A

Mini Project Report

on

Recipe Recommendation Using AI

Submitted in partial fulfillment of the requirements for the

degree

Third Year Engineering – Computer Science Engineering (Data Science)

by

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Academic year: 2023-24

CERTIFICATE

This to certify that the Mini Project report on **Recipe Recommendation Using AI** has been submitted by Radhika Pradhan 22107005, Gauri Salvi 22107014, Tejas Patil 22107024 and Chinmay Pawaskar 22107000 who are bonafide students of A. P. Shah Institute of Technology, Thane as a partial fulfillment of the requirement for the degree in **Computer Science Engineering (Data Science)**, during the academic year **2023-2024** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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Date:

ACKNOWLEDGEMENT

This project would not have come to fruition without the invaluable help of our guide **Ms. Aishwarya Londhe**. Expressing gratitude towards our HoD, **Ms. Anagha Aher**, and the Department of Computer Science Engineering (Data Science) for providing us with the opportunity as well as the support required to pursue this project. We would also like to thank our project coordinator **Ms. Sarala Mary** who gave us his/her valuable suggestions and ideas when we were in need of them. We would also like to thank our peers for their helpful suggestions.

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ABSTRACT

This project focuses on developing an AI-driven recipe recommendation system that revolutionizes how users discover and engage with culinary content. By utilizing advanced machine learning algorithms and user-friendly web technologies, the platform offers personalized recipe suggestions based on individual preferences, dietary restrictions, and available ingredients. Algorithms such as TF-IDF and feed ranking enhance the relevance and accuracy of recommendations, significantly improving user satisfaction.

The system will feature a responsive design for seamless navigation across devices. By fostering a community of culinary enthusiasts through social sharing and user-generated content, the project aims to create an interactive environment that encourages exploration and creativity in cooking, making the culinary experience more enjoyable and accessible for everyone.

Chapter 1

Introduction

The advent of AI in the culinary world has revolutionized the way individuals explore and discover new recipes. AI-driven recipe recommendation systems offer a dynamic and intelligent solution to the challenges commonly faced by food enthusiasts, such as finding meals that suit dietary restrictions, ingredient availability, and personal taste preferences. By leveraging machine learning algorithms, these systems analyze user data, including past interactions, cooking habits, and nutritional needs, to provide personalized and relevant recipe suggestions.

Beyond simplifying meal planning, these systems also enable users to make the most of available ingredients, reducing food waste while promoting creativity in the kitchen. Additionally, AI-based recipe recommendations continuously learn from user feedback, refining suggestions over time to better match evolving preferences. This innovation not only enhances convenience but also introduces new culinary possibilities, making cooking a more engaging and efficient experience.

As AI continues to advance, its role in transforming the culinary experience is set to grow, offering more personalized, sustainable, and inventive ways for users to interact with food.

1.1. Purpose:

- **Personalization**: Provide customized recipe suggestions based on dietary preferences, restrictions, and taste.
- **Ingredient Optimization**: Suggest meals that utilize available ingredients, reducing food waste.
- **Efficiency**: Save time by reducing the effort required to find suitable recipes.
- **Adaptability**: Learn from user behavior over time to refine and improve recommendations.

1.2. Problem Statement

In today’s fast-paced world, food enthusiasts and home cooks often face challenges in finding recipes that meet their dietary preferences, ingredient availability, and time constraints. Traditional methods of recipe discovery can be time-consuming, and inefficient, and result in wasted

ingredients due to lack of proper meal planning. Additionally, catering to specific dietary needs (such as vegan, gluten-free, or low-carb) or dealing with limited ingredient options adds complexity to the cooking process. There is a need for a solution that simplifies meal planning, offers personalized recipe suggestions, and optimizes ingredient usage, while also promoting creativity and reducing food waste. AI-driven recipe recommendation systems address these issues by providing intelligent, tailored, and adaptive solutions to enhance the overall cooking experience.

1.3. Objectives:

- To develop a Modern Search Bar for Recipe Name Search using an Autocomplete Feature.
- To process recipe descriptions based on available ingredients with the user using TF-IDF vectorization.
- To Generate a Recipe Feed Based on Search and Recommendations using the Word2Vec Algorithm.
- Implement an AI Chatbot for Recipe Recommendations.

1.4. Scope:

- **Real-Time Ingredient Matching**: By syncing with a user's pantry or fridge inventory (via manual input or smart kitchen devices), the system will suggest recipes based on the available ingredients in real time, allowing users to minimize food waste and plan meals efficiently without needing additional grocery shopping.
- **Cooking Assistance & Step-by-Step Guidance**: The system can provide detailed step-by-step instructions for cooking each recipe, including video tutorials, voice-guided instructions, and estimated cooking times, ensuring users of all skill levels can follow along easily.
- **Cuisine Exploration**: The system will introduce users to a wide variety of cuisines and dishes, encouraging cultural exploration and creativity in the kitchen.
- **Adaptive Learning**: The system will continuously learn from user behavior, refining its suggestions based on past interactions, favorite recipes, and evolving preferences over time.

Chapter 2

Literature Review

A literature review analyzes existing research, offering insights into methodologies, outcomes, and gaps in the current knowledge. Multiple studies have examined how AI can enhance recipe discovery by personalizing suggestions based on user preferences and inputs in the context of AI-driven recipe recommendation systems.

1. AI-Based Recipe Recommendation by X. Zhang and L. Chen (2023):

Zhang and Chen developed a recommendation system using ingredient matching and ranking. They applied TF-IDF to measure ingredient similarity and ranked the most relevant recipes through a feed algorithm. The system achieved 85% accuracy in recommending recipes that align with user preferences. [1]

2. Personalized Recipe Suggestions by S. Kumar and A. Patel (2022):

This study introduced an AI-based autocomplete feature to improve recipe searches. By combining autocomplete for ingredients and a ranking algorithm, the system reduced search time by 40%, providing users with accurate and fast recipe suggestions. [2]

3. AutoChef: AI Chatbot for Recipe Suggestions by P. Singh and M. Verma (2021):

Singh and Verma designed an AI-powered chatbot that interacts with users in real-time to recommend recipes. Using TF-IDF for ingredient similarity analysis, the chatbot achieved a 75% success rate in providing personalized recipe suggestions that met user expectations. [3]

4. Smart Recipe Chatbot by K. Lee and J. Park (2020):

Lee and Park created a smart chatbot to assist users in finding healthy recipes. The chatbot's autocomplete and recommendation features allowed users to quickly discover recipes that aligned with their health goals, enhancing the overall user experience. [4]

Chapter 3

Proposed System

The proposed AI-driven recipe recommendation system aims to enhance user experience by offering personalized recipe suggestions based on individual preferences, available ingredients, and dietary restrictions. Utilizing machine learning algorithms, the system will analyze user inputs and past interactions to recommend recipes that best match their tastes. The system will also integrate an AI-powered chatbot for real-time recipe assistance, making it easier for users to find suitable meal options while reducing search time and improving overall satisfaction.

