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Intelligent Process Automation for Recipe Suggestion & Prediction

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Abstract This paper introduces the concept of designing an Intelligent Process Automation Model for Recipe Suggestion & Prediction that leverages the power of machine learning and artificial intelligence to provide recipe suggestions and culinary advice specifically tailored to each user. The developed model will generate custom-made recipe suggestions, ingredient substitution proposals, and provide feedback and learning capabilities. Through suggesting recipes based on the user's dietary preferences, the ingredients they have in hand, and their competency in cooking the model will help people develop a more balanced and varied meal plan. This research paper will describe the development and design of an intelligent cookbook, as well as identify and discuss possible implications for the food industry.

***IndexTerms*: AI Cookbook, Intelligent Recipe Recommendations, Dynamic API Integration, Machine Learning in Cooking.**

I. Introduction

An advanced recipe app is a thrilling project that was born at the crossroads of culinary science and the rapidly expanding possibilities of modern web application creation to meet the increasing demand for novel, passionate, and imaginative user-friendly web applications. The study focuses on the development of a recipe application that embraces JavaScript and several APIs to offer a beautiful, agile user experience. The application possesses a responsive design which is ideal for a variety of devices and includes both light and dark modes.

The responsiveness of this application is another most crucial element that allows the user to satisfy various needs on different devices. The application is developed with screen fitting programming language and can be responsive on different screens on devices and operating systems, such as desktop, tablet, or smartphone. Addition to that, the application UI can be enhanced in the light and dark theme, which makes it look beautiful and more creative based on user preference. Culinary and technical work combined have been an exciting area to study in a volatile field of web development. The paper presented above is a way of navigating assisting areas of the field that contribute to the user's cooking and their part of the modern applications.

The proposed journey, created at the intersection of the culinary arts and technology, gracefully intertwines the millennia-old culinary traditions and the rapidly developing field of innovation, forming an exciting tapestry of discoveries. Since its origin, culinary arts have been continually affected by technological innovation, transforming the ways we harvest, prepare, and consume food. Technological progress has directly affected the evolution of the culinary arts, from mastering fire in ancient civilizations to the kitchen's mechanization during the Industrial Revolution. Today's marriage of innovation technology with creative cookery has reached unprecedented heights, leading to the creation of digital gastronomy. It redefines how we search for, cook and enjoy food, utilizing smartphone apps, smart devices, and artificial intelligence. This Lineage traces the evolution of our culinary history as well as emphasizes how technology continues to revolutionize and remake the gastronomic world. While using artificial intelligence and machine learning, this inquiry also looks to create an intimate dining experience for its readers. Unlike other advanced cookbook applications, the authors argue that their approach offers personalized food ordering, interchangeable ingredients, and continuous feedback aside from recipes. Moreover, as users imprint their dietary needs, ingredient availability, and cooking ability, the intelligent cookbook becomes a more sophisticated solution that fosters both chef-like innovation and good choices. The paper seeks to uncover the layers of intelligent process automation.

II. Literature Survey

The digital world is constantly accumulating an enormous set of recipes. However, with an increasing number of recipes it becomes more difficult to navigate through them. Recipe suggestion and prediction system can help with that – it is able to suggest a set of recipes best fitting the user and the context. This work will attempt to explore the key areas of research into such a system. This review explores the key research areas within this domain.

A. "RecipeIS—Recipe Recommendation System Based on Recognition of Food Ingredients" by Rodrigues, M.S., Fidalgo, F., & Oliveira, Â. in Applied Sciences (2023).

In the research paper RecipeIS—Recipe Recommendation System Based on Recognition of Food Ingredients by Rodrigues, M.S., Fidalgo, F., & Oliveira, Â. , the authors' goal was to develop a system that would recommend a recipe by recognizing the ingredients. The attention was paid to the digital solutions that suggest a recipe by recognizing an ingredient or an image, the frameworks for recognizing the ingredient, and the approaches to solving the problem of recommending the recipes by using the leftover meal. A model of recognizing an ingredient was presented, and the dataset consisting of 36 classes of food ingredients and 3115 images was described. The results achieved were discussed. The model has the routes of recognizing the images, allowing the users to upload the images of food ingredients and get a recommendation of a recipe. In the analyzed study, the research capitalized on the necessity to find a suitable recipe based on the user's choice of ingredients. Such an ability is particularly relevant for both amateur and professional cooks as failing to identify the healthy and compatible ingredients can negatively affect the cooking process.

