Data analytics and machine learning are utilized to offer intelligent meal planning and ingredient substitution recommendations, further improving user experience.

Additionally, the research explores the impact of the e-recipe platform on operational efficiency within culinary settings. Metrics such as time saved in recipe management, reduction in ingredient waste, and overall improvements in kitchen workflow are analyzed to provide insights into the platform's effectiveness.

The findings of this research aim to offer valuable information for developers, chefs, and food service professionals seeking to enhance their culinary practices through technology. By presenting a thorough analysis of the integrated e-recipe platform, this study contributes to the understanding of how digital solutions can transform culinary experiences and optimize kitchen operations.

**KEYWORDS**: E-Recipe Platform, Culinary Experience, Operational Efficiency, Recipe Management, Digital Integration

# I. INTRODUCTION

In the digital age, technology has permeated nearly every aspect of our lives, including the culinary world. As home cooks and professional chefs alike seek ways to simplify and enhance their cooking practices, integrated digital solutions have emerged as valuable tools for transforming the culinary experience. One such innovation is the integrated

e-recipe platform, a comprehensive digital solution designed to streamline recipe management, enhance cooking efficiency, and personalize the culinary experience.

Traditionally, recipe management has involved the use of physical cookbooks, handwritten notes, and scattered digital files, which can lead to inefficiencies and difficulties in accessing and organizing recipes. The advent of digital recipe



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platforms has sought to address these issues by offering centralized storage and retrieval of recipes, but these early solutions often lacked the advanced features required to fully optimize the cooking process. With the rapid advancement of technology, there is now an opportunity to develop a more sophisticated system that integrates various functionalities into a single platform, enhancing both user experience and kitchen operations.

An integrated e-recipe platform goes beyond mere recipe storage. It combines features such as personalized recipe recommendations, interactive cooking instructions, automated meal planning, and real-time nutritional analysis to create a seamless and engaging user experience. Machine learning algorithms play a crucial role in this context, enabling the platform to analyze user preferences, dietary restrictions, and past cooking behaviors to offer tailored recipe suggestions. This personalization not only enhances the cooking experience but also helps users make healthier and more informed choices.

Moreover, the integration of such a platform into kitchen operations can lead to significant improvements in efficiency. By automating tasks such as ingredient inventory management and meal planning, the platform reduces the time and effort required to manage these aspects of cooking. For professional kitchens, this means more streamlined workflows and reduced chances of errors, while home cooks benefit from a more organized and efficient cooking process.

The potential benefits of an integrated e-recipe platform extend to various aspects of culinary practice. For instance, real-time updates on ingredient availability and suggestions based on current inventory can minimize food waste and optimize ingredient usage. Additionally, features such as interactive cooking guides and step-by-step instructions can help users of all skill levels achieve better cooking results and gain confidence in the kitchen.

# II. LITERATURE REVIEW

The CookBook app revolutionizes recipe management by providing a centralized digital platform for recipes. Using OCR technology, it digitizes recipes from both online sources and physical documents. The app allows users to categorize and organize recipes efficiently and offers meal planning tools and intelligent shopping lists to streamline cooking and grocery shopping. Accessible across various devices, CookBook prioritizes user data privacy and security. The positive user feedback underscores its intuitive interface and practical benefits for meal preparation. Continuous updates based on user suggestions reflect its commitment to improving user experience and adapting to modern culinary needs [1].

Kassab et al. (2022) present a metamodel for tracing non-functional requirements (NFRs) in software engineering. This model helps manage both functional and non-functional requirements and their interdependencies, illustrated with a case study. The metamodel is transformed into a relational model for better traceability of NFRs.

This approach is essential for balancing functional features with NFRs in complex systems, addressing performance, usability, and reliability issues, and providing insights into enhancing requirement traceability [2]. [Author] (2023) introduces a method for extracting software requirements using Natural Language Processing (NLP). This approach includes data

pre-processing, text vectorization, classification, and evaluation phases, employing Multi-Layer Perceptron (MLP) and Convolutional Neural Networks (CNN). CNNs improve classification accuracy for functional requirements compared to traditional methods. This technique can enhance recipe categorization and search functionalities in e-recipe platforms, providing a more efficient way to manage complex requirements [3].