3.1. Features and Functionality:

1. Personalized Recipe Recommendations:

The system will analyze user preferences, past behavior, and dietary restrictions to offer tailored recipe suggestions. This personalization ensures that users receive recipe ideas that align with their tastes and needs, enhancing the overall user experience.

2. Ingredient-Based Search:

Users can input ingredients they have on hand, and the system will generate recipes using those ingredients. This feature helps users minimize food waste while discovering new meal ideas based on available ingredients.

3. AI-Powered Chatbot:

A conversational AI chatbot will assist users in real-time by answering questions, recommending recipes, and offering cooking tips. Users can interact with the chatbot through natural language, making recipe discovery easier and more interactive.

4. Instant Recipe Retrieval:

Users can enter the name of a recipe in the search bar, which instantly retrieves and displays the corresponding recipe details, including the name, ingredients, cooking instructions, and an image. This feature allows for quick access to recipe information, enhancing user convenience and engagement.

Chapter 4

Requirement Analysis

Requirement analysis is a systematic process that involves identifying, documenting, and evaluating the needs and expectations of stakeholders. This phase defines the system's scope, functionalities, and constraints, ensuring that the final product aligns with user requirements. By thoroughly understanding these needs, the development team can create a system that effectively meets user expectations and delivers value.

- Dataset: The system requires a structured dataset of recipes, ingredients, and nutritional information to power the AI recommendation engine, ensuring accurate and personalized suggestions.

- Ingredient Input Interface: A straightforward input interface should allow users to enter multiple ingredients for tailored recipe suggestions.
- Recipe Recommendation Engine: The core functionality should be an AI-powered engine that analyzes user input and past behavior to provide personalized recipe suggestions based on available ingredients and dietary restrictions.
- Real-Time Chatbot Assistance: An AI-driven chatbot should assist users by answering questions, offering cooking tips, and providing recipe suggestions through a conversational interface.

Chapter 5

Project Design

Project design refers to the process of conceptualizing and planning the structure, components, and functionalities of a project to achieve specific objectives. It involves translating the requirements and goals identified during the initial phases (such as requirement analysis) into a detailed blueprint or roadmap for implementation.

5.1. Use Case Diagram:

A use case diagram is a visual representation of the interactions between users (or "actors") and a system. It's part of the Unified Modeling Language (UML) and helps in understanding the functional requirements of a system.

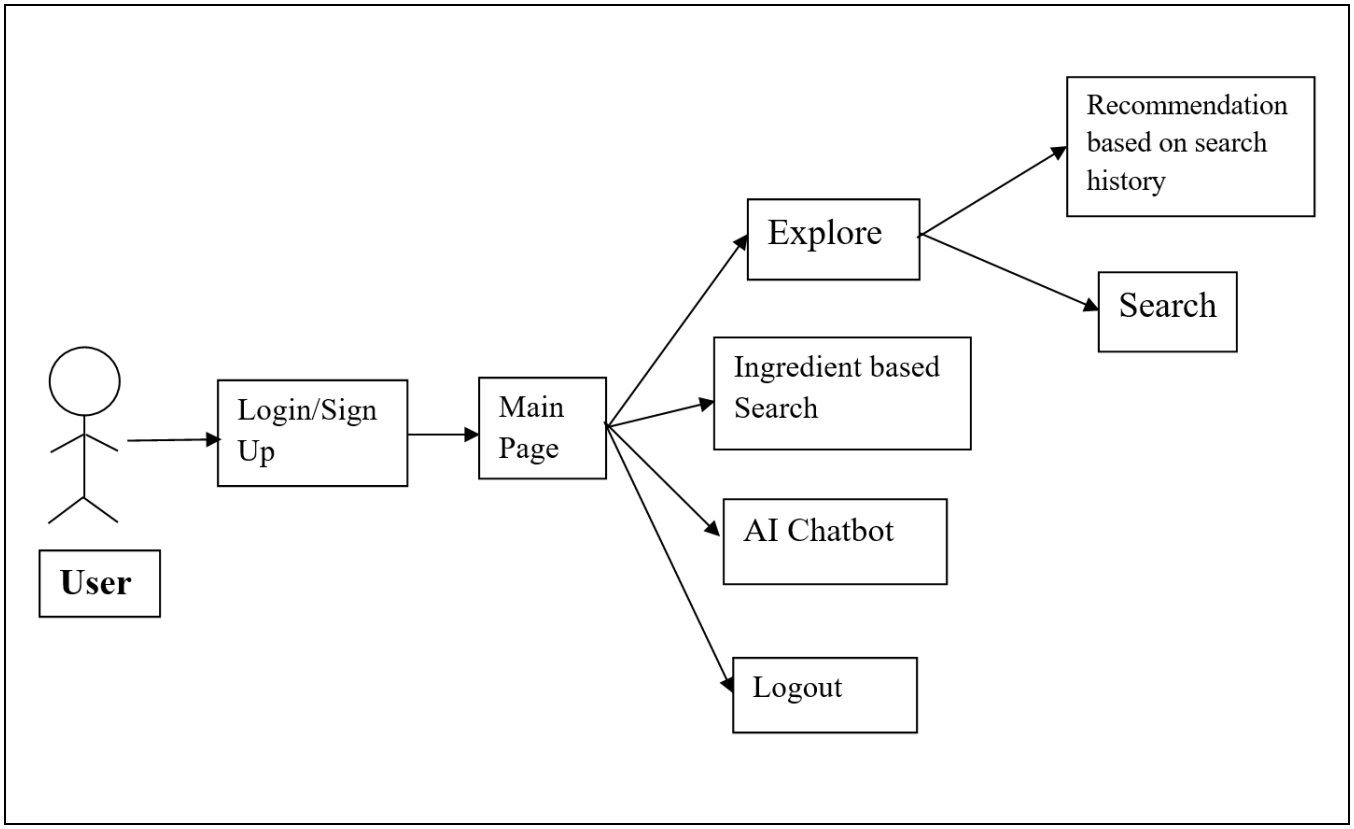


Fig. 5.1.1 Use Case Diagram for Recipe Recommendation

The use case diagram for recipe recommendation presents a simplified view of a user's interaction with a food or recipe-related application. It highlights several key features:

- **Login/Sign Up:** The user must first create an account or log in to access the application's functionalities.
- **Main Page:** This is likely the initial landing page after login, providing a central hub for navigation.
- **Explore:** This use case might represent a section where users can browse recipes, ingredients, or other content.
- **Search:** This use case allows users to search for specific recipes.
- **Ingredient-Based Search:** A more focused search option, specifically targeting recipes based on ingredients.
- **AI Chatbot:** An interactive feature that allows users to ask questions, get recommendations, or seek information.
- **Recommendation Based on Search History:** The system can suggest recipes or products based on the user's past searches.
- **Logout:** The user can exit their session.

Relationship Analysis

- **Main Page as a Central Hub:** The Main Page likely acts as a starting point, linking to other key functionalities.
- **Explore and Search:** These two use cases might be related, with Explore providing a more general overview and Search allowing for specific queries.
- **Ingredient-Based Search:** It provides recipe based on the ingredients available.
- **Recommendations:** It provides recommendations based on the user's interactions or search history, making it a complementary feature.

5.2. DFD (Data Flow Diagram):

A DFD is a graphical representation of the flow of data through a system. It shows the processes that transform data, the data stores that hold data, and the data flows that connect them.

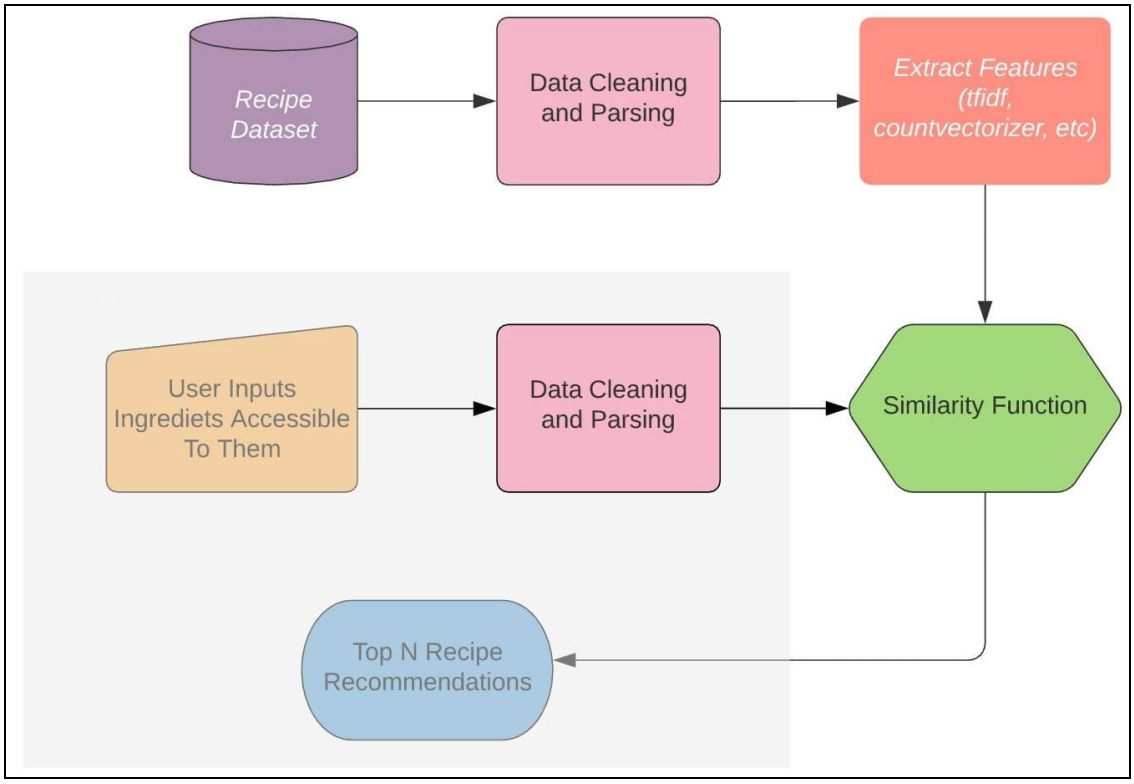


Fig. 5.2.1 Data Flow diagram for Recipe Recommendation

In this data flow diagram for Recipe Recommendation, a recipe recommendation system is depicted. The system starts with a dataset of recipes and user-provided ingredients. Both datasets undergo data cleaning and parsing to prepare them for analysis. Relevant features, such as ingredient terms or cooking techniques, are extracted from the recipe dataset. Then, a similarity function calculates the similarity between the user's input and the recipes in the dataset. Finally, the system recommends the top N recipes based on their similarity scores, providing personalized recommendations to the user.

