STM JOURNALS

Journal of
Artificial Intelligence
Research & Advances

ISSN: 2395-6720
Volume 12, Issue 2, 2025
May–August
DOI Journal: 10.37591/JoAIRA

https://journals.stmjournals.com/joaira

Review JoAIRA

FoodieHUB: Food Recipe Suggestion Using AI-ML On Web

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Abstract

Finding a delicious recipe to cook with limited ingredients at home can be a challenging task. Many individuals struggle to prepare meals using only the ingredients they have on hand, creating uncertainty and limiting options. This project aims to develop a recipe recommendation system that utilizes machine learning algorithms to suggest recipes based on available ingredients, dietary preferences, cuisine types, cooking time, and user ratings. The project utilizes a Gradient Boosting algorithm, which is an ensemble learning technique that merges multiple weak prediction models to form a robust classifier. This approach effectively analyzes user inputs to recommend suitable recipes. The system includes both backend and frontend components to ensure a smooth user experience. The web interface offers personalized recipe recommendations, supports user authentication, and includes features such as multilingual support, recipe categories, and notifications for subscribed users. The system allows users to discover new recipes and prepare healthy meals at home while adhering to high standards of hygiene and freshness. By offering personalized recipe suggestions, the system helps users avoid eating out and promotes creativity in the kitchen, enabling them to cook the best possible dishes with their existing ingredients. Our 'FoodieHub' project aims to improve home cooking experiences by helping people prepare delicious meals with the resources available to them while prioritizing hygiene and healthy eating habits.

Keywords: Machine learning, gradient boosting classifier, artificial intelligence, recipe generation, user based, item based

INTRODUCTION

"Artificial Intelligence and Machine Learning Based Food Recipe Suggestion System" is an innovative project because with this project, everyone will learn how to make delicious food at home and how health can be maintained through home cooking. In this fast paced world, people often find themselves in a time crunch, especially when it comes to food preparation and cooking [1]. Then "FoodieHub" Project can help them. This project aims to harness the power of AI and ML to develop a web-based application that provides users with curated recipe recommendations based on their specific needs and tastes.

Furthermore, the system will facilitate user interactions through an intuitive and responsive web interface and provide detailed information about the ingredients in the recipe, cooking instructions, images, ratings and reviews, cuisine type, diet label,

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Received Date: September 25, 2024
Accepted Date: March 28, 2025
Published Date: April 16, 2025

Citation: Jaishri Shilpakar, Pooja Pal, Shivani Sangale, Nikita Shinde, Dinisha Suryawanshi. FoodieHUB: Food Recipe Suggestion Using AI-ML On Web. Journal of Artificial Intelligence Research & Advances. 2025; 12(2): 1–7p.

Figure 1. Homemade recipe bowl.

cooking-time, servings and the videos of the recipes. Moreover, people have diverse dietary preferences, including vegetarian, vegan, gluten-free, and more, making finding suitable recipes time-consuming [2]. The web interface is designed by using the ReactJs as Frontend and AI-ML for Backend (Figure 1).

The main goal of this project is to develop a user-friendly web application that utilizes AI/ML algorithms to analyze user inputs, including factors such as dietary restrictions, ingredient availability, cooking time, servings, etc. This analysis will enable the system to provide real-time, personalized recipe recommendations tailored to each user's unique criteria [3].

The success of this project will be measured by user satisfaction, recipe recommendation accuracy, system responsiveness, and adherence to data privacy regulations. By integrating AI-ML technologies including ML algorithms into cooking recipe generation, we aim to simplify meal planning, improve health, reduce food waste, and provide users with personalized and convenient solutions for their daily food needs [4]. The purpose of this is limited availability of certain ingredients or the need to use up leftovers often leads to frustration and wasted food.

OBJECTIVES

Providing a diverse range of recipe options to cater to different tastes, cuisines, and dietary needs: Our platform customizes recipe recommendations based on each user's preferences, dietary restrictions, and cooking habits [5]. Also, promoting healthier eating habits by recommending nutritious recipes that align with dietary guidelines and user wellness goals. Improving the overall user experience through intuitive interfaces, smooth navigation, and easy access to recipe recommendations [6].