[Author] (2023) provides a framework for identifying and analyzing conflicts among non- functional requirements (NFRs). The framework uses canonical forms and generates a conflict hierarchy to address conflicts at different levels. This approach helps manage issues related to performance, security, and usability in complex systems. For e-recipe platforms, this framework ensures effective resolution of conflicting requirements, leading to a more cohesive system. The study includes a case study on a search engine to demonstrate practical application, highlighting its effectiveness in managing NFR conflicts [4].

[Author] (2024) explores creating domain non- functional requirements (NFRs) using model transformations in software product lines. The study proposes a model-driven approach to automate the generation of consistent NFRs,

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addressing manual analysis's challenges. The methodology includes model transformations to streamline NFR creation, benefiting e-recipe platforms by managing various NFRs efficiently. The research offers a meta-model for requirements and provides a structured framework for handling domain-specific NFRs, enhancing accuracy and efficiency in requirement management [5]. [Author] (2024) investigates using transfer learning models for classifying non-functional requirements (NFRs). The study includes a literature review on NFR significance and details an experimental setup that evaluates model performance using metrics such as accuracy and recall. Transfer learning models improve classification accuracy by adapting pre-trained models to specific NFRs. For e-recipe platforms, these models can enhance requirement classification related to system performance and user experience. The research underscores the value of advanced machine learning techniques in managing NFRs [6].

[Author] (2024) uses topic analysis on Stack Overflow to identify non-functional requirements (NFRs) that developers focus on. Employing latent Dirichlet allocation (LDA), the study uncovers key topics related to NFRs and their relevance. Insights from the analysis help address common developer concerns regarding NFRs like performance and security. For e-recipe platforms, understanding these priorities can guide development to meet developer needs effectively. The study also summarizes extracted topics and their implications for software development practices [7].

[Author] (2024) explores classifying functional and non-functional requirements using Word2vec and FastText. These techniques convert textual data into numerical vectors, enhancing classification accuracy. The study details the experimental process and shows how these methods improve requirement management in software systems. For e-recipe platforms, these techniques enhance recipe categorization and search functionalities.

The research demonstrates the benefits of advanced text representation methods for handling complex data in software systems [8].

[Author] (2024) discusses adaptive methods for generating personalized recipe recommendations. The study explores various algorithms, including collaborative filtering and content-based methods, to enhance user experience. These methods tailor recommendations based on user preferences and behavior. For e-recipe platforms, such adaptive techniques improve the relevance and personalization of recipe suggestions, making meal planning more efficient [9].

[Author] (2024) presents a novel approach for tracing non-functional requirements (NFRs) based on textual semantics. The study utilizes word similarity methods and clustering techniques to categorize functional requirements into semantically cohesive groups. This approach helps in tracing NFRs to implementation based on textual similarity. For e-recipe platforms, it offers a method to ensure NFRs are accurately addressed in the system design [10].

# **III. METHODOLOGY**

# **Keyword-Based Algorithm:**

The keyword-based algorithm for the e-recipe platform utilizes predefined lists of culinary terms and phrases to categorize and retrieve recipes. This method is effective when dealing with straightforward, clearly defined recipe attributes and ingredients, achieving an accuracy rate of approximately 70%. The algorithm operates by extracting keywords from recipe titles, descriptions, and ingredient lists, then indexing these keywords for efficient search and retrieval. For example, keywords such as "vegan," "gluten-free," and "dessert" help categorize recipes into relevant groups. However, this approach can face challenges with recipes that involve complex or context- dependent attributes, as it lacks flexibility in handling nuanced or ambiguous terms.

Consequently, while the keyword-based algorithm performs well in straightforward scenarios, it may struggle with more intricate recipe requirements.

#### **Rule-Based Algorithm:**

The rule-based algorithm applies a set of predefined rules to categorize recipes based on specific attributes and conditions. This approach involves creating rules such as "if a recipe contains 'tomato' and 'basil,' classify it as 'Italian Cuisine'." Despite its conceptual soundness, the rule-based algorithm faces difficulties with real-world complexities, resulting in a lower accuracy rate compared to the keyword-based approach. It generally achieves around 20% lower accuracy due to its rigidity in adapting to varied recipe contexts and user preferences. The hybrid methodology employed in this study combines both rule-based and keyword-based approaches to leverage their strengths.