5.3. System Architecture:

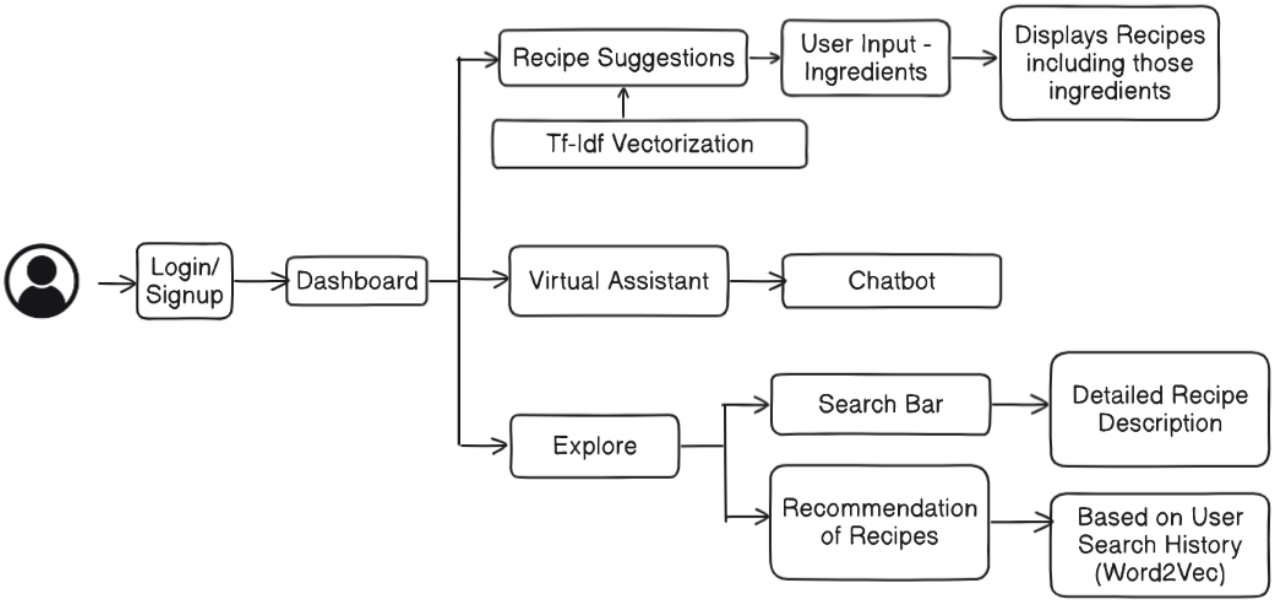


Fig 5.3.1 System Architecture for Recipe Recommendation

The System architecture for recipe recommendation is built using a modular architecture, with Flask serving as the core framework for backend development, managing essential functions and facilitating interactions between different modules. The User Interface (UI) efficiently handles user inputs, where users provide their ingredients for analysis. These ingredients are processed by the recipe recommendation module, which leverages machine learning techniques, such as TF-IDF vectorization, to recommend relevant recipes. Based on these inputs, the system seamlessly suggests personalized recipes and related cooking instructions. The backend also includes a database module that securely stores user history, including ingredient entries and previous recipe recommendations, allowing for future reference and improved user experience. This modular design ensures streamlined functionality, scalability, and ease of integration for additional features, such as chatbot assistance and advanced search filtering, in the future.

5.4. Implementation:

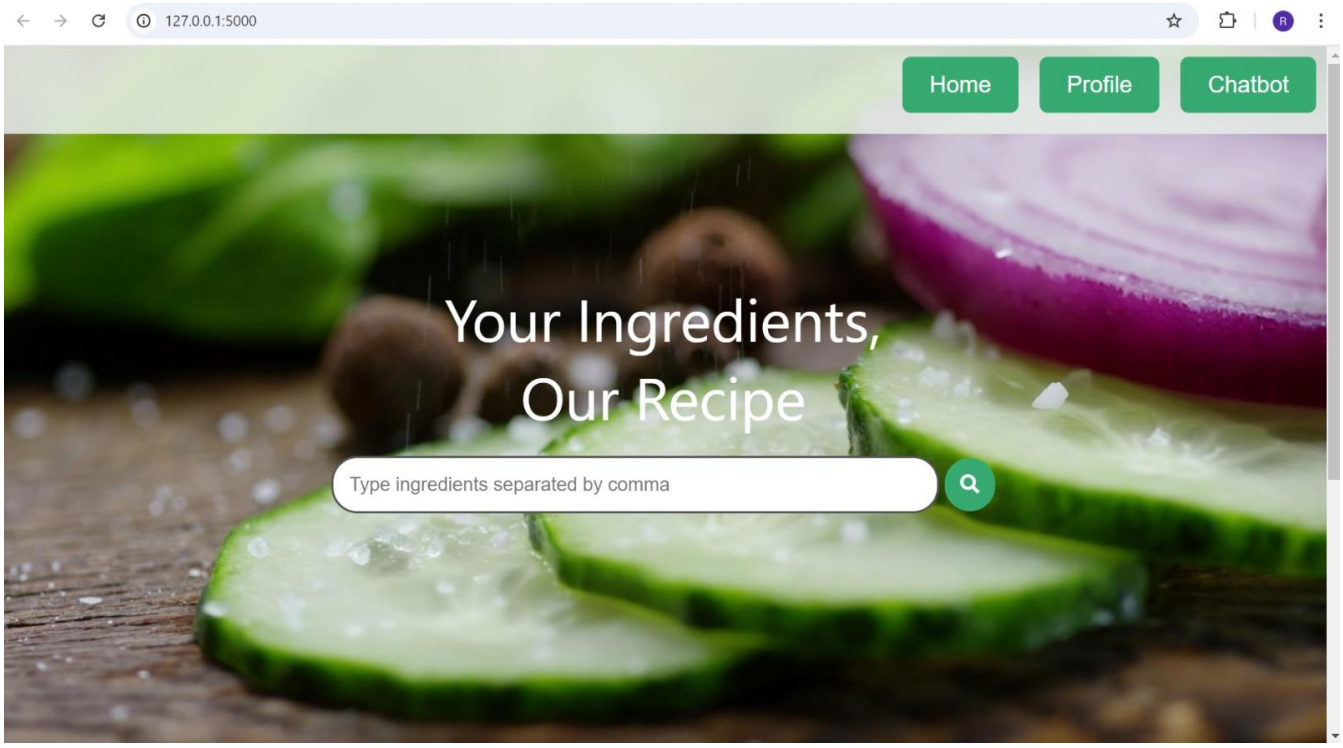


Fig. 5.4.1 Dashboard

From this page user will be able to search recipes based on ingredients available and also access the chatbot.