- To provide clear and detailed instructions, including ingredient lists, cooking time, cuisine types.
- To encourage the use of fresh, seasonal, and locally sourced ingredients when possible.
- Recommending recipes based on available ingredients in the user's pantry or kitchen, reducing food waste and encouraging efficient use of resources.

ARCHITECTURE

Figure 2 presents the architecture of the system developed using the Fast API framework [7]. The process starts when users interact with the application, which collects their profile information and stores the necessary details in a database. Using this information, the system generates personalized food recipe recommendations.

A recommendation engine processes the user data and applies a training algorithm, specifically, the Gradient Boost Classifier, to create precise prediction models. Before training, the data is cleaned and structured using a data mining technique [8]. The Fast API framework manages the entire workflow, allowing for smooth, real-time recommendation delivery and user interaction.

- *User profile:* This refers to the data collected about the user, which can include their dietary restrictions, preferences, and past browsing behavior. This information is used by the recommendation engine to suggest recipes that are likely to appeal to the user.

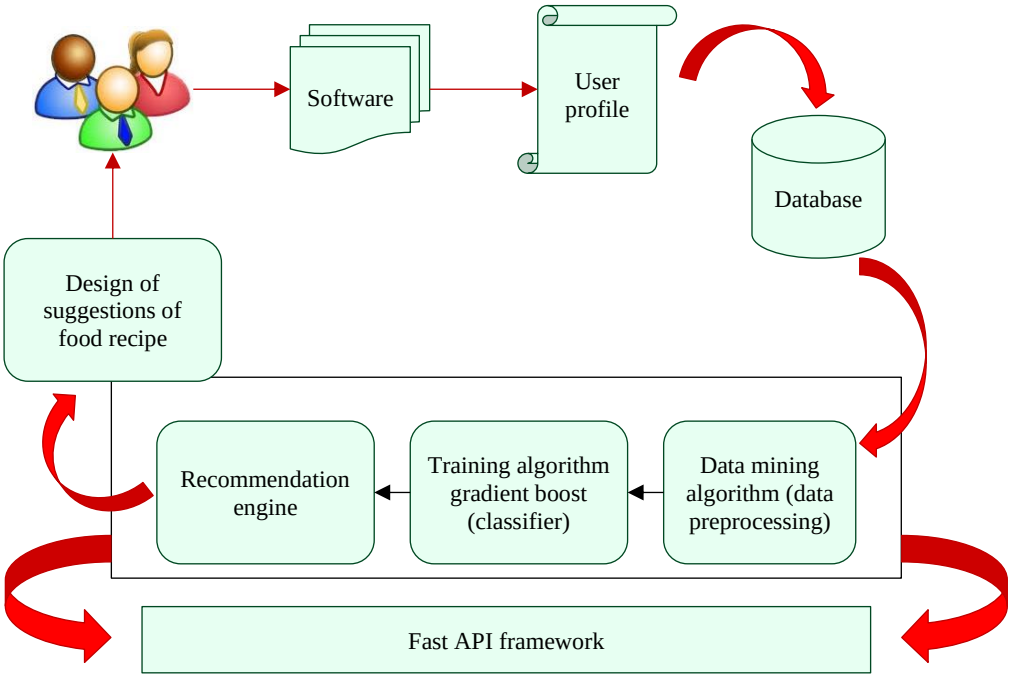

Figure 2. Proposed system architecture.

- *Database:* The system relies on a database to store user profiles, recipes, and other relevant data. This is where all of the data that is used by the system is stored.
- *Data mining algorithm:* Gradient boosting is a powerful data mining algorithm used for regression and classification tasks. It is part of the ensemble learning family, which focuses on combining multiple weak learners to develop a more robust predictive model.
- *Data training algorithm:* The gradient boosting is a training algorithm. It is an ensemble learning technique that integrates multiple weak models, typically decision trees, to form a more robust model.
- *Recommendation engine:* This is a machine learning algorithm that analyzes the user profile and other data to generate recipe recommendations.

LITERATURE REVIEW

In the domain of recipe recommendation systems, existing research has primarily focused on traditional methods such as recipes-by-name search and recipe recommender systems. One notable gap in existing systems is the absence of a recipes-by-ingredients search system [9]. While recipes-by-name search allows users to find specific recipes by their titles, it may not be practical when users have limited knowledge of the recipe names.