B. "Recipe Recommendation With Hierarchical Graph Attention Network" (2021).

The research paper proposes a novel model, namely hierarchical graph attention network for recipe recommendation. The main idea is to utilize the information from multiple types of relations between users, recipes and food ingredients on the recommendation task.

The HGAT model consists of several key components:

1. Type-specific transformation: We use a transformation matrix to project the information from the heterogeneous content of the node vi onto a shared embedding space.
2. Node-level attention: We encode the neighborhood of a given node in the graph based on a new designed attention module, where the goal is to weight the neighbors according to the type of relation they present to the current node.
3. Relation-level attention: Another attention module is built to fuse all the relation-specific embeddings with different weights and get the final embedding for each node by considering the information of the relationship and the node content at the same time.
4. Score predictor and ranking-based objective: A score predictor is added, and the module is trained using a ranking-based loss function considering user and recipe embeddings that have been learned.

The point that the relational information is essential for understanding user preferences and should be used for recipe recommendation is justified. Extensive experiments showed that the proposed HGAT model outperforms multiple baseline methods. However, the authors could mention that incorporating even more information, such as user reviews or health concerns, can be the future work.

C. "On the predictability of the popularity of online recipes" by EPJ Data Science (2018).

The significance of the research is one of the four key questions the authors seek to answer. The food and nutritional psychology literature about online rating is what the authors will research. How the two online communities of food in Allrecipes.com and Kochbar.de differ, or are they the same, from known features of areas in food and nutrition psychology will be investigated. To what degree are there any potential correlations that could be leveraged in a certain prediction task? To what degree is the popularity of online recipes predictable, and what are the most useful predictors in this prediction task?

There are differences in the provided data from the two platforms based on ways recipes are cooked and stored, shared, and represented along with the nutrition characteristics of the chosen food. However, the authors have managed to determine that several correlations between the recipe features and corresponding proxies for popularity existed allowing to predict the popularity of the recipe for the two datasets well and passably. The paper highlights the potential for using data-driven approaches to understand and predict the popularity of online recipes, which could have practical applications in areas like recipe recommendation systems. The authors discuss the limitations of their study and propose future research directions in this domain.

D. "Recipes for Success: Data Science in the Home Kitchen" by Drozdzal, M., Giro-i-Nieto, X., & Romero, A. (2019).

The research "Recipes for Success: Data Science in the Home Kitchen" by Drozdzal, M., Giro-i-Nieto, X., & Romero, A. deals with using data science when it comes to home cooking. Researchers wish to investigate and enhance the generation of recipes from photographs of specific food. They aim to create the cooking process more efficient by giving cohesive recipes comprising an ingredients list, methods, and a step-by-step order. Moreover, the authors talk about the recipe writing issue and the dish on which working to make these recipes consistent. They mention the importance of data-driven design when it comes to the context of recipes regeneration and the dedication of making these recipes to ensure that people do good cooking in their homes.

The paper also mentions that abstractive systems have the opportunity to suffer from a lot less stove topology common in the recipes generated as it is able to output a recipe that does not exist in the exact same form on any infinitive. The authors mention various other works on enhancing the coherence of the generated recipes, while giving users more control over the generation. To sum up, the text offers an interesting view of data science making lives better by changing their home cooking practices.

E. "Recipe recommendation using ingredient networks" by J. Cheng and Y. Shen

In their research paper, Recipe recommendation using ingredient networks, J. Cheng and Y. Shen explore the world of recipe recommendation by the means of ingredient networks. The study is concerned with learning more about the connection between ingredients in recipes that can be used to improve the process of recommendation. To begin with, the authors analyze how often various ingredients appear together and user-provided advice on substitutions of a product with another based on taste. This yield two principal types of networks: the network of complements and the network of substitutes. The former feature the set of ingredients that often accompany each other, with the communities formed by the ingredients grouped according to their taste, i.e., sweet and savory.