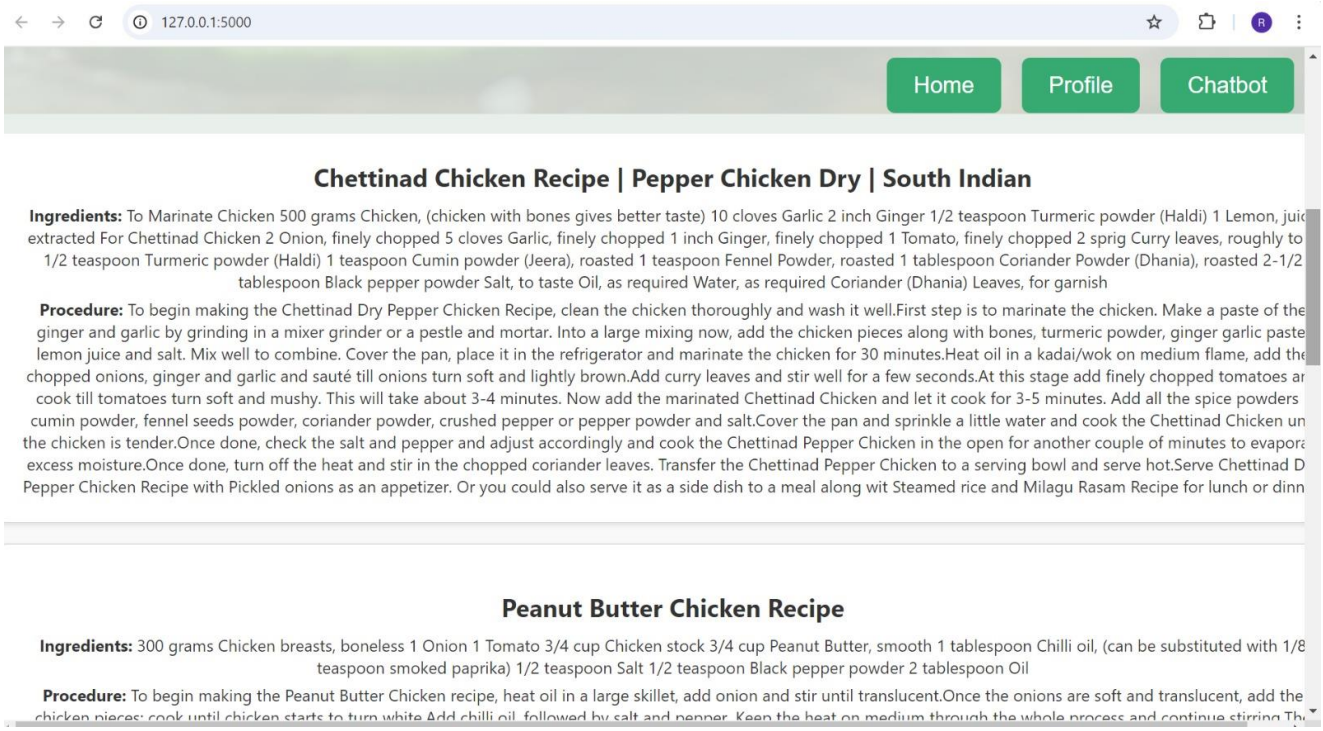


Fig 5.4.2 Recipes searched based on ingredient

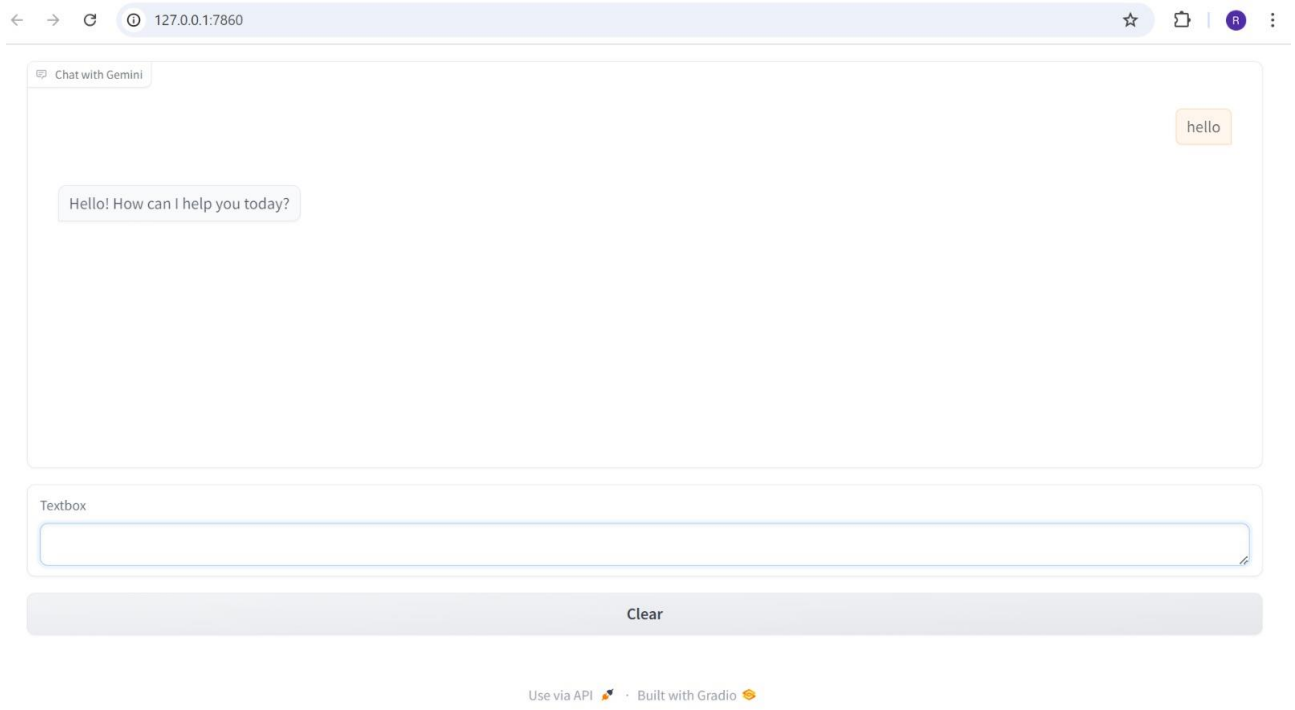


Fig. 5.4.3 AI Chatbot

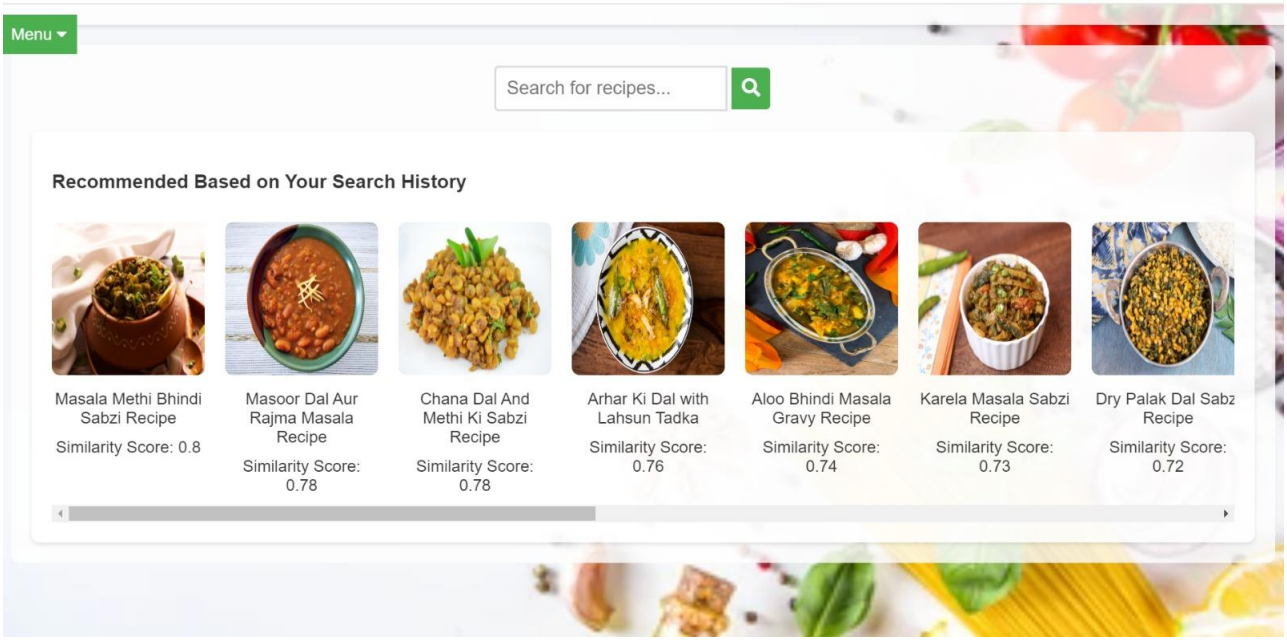


Fig. 5.4.4 Recipe Recommendation Based on Search History.

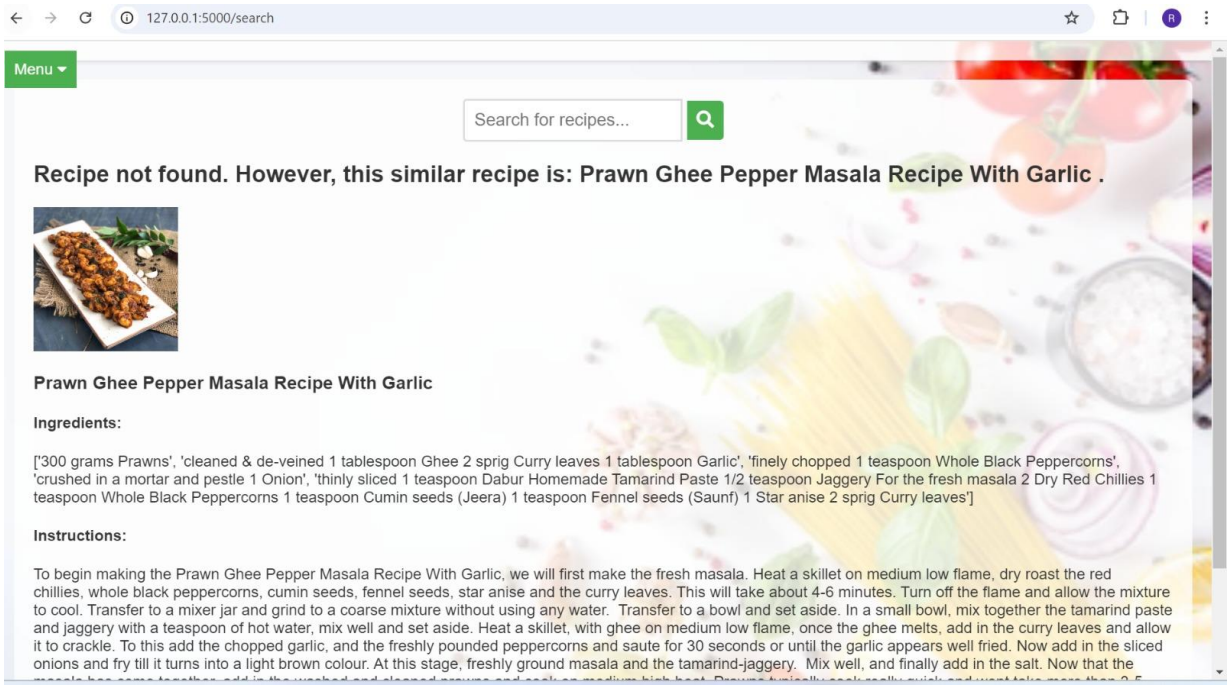


Fig. 5.4.5 Recipe.

Chapter 6

Technical Specification

Technology specification refers to a detailed outline of the technologies, tools, and methodologies that will be used in a project. It encompasses the selection of programming languages, frameworks, libraries, and platforms that will shape the development process and define how various components of the system interact. The specification serves as a guideline for the development team, ensuring consistency and coherence throughout the project lifecycle.

❖ **Web Technologies:**

Frontend:

- HTML5: HTML5 is the latest version of the Hypertext Markup Language used for structuring and presenting content on the web. It allows developers to create semantic and accessible web pages, supporting multimedia elements such as audio, video, and graphics
- **CSS** : CSS (Cascading Style Sheets) is used for styling and visually presenting HTML elements. It provides developers with powerful tools for layout design, including flexbox and grid systems, as well as advanced features like animations, transitions, and media queries for responsive design.