Similarly, the lack of a recipes-by-images search system represents another limitation in current recipe recommendation systems. Image-based search capabilities can significantly enhance user experience by allowing users to visually identify ingredients or dishes of interest [10].

AI-ML Based Food Recipe Suggestion System

Furthermore, the absence of comprehensive datasets containing information on ingredients, recipes, and associated images presents a significant challenge for researchers and practitioners in the field. While datasets such as Recipe1M+ provide extensive collections of recipes, they may lack detailed ingredient lists or accompanying images, limiting their utility for certain applications. The food items that are now accessible are represented as NoSQL and stored in MongoDB document-oriented databases [11]. Future research efforts should focus on developing recipes-by-ingredients and recipes-by-images search systems, as well as creating comprehensive datasets to support the advancement of recipe recommendation technology.

EXPERIMENTS

An extensive experimental analysis has been done by deploying the system on the windows platform with Python 3.8.7.

Data Collection

Data collection for training a gradient boosting algorithm involves gathering relevant datasets containing features and corresponding target variables. These datasets are typically sourced from a variety of channels, including databases, APIs, or manual data entry methods (Table 1).

Data Preprocessing

Preprocess the extracted features to prepare them for input into machine learning models. Data preprocessing steps are crucial for ensuring that the data is clean, consistent, and correctly formatted.

Algorithm

Gradient boosting algorithm: Utilizing gradient boosting algorithms for food recipe suggestion involves preprocessing recipe data, training a model on features like ingredients and user preferences, and integrating it into a web application.

Algorithm Steps

- *Input:* Train Feature Set {} containing the values from the training dataset, Test Feature Set {} comprising the values from the test dataset, Threshold T, and Label L.
- *Output:* Categorized all instances with their corresponding weight and label.
- *Step 1:* Retrieve all features from the test set using the following method:

  $\text{TestFeature} = \sum_{j=1}^{n}(T[j])$

- *Step 2.* Retrieve all features from the training set using the following method:

  $\text{TrainFeature} = \sum_{k=1}^{m}(T[k])$

- *Step 3:* Calculate the weights for both feature sets:

  $W = (\text{TrainFeature}, \text{TestFeature})$

- *Step 4:* Verify Threshold:
  Selected Instance= result =W>T? 1: 0;
  Add each selected instance into L, when n = null
- *Step 5:* Return L.

Food Recipe Suggestion

After applying the information mining method in the final step, we obtain a wealth of valuable information. With this data, we can recommend a food recipe tailored to the user's individual circumstances. The suggestions provided by our recommendation system will enhance your dietary structure and improve your health standards (Figures 3 and 4).

Table 1. Dataset information.

Index	Title	Cuisine	Diet-label	Cook-time
37073	Fried potatoes	Western	Gluten-free	40 min
94710	Italian fries	Italian	Vegan	15 min
60219	Mexican pasta	Italian	Vegan	25 min
40237	Wacky cake	American	Gluten-free	40 min
85994	Roasted fries	Western	Gluten-free	35 min