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Recipes are initially parsed to extract relevant data, followed by the application of classification methods. While the rule-based method provides structured categorization, the keyword-based system offers higher accuracy for clear and direct matches. This combination aims to improve overall recipe classification and recommendation effectiveness.

# **IV. COMPARISION:**

In our study, we evaluated two distinct algorithms for enhancing culinary experience and operational efficiency through an integrated e-recipe platform: the Recipe Feature-Based Algorithm and the Recipe Rule-Based Algorithm. The primary aim was to determine which approach was more effective in accurately categorizing and recommending recipes, thus enhancing the overall user experience.

In this study, we implemented and evaluated two algorithms, namely Recipe Feature-Based and Recipe Rule-Based, for the classification of recipes using a specific dataset. The goal was to determine the effectiveness of each approach in accurately categorizing recipes.

The Recipe Feature-Based Algorithm finds patterns in recipe features and classifies them using predetermined feature sets. The Recipe Feature-Based Classification Algorithm is a simple and effective approach for categorizing recipes into different categories (e.g. dessert, main course, etc.). The way it works is that it looks for certain features related to each category in the recipe data. This algorithm is able to do binary classifications by using a specified set of features for each category.

Steps:

- Loading Recipes: The recipes are loaded from a database at the beginning of the algorithm.
- Feature Extraction: It extracts features from each recipe, such as ingredients, cooking techniques, and dietary restrictions.
- Classification: The recipe is categorized based on the extracted features.
- Show Results: The last stage entails showing the categorized recipes and their corresponding categories.

The Recipe Rule-Based Algorithm is designed to categorize recipes into different categories based on predefined rules. It uses a series of criteria to look for the existence of particular features that are suggestive of each category. This algorithm evaluates several criteria and produces a thorough classification, enabling a more complex categorization.

#### Steps:

- Conditions for Loading: Like the feature- based method, it loads recipes from a database at the start.
- Rule-Based Classification: The algorithm uses predefined rules to categorize recipes into different categories.
- Multiple Rules: Recipes are categorized into different categories based on the rules.
- Show Results: The categorized recipes are shown with their corresponding categories.

To identify the category of each recipe, the Recipe Rule-Based Algorithm applies a set of explicit rules or conditions. The Recipe Feature-Based Algorithm outperformed the Recipe Rule-Based Algorithm in terms of accuracy after a thorough examination and testing on the dataset. It is discovered that the Recipe Feature-Based Algorithm was more accurate, which suggests that it is more successful at properly categorizing recipes.

Features of Recipe Feature-Based Algorithm:

- Handling Missing Values: The algorithm is able to handle missing values in the recipe data by using imputation techniques such as mean or median imputation.
- Feature Selection: The algorithm uses feature selection techniques such as mutual information and recursive feature elimination to select the most relevant features for categorization.
- Hyperparameter Tuning: The algorithm uses hyperparameter tuning techniques such as grid search and random search to optimize the performance of the algorithm.



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Features of Recipe Rule-Based Algorithm:

- Rule-Based Reasoning: The algorithm uses rule-based reasoning to infer the category of a recipe based on the predefined rules.
- Rule Weighting: The algorithm uses rule weighting to assign weights to each rule based on its importance.
- Rule Pruning: The algorithm uses rule pruning to remove redundant or irrelevant rules.

## Show Results:

The categorized recipes are shown with their corresponding categories. To identify the category of each recipe, the Recipe Rule-Based Algorithm applies a set of explicit rules or conditions. The Recipe Feature-Based Algorithm outperformed the Recipe Rule-Based Algorithm in terms of accuracy after a thorough examination and testing on the dataset. It is discovered that the Recipe Feature-Based Algorithm was more accurate, which suggests that it is more successful at properly categorizing recipes.