Algorithms:

1.. TF-IDF (Term Frequency-Inverse Document Frequency):

TF-IDF is a statistical measure used to evaluate the importance of a word in a document relative to a collection of documents (corpus). It combines two components:

- Term Frequency (TF): The number of times a term appears in a document.
- Inverse Document Frequency (IDF): A measure of how much information a word provides, calculated as the logarithm of the total number of documents divided by the number of documents containing the term.

By using TF-IDF, the system can identify and rank relevant terms in recipes or user queries, improving the quality of search results and recommendations.

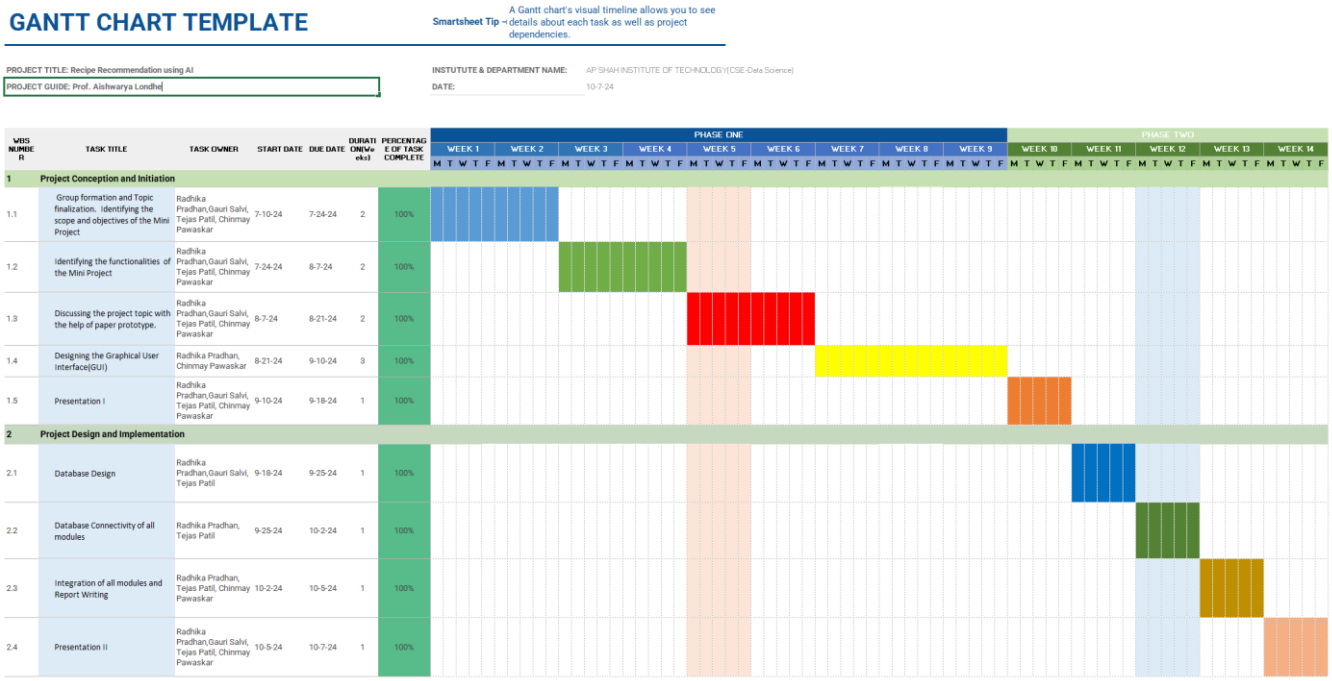
2. Word2Vec: The Word2Vec model is utilized to analyze and understand the relationships between ingredients and recipes by representing them as vectors in a continuous vector space. This approach allows the recommendation system to calculate the semantic similarity between recipes based on their ingredient lists. When users search for a recipe or an ingredient, the model identifies and recommends similar recipes that share common ingredients or cooking techniques. By leveraging user search history, Word2Vec can also enhance personalization, ensuring that recommendations align with individual user preferences. This dynamic adaptability helps create a more engaging and relevant experience, ultimately improving user satisfaction with the recipe discovery process.

Chapter 7

Project Schedule

Sr No.	Group Members	Duration	Task Performed
1.	Radhika Pradhan Gauri Salvi Tejas Patil Chinmay Pawaskar	2nd Week of July	Group formation and Topic finalization. Identifying the scope and objectives of the Mini Project. Discussing the project topic with the help of a paper prototype.
2.	Tejas Patil Chinmay Pawaskar	1st Week of August	Identifying the functionalities of the Mini Project. Designing the Graphical User Interface (GUI)
3.	Radhika Pradhan Gauri Salvi	3rd and 4th Week of August	The recipe recommendation model integrates advanced machine learning to provide accurate recipes from user inputs.
4.	Tejas Patil Chinmay Pawaskar Radhika Pradhan	1st Week of September	The model is seamlessly integrated into the website's graphical user interface (GUI), facilitating an intuitive and user-friendly experience.
5.	Radhika Pradhan Gauri Salvi	2nd and 3rd Week of September	The recommendation system is integrated to provide personalized recommendations based on user search history. Also AI Chatbot which seamlessly converse with user making the system more user-friendly.
6	Radhika Pradhan Gauri Salvi Tejas Patil, Chinmay	1st week of October	Report making and approving, Review 2

Gantt Chart



GANTT CHART TEMPLATE

Smartsheet Tip → A Gantt chart's visual timeline allows you to see details about each task as well as project dependencies.