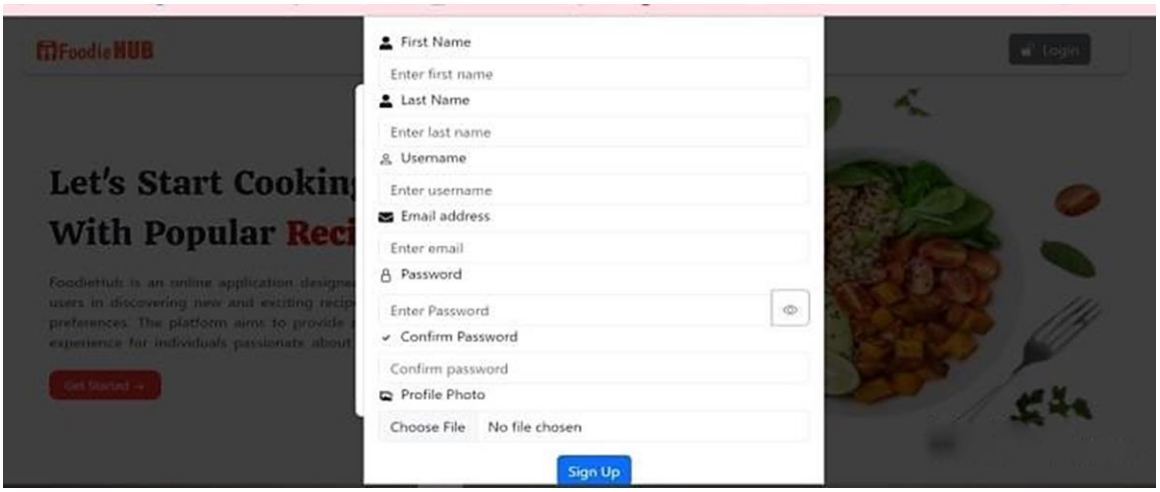

Figure 3. Register user.

Figure 4. User login.

RESULTS

The AI-ML project for personalized food recipe suggestions achieved successful recommendations by leveraging a Gradient Boosting classifier to predict user preferences accurately. The system incorporates user data, search input data, and recipe information, allowing it to offer customized and relevant recipe suggestions while considering dietary restrictions. The algorithm's transparency and interpretability enhance user trust by providing explanations for each recommendation, improving user engagement and satisfaction. The system interacts seamlessly with a database to store and retrieve user and recipe data, facilitating real-time personalized recommendations. The model's deployment on a Windows platform with Python 3.8.7 proved effective, and extensive experimental analysis confirms the approach's success. Users report delight with the personalized recipe suggestions, finding them valuable for planning meals and exploring diverse culinary options (Figures 5 and 6).

Figure 5. Different recipe categories.

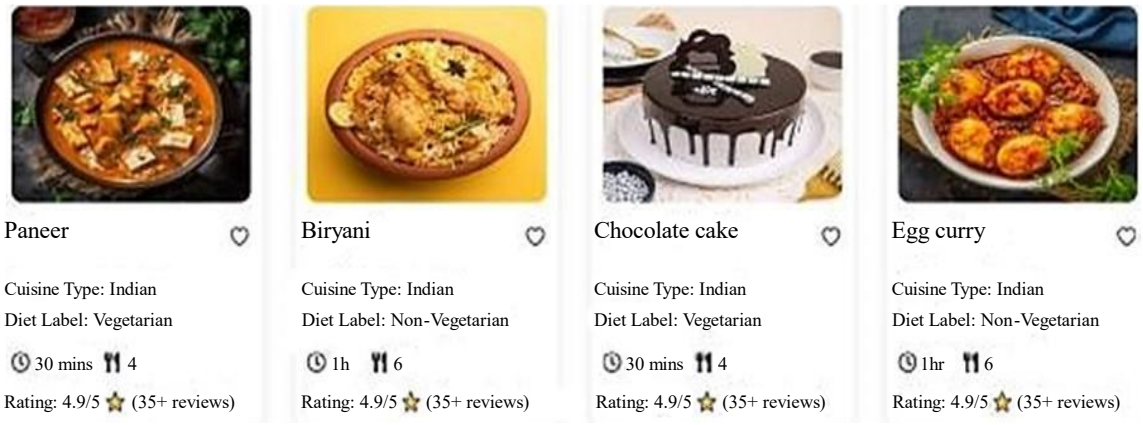

Figure 6. Menu details.

CONCLUSION

The "Food Recipe Suggestion Using AI-ML" project offers a promising solution for users seeking personalized recipes. Integrating artificial intelligence and machine learning, this project has transformed the landscape of food recipe recommendations, delivering tailored suggestions aligned with individual preferences and dietary requirements. Cutting-edge algorithms provide accurate, personalized recipe suggestions, enriching users' culinary experiences. By conducting careful data collection, preprocessing, and model training, we have created a recommendation algorithm that effectively predicts recipe likability. The user interface offers a smooth experience, allowing users to easily input their preferences and receive pertinent recipe suggestions in return.

Future Work

Developing a mobile application for the recipe recommendation system to offer on-the-go access and seamless user experience across different devices. By examining user interactions and preferences, the system can continually adjust and enhance its recommendations over time. Implementing strategies to enhance user engagement and retention, such as gamification, social sharing features, and community forums for recipe sharing and discussion.

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