In contrast, the alternative network records the preferences of users toward healthier alternatives for the ingredients. It has been established that the ratings of recipes can be accurately predicted using features derived from ingredient networks. On a larger scale, the use of derived features and nutrition byproducts is beneficial as the approach is instrumental in providing the relationship that exists among ingredients and the preferences of users removing ambiguity and uncertainties in the cooking experiences.

F. "DeepFood: Automatic multi-class classification of food ingredients using deep learning." by Pan, L., Pouyanfar, S., Chen, H., Qin, J., & Chen, S.C (2017)

Pan, L., Pouyanfar, S., Chen, H., Qin, J., & Chen, S.C., 2017 DeepFood: Automatic multi-class classification of food ingredients using deep learning. 2017 IEEE International Conference on Computational Science and Engineering CSE and IEEE International Conference on Embedded and Ubiquitous Computing EUC, 2017 , 679-686.

The research paper presents a new framework known as DeepFood based on deep learning techniques for automatic multi-class classification of food ingredients. The authors purport to solve the challenges of food ingredient classification by taking advantage of deep learning and transfer learning. The research paper consists of an introduction, related work, a discussion on the DeepFood framework, experimental results, and the conclusion. The DeepFood framework contains two main modules:

1. Deep Feature Extraction: In this framework, the authors used a pre-trained set of Convolutional Neural Networks CNN as a fixed feature extractor for about fifty thousand potato images. The potato images were utilized to extract rich and effective roots of features.
2. Multi-Class Classification: In the final implementation, the classification results are analyzed and ranked to determine the class to which the extracted features belong from a multi-class list.

The experimental results by the authors show that the proposed method enhances the recognition accuracy of food ingredients. The performance of various CNN models on the multi-class dataset of 41 classes with 100 images is analyzed. To optimize the results of classification, as well as find the most appropriate feature selection method, the authors evaluated the performance of different feature selection technologies, including Information Gain feature selection. In the paper, it has been proven that the proposed DeepFood framework vastly enhances the recognition accuracy of food ingredients.

G. "Inverse cooking: Recipe generation from food images" by Shirai, Y., Kobayashi, W., Takei, K., Yoshizawa, K., & Sato, N. (2017).

The research paper “Inverse cooking: Recipe generation from food images” by Shirai, Y., Kobayashi, W., Takei, K., Yoshizawa, K., & Sato, N., it is devoted to the implementation of the system which is capable to generate recipes from food images. In writing the article, the authors consider the requirements for the use of systems that identify the images of food in an attempt to create recipes; including the ability of the latter to use food products and the sequence of the creation of dishes. The use of the recipe by ordinary people is especially important since the many substance websites are abstractive but not available, and it is valuable when abstractive systems can generate more coherent recipes that can be generally followed.

The authors describe a system that can recognize food ingredients and cooking techniques from images and generate a recipe. They show that their system can discriminate between sets of recipes with same ingredient distributions and distict cooking distributions. In addition, it is shown that the same image would lead human raters to consistently prefer recipes from the model over those from websites that are similar to that of the authors. The paper then finds that the system can generate recipes from food images and can serve as an important platform in the evolution of fully automatic food detection. The authors also mention that their approach can be useful in food safety and control of food quality, as well as in the development of systems for personalized nutrition and meal scheduling.

H. "Reciptor: an effective pretrained model for recipe representation learning" by Li, D., & Zaki, M.J. (2020).

The research paper “Reciptor: An Effective Pretrained Model for Recipe Representation Learning” by Li, D., & Zaki, M.J. presents a novel approach to learning effective pretrained recipe embeddings using both ingredients and cooking instructions. The authors propose a joint model, Reciptor, which combines a set transformer-based architecture with a knowledge graph KG derived triplet sampling approach to optimize the embeddings.The Reciptor model is designed to preserve permutation invariance for the ingredient set, ensuring that the order of ingredients is irrelevant to the recipe representation. The model also incorporates a novel KG-based triplet sampling approach to optimize the embeddings learned by the model, so that related recipes are closer in the latent semantic space.