PROJECT TITLE: Recipe Recommendation using AI
PROJECT GUIDE: Prof. Aishwarya Londhe
INSTUTUTE & DEPARTMENT NAME: AP SHAH INSTITUTE OF TECHNOLOGY (CSE-Data Science)
DATE: 10-7-24

PHASE ONE: WEEK 1 | WEEK 2 | WEEK 3 | WEEK 4 | WEEK 5 | WEEK 6 | WEEK 7 | WEEK 8 | WEEK 9
PHASE TWO: WEEK 10 | WEEK 11 | WEEK 12 | WEEK 13 | WEEK 14

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION(Weeks)	PERCENTAGE OF TASK COMPLETE
1	**Project Conception and Initiation**					
1.1	Group formation and Topic finalization. Identifying the scope and objectives of the Mini Project	Radhika Pradhan,Gauri Salvi, Tejas Patil, Chinmay Pawaskar	7-10-24	7-24-24	2	100%
1.2	Identifying the functionalities of the Mini Project	Radhika Pradhan,Gauri Salvi, Tejas Patil, Chinmay Pawaskar	7-24-24	8-7-24	2	100%
1.3	Discussing the project topic with the help of paper prototype.	Radhika Pradhan,Gauri Salvi, Tejas Patil, Chinmay Pawaskar	8-7-24	8-21-24	2	100%
1.4	Designing the Graphical User Interface(GUI)	Radhika Pradhan, Chinmay Pawaskar	8-21-24	9-10-24	3	100%
1.5	Presentation I	Radhika Pradhan,Gauri Salvi, Tejas Patil, Chinmay Pawaskar	9-10-24	9-18-24	1	100%
2	**Project Design and Implementation**					
2.1	Database Design	Radhika Pradhan,Gauri Salvi, Tejas Patil	9-18-24	9-25-24	1	100%
2.2	Database Connectivity of all modules	Radhika Pradhan, Tejas Patil	9-25-24	10-2-24	1	100%
2.3	Integration of all modules and Report Writing	Radhika Pradhan, Tejas Patil, Chinmay Pawaskar	10-2-24	10-5-24	1	100%
2.4	Presentation II	Radhika Pradhan,Gauri Salvi, Tejas Patil, Chinmay Pawaskar	10-5-24	10-7-24	1	100%

Following is the detail of the Gantt chart – In the third week of July, Radhika Pradhan, Gauri Salvi, Tejas Patil, and Chinmay Pawaskar formed a group for their mini-project. We have discussed and finalized the project's topic, scope, and objectives during this meeting. In the following weeks, Radhika Pradhan, Gauri Salvi, Tejas Patil, and Chinmay Pawaskar used a paper prototype to explore and refine project ideas, completing this phase by the 2nd week of August.

In late August, Radhika Pradhan, Tejas Patil, and Gauri Salvi executed the design and integration of the graphical user interface (GUI). Afterward, on the 20th of September, the first project review took place, and the faculty suggested some changes to the GUI, which were subsequently approved. Following this, Chinmay Pawaskar, and Tejas Patil collaborated to create a structured database system, facilitating the systematic storage of information.

This made it easier for Radhika Pradhan and Gauri Salvi to connect the database to the project. This database work was completed by the end of September. Finally, the team integrated all modules and completed the report writing, resulting in their final presentation on 07th October, which was approved by the faculty

Chapter 8

Results

The implementation of the AI-driven recipe recommendation system is poised to transform the culinary experience for users by leveraging cutting-edge web technologies and sophisticated algorithms. The anticipated results encompass several critical aspects that collectively enhance the overall functionality, user engagement, and performance of the platform.

- Improved User Experience: Users will have access to a visually appealing, responsive, and easy-to-navigate platform that enhances their cooking journey.
- Accurate Recipe Recommendations: The use of TF-IDF and feed ranking algorithms will ensure users receive relevant and personalized recipe suggestions tailored to their tastes and ingredient availability.
- Efficient Data Handling: Backend technologies will provide a reliable and efficient way to manage user data and interactions, ensuring quick response times and a seamless experience.
- Scalability: The chosen technologies will allow the system to handle an increasing number of users and recipes, ensuring long-term viability and adaptability.
- Community Engagement: Features such as user ratings and reviews will foster a community around cooking, encouraging interaction and sharing among users

Chapter 9

Conclusion

In conclusion, the AI-driven recipe recommendation system aims to revolutionize the culinary experience by integrating advanced web technologies and intelligent algorithms. The incorporation of advanced algorithms, including TF-IDF and feed ranking, allows for highly personalized recipe recommendations tailored to individual preferences and available ingredients. This not only enhances user satisfaction but also encourages users to explore new recipes and expand their culinary skills. By providing personalized recipe suggestions, enhancing user engagement, and ensuring efficient data management, the platform is designed to meet the diverse needs of its users. As it fosters a vibrant community and remains scalable for future growth, the system is set to redefine how individuals explore and enjoy cooking, making it more accessible and enjoyable for everyone.

Chapter 10

Future Scope

The future scope of the AI-driven recipe recommendation system is expansive, presenting numerous opportunities for enhancement and growth. As the platform accumulates user data, the underlying machine learning models can be refined to increase the accuracy and personalization of recipe recommendations. Potential improvements include integrating nutritional analysis and meal planning features, allowing users to track their dietary intake and generate tailored meal plans based on their health goals and available ingredients. Additionally, incorporating voice commands and visual recognition technologies would further streamline user interactions, making it easier to search for recipes and follow cooking instructions.

Furthermore, the system can evolve by adding enhanced social features that enable users to connect, share their culinary creations, and collaborate on cooking projects, fostering a vibrant community around food. Expanding the database to include a wider variety of international cuisines will attract a diverse audience, while integration with smart kitchen appliances can automate cooking processes for a more seamless experience. By promoting user-generated content and customization options, the platform can encourage individual contributions, enhancing engagement and personalization. Ultimately, by embracing these advancements, the AI-driven recipe recommendation system can redefine culinary exploration and adapt to emerging trends in cooking and dining.

References

[1] Zhang, X., & Chen, L. (2023) “AI-Based Recipe Recommendation Using TF-IDF and Feed Ranking”. Developed a recipe recommendation system using ingredient similarity (TF-IDF) and feed ranking to personalize suggestions.

[2] Kumar, S., & Patel, A. (2022) “Personalized Recipe Suggestions with Autocomplete and Feed Ranking”. Introduced an autocomplete feature and a feed ranking algorithm for faster and more relevant recipe searches.

[3] Singh, P., & Verma, M. (2021) “AutoChef: AI Chatbot for Recipe Suggestions”. Designed an AI chatbot that provides real-time, conversational recipe suggestions based on user input and preferences.

[4] Lee, K., & Park, J. (2020) ‘Smart Recipe Chatbot with Autocomplete and AI Ranking”. Created a chatbot to assist in finding healthy recipes, using autocomplete for faster searches and feed ranking for personalized recommendations.