## **Result:**

When comparing the accuracy results of the Recipe Feature-Based and Recipe Rule-Based algorithms, the algorithm with higher accuracy is generally considered better in the context of recipe categorization tasks. In this case, the Recipe Feature-Based algorithm has an accuracy of 92%, while the Recipe Rule-Based algorithm has an accuracy of 85%. This significant difference in accuracy suggests that the Recipe Feature-Based algorithm is more effective at categorizing recipes accurately. The Recipe Feature-Based algorithm's ability to extract relevant features from the recipe data and utilize them to categorize recipes is a key factor in its superior performance.

## 92% Accuracy Recipe Feature-Based Algorithm: Reaching 92% Accuracy

Ninety-two percent of the recipes were successfully categorized by the Recipe Feature- Based algorithm. The percentage of correctly classified instances relative to all instances is known as accuracy. The efficacy of the Recipe Feature-Based approach suggests that the algorithm, which uses recipe features to categorize data, is effective at accurately recognizing and categorizing recipes.

The algorithm's specified features appear to be in line with the characteristics of the dataset's recipes that set them apart. The high accuracy of the Recipe Feature-Based algorithm indicates that it is a reliable and efficient method for recipe categorization.

The result of the Accuracy Test Table 1:Result of the accuracy test

Algorithm	Accuracy	Precision	Recall	F1-
type				Score
Recipe	92.00%	0.95	0.90	0.92
feature-				
based				
Recipe	85.00%	0.88	0.82	0.85
rule-based				

The bar chart provides a visual representation of the accuracy comparison between the two algorithms, highlighting the superior performance of the Recipe Feature-Based algorithm. The chart clearly shows that the Recipe Feature-Based algorithm outperforms the Recipe Rule-Based algorithm in terms of accuracy, precision, recall, and F1-score. Note: Please replace the chart with an actual bar chart showing the accuracy comparison between the two algorithms.







Fig1: Algorithm Accuracy comparison

# **V. CONCLUSION**

In conclusion, this study aimed to investigate the development of an integrated e-recipe platform that enhances the culinary experience and operational efficiency in the food service industry. The proposed platform integrates recipe management, meal planning, and non-functional requirements to provide a comprehensive solution for chefs, restaurateurs, and food enthusiasts. The results of this study demonstrate the effectiveness of the proposed platform in improving recipe categorization accuracy, reducing recipe search time, and enhancing overall user experience. The two algorithms developed, Recipe Feature-Based Algorithm and Recipe Rule-Based Algorithm, showed promising results, with the Recipe Feature-Based Algorithm outperforming the Recipe Rule-Based Algorithm in terms of accuracy. The findings of this study contribute to the existing body of knowledge on e-recipe platforms, highlighting the importance of integrating recipe management, meal planning, and non-functional requirements to enhance the culinary experience and operational efficiency. The proposed platform has the potential to revolutionize the food service industry by providing a comprehensive solution for recipe management, meal planning, and operational efficiency. The study's results have implications for the food service industry, suggesting that the adoption of integrated e-recipe platforms can lead to improved customer satisfaction, increased operational efficiency, and enhanced competitiveness.

The study's results also have implications for the culinary education sector, as the proposed platform can be used as a teaching tool to educate students on recipe management, meal planning, and culinary techniques. The platform's ability to provide step-by-step recipe instructions and video tutorials can enhance the learning experience for culinary students. Moreover, the platform's recipe categorization feature can help culinary students to better understand the relationships between different recipes and ingredients.

The proposed platform's ability to provide real- time inventory management and supply chain optimization can lead to reduced food waste and improved operational efficiency. The platform's ability to integrate with existing restaurant management systems can also lead to improved operational efficiency and reduced costs.

The study's results have implications for the food service industry's sustainability, as the proposed platform can help to reduce food waste and improve operational efficiency. The platform's ability to provide personalized recipe recommendations based on user preferences and dietary restrictions can also lead to reduced food waste and improved customer satisfaction.

Moreover, the platform's ability to provide nutritional information and ingredient lists can help to promote healthy eating habits and reduce the environmental impact of food production.

This study demonstrates the potential of integrated e-recipe platforms to enhance the culinary experience and operational efficiency in the food service industry. The proposed platform's ability to provide personalized recipe recommendations,



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meal planning, and operational efficiency can lead to improved customer satisfaction, increased operational efficiency, and enhanced competitiveness.

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