The authors present empirical results that show the effectiveness of their Reciptor model on two downstream tasks, outperforming state-of- the-art baselines by a wide margin. Experiments demonstrate that “the Reciptor model can learn general-purpose or pretrained representations for recipes” in a way that captures many essential facts known about the recipes, such as the ingredients and instructions needed. The takeaways of this paper are that the Reciptor model is a huge improvement to recipe representation learning and that its potential applications to food computing, like perception, recognition, recommendation, and more, benefit from such kinds of representations.

I. "User's food preference extraction for personalized cooking recipe recommendation" by Ueda, M., Takahata, M., &

Nakajima, S. (2011).

In the research paper "User's Food Preference Extraction for Cooking Recipe Recommendation" by Ueda, M., Takahata, M., & Nakajima, S. , the authors introduce a method for a personalized recipe recommendation relying on the user's food preferences. The ultimate goal of the authors is to identify a user's food preferences relying solely on their recipe browsing and cooking history. It is considered a crucial step in a personalized cooking recipe recommendation. Recipes are disintegrated into their components – ingredients, and each is peer-reviewed based on its frequency of occurrence and the extent of its detection. The user's food preferences are traced back in time; thus if a user has ingested food with a varying degree of categorization in previous several days, the system will not recommend dishes with the same ingredient separation. The approach ensures that users are recommended only dishes that are in line with their positively ascertained tastes and conditions. The results show that the proposed method can extract the user's favorite ingredients with a precision of 60 to 83% and unfavorite ingredients with a precision of 14.7%. Moreover, the value of F-measure to evaluate the proposed method can be 60.8% in the case of extracting favorite ingredients when the target category is 20 top ingredients. Therefore, from the evaluation of the results, it is possible to conclude that the proposed method is effective in food preference extraction and in its ability to provide cooking recipe recommendations. It means that the application of the developed method can improve the quality of life by providing users with healthy food options based on their needs and preferences.

J. "An evaluation of recommendation algorithms for online recipe portals" by Trattner, C., & Elsweiler, D. (2019).

The research paper entitled "An Evaluation of Recommendation Algorithms for Online Recipe Portals" by Trattner, C., & Elsweil er, D. provides a detailed evaluation of recommendation algorithms for online recipe portals. The analysis is done by considering the assessment of collaborative filtering and content-based approaches with the use of the large data set of naturalistic user interaction data examined over 15 years from online recipe portals. As a result, it is shown that CF approaches outperform CB approaches when using the complete dataset, which means that collaborative filtering methods are critical in the domain of recipe recommendation.

Moreover, the article raises the issue of food recommendation algorithms that can help improve the healthiness of diets and coping with such dietary-related problems as diabetes or obesity. The paper also mentions the need for the datasets and the significance of health-related factors added to the recommendation algorithms to make them work in a better and more effective way. In other words, the article sheds light on the challenges associated with food recommendation systems that will be helpful to users in terms of their health issues, indicating the need for developing persuasive technologies as part of such systems.

III. Existing System

One of the leading tools within the food enterprise is the intelligent process automation system based on machine-learning, such as forecasting and recommending recipes obtain notable research and initiatives like Chef Watson [10]. These systems operate on large datasets with food photos, ingredients, and recorded recipes to identify and predict them accurately. The ultimate aim is to promote healthy eating, simplify the process of discovering new dishes, and help chefs to explore new approaches to culinary art.

K. Few Intended IPA Schemes

1) Website on Diet Recommendation Using Machine Learning

The FRS is recommended for diabetic patients that gathered K-mean clustering and Kriging was self-organizing contour for clustering of food investigation. The proposed system suggests the substitute foodstuffs according to food and foodstuffs specifications. However, FRS does not give acceptable food to disease intensity problem. The basis of disease intensity may fluctuate hourly in several cases in the understanding of the suggested food vehicle may also differ as said earlier. The android-based food recommender system employs tags and idle figure extended. The system recommends personalized recipes for the user, based on labels and ratings provided in client inclinations. The proposed system uses idle figure vectors and system factorization in the algorithm. Prediction precision is executed by several precise tags which are nearby match. The formulas recommended with the coordinating fixing. The nourishment components are not viewed by the creators because it alters within the diet. Possibility of indistinguishable proposal as it shows since the inclination of the client may not alter on everyday basis. The over counted diets proposal frameworks are stocked with a number of solutions. Some meals or counted diets are especially dealing with a few infections or attached to equality the counted diets. While proposition food for a number of ailments, the frameworks prescribe distinctive nourishments for individuals without judging the level of disease; this might alter in a number of cases, having extreme influence to the patient. Equally when auditing food to correspondent the diets, the nourishment components are not judged that are really linked to review food and diet plans.

<u>FRAMEWORK:</u>

1. User flow: Users will input their physical data into the system then the ML model will process the data and recommend the user diet consisting of breakfast, lunch, dinner. The architecture of the system.
2. System Architecture: Users will input their age, gender, weight participate on the website: then their data goes through the ML model as follows:
   - K-Means clusters the food according to calories.
   - Random Forest Classifier classifies the food then predict the food based on the input.
   - The system is going to calculate all and showcase the users' BMI, and then their status "Overweight, Underweight, Healthy.
   - The three outputs of the users' diet see based on the input "Breakfast, lunch, and dinner".
   - Users will have several recommendations on each output above, then they will choose whichever they want.
   - The users' data will be calculated.
3. The user's diet plan is then created.

Figure 1: Diet Recommendation Flowchart

2) IBM Chef Watson

Chef Watson is a cooking application from IBM that makes a difference cooks discover and make unique, one-of-a-kind formulas with the help of flavor compound algorithms. It enhances clients by suggesting fixing combinations that work well together after analyzing expansive sums of information from our enormous formula databases and recognizes designs of ingredients. If one doesn't have the necessary fixings, Chef Watson will assist them with discovering other ideal fixings as close to the formula as possible.

Key features of IBM Chef Watson include:

1. Ingredient suggestion: The user should give the ingredient they have, and it assists y'all with proposing appropriate recipes for the given fixing. It acts like a bot that is both time and resources effective.
2. Generating recipes: It helps me by suggesting recipes based on the given ingredients, and indeed gives you homogenous instructions.
3. Cuisine selection: If you would wish to try a specific type of cuisine, you can select and that narrows down the search for suitable recipes; that is one knocking feature.
4. Adaptability: Chef Watson improves its performance over time by learning from user feedback and enhancing its recommendations based on such feedback.
5. Professional version: A professional version of Chef Watson with more extensive datasets and advanced analytic features is available.
6. Accessibility: Chef Watson is available to the public via a user-friendly interface that encourages people to try its features.

FRAMEWORK:

Chef Watson prompts the user to input the ingredients you have or preferences such as cuisines, dietary restrictions, etc. The IBM's machine learning model collects data from various sources such as recipe databases, food blog posts, culinary literature, and more. Data processing is initiated to use the new data and extract meaningful details such as ingredient combinations, flavor profiles, cooking techniques, etc. The machine learning model then uses the processed data to identify patterns, trends, relationships, and potential correlations between distinct ingredients, flavors, and cooking styles. Finally, based on the user's input and the machine learning model's insights, Chef Watson will come up with personalized recipe suggestions. The user may adjust the recipe recommendations based on their preferences, such as serving size, ingredients omission, or changes in cooking techniques [19].

API Retrieved: In case chef Watson finishes the user, recommendations and needs more API for improving the information or content for the final recommendation, it can withdraw the dynamic API to search for more conclusions. In static statement, Chef Watson output will assist the user in the final recommendation of the menu along with the detailed information for the ingredients prepared and the nutrition of the suggestions provided.

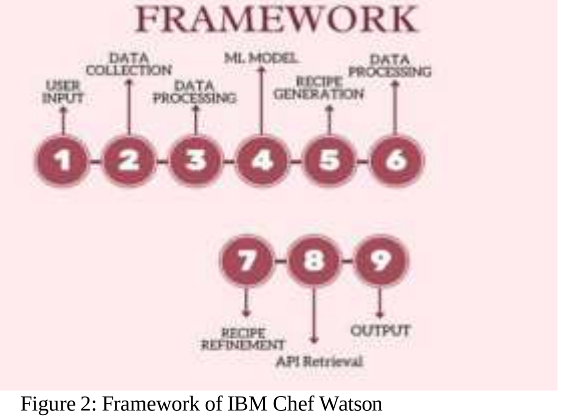

Figure 2: Framework of IBM Chef Watson

IV. Proposed Framework

Intelligent process automation is a relatively new and novel technology approach that leverages machine learning and artificial intelligence to revolutionize the way people discover and curate culinary experiences and other forms of interests. As set up to static recipe databases, IPA offers an adaptable, dynamic, and user-specific system of recipe discovery and recommendation. IPA uses advanced artificial intelligence (ai) and machine learning to input sophisticated techniques to offer unique and personalized suggestions centered on the user's preferences. Additionally, it provides context-based and real-time recommendation as well as multimodal interaction above passive suggestion systems.

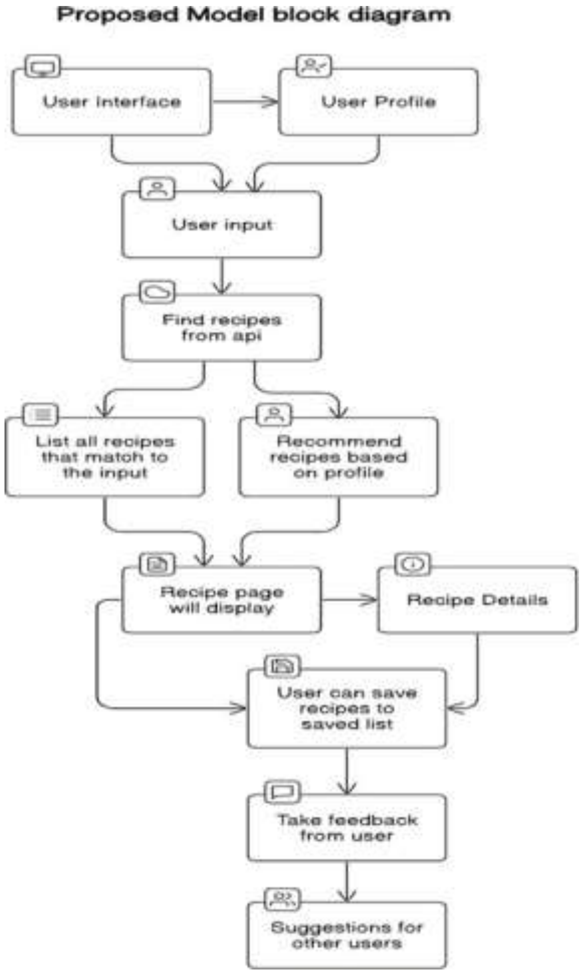

Figure 3: Proposed Model Block Diagram

In summary, this system will include profile analysis, dynamic API-based recipe retrieval, and user input, facilitating Intelligent Recipe Recommendation and User Engagement platform creation. More importantly, with user participation to enhance the culinary effect and personalized recipe recommendations, as well as informative insight for further system development. The suggested model, as seen in Figure 1, described above.

1. User Interface: It is the location where users have their first experience with a system and is created to be stunning and user-friendly. After integrating users into the system,
2. User Input: the user Input must be specified the users' nutritional needs, culinary tastes, and some other essential details. This is when users design their recipes following the information given.
3. User Profile: This process includes creating and editing a user profile for the given input. A profile is information on the user's dish limitations, cooking expertise, and favorite recipes.
4. Find Recipes from API: The external API will be used to get users' recipes according to basic input. The API provides open-source food data, ensuring that all types of recipes are available.
5. List all recipes: The system accumulates and shows a list of all recipes that satisfy the input parameters the user had entered. This is actually only an initial list of suggestions, which emphasizes the fact that the choice is still diverse.
6. Recommend recipes from profile: By analyzing and picking recipes that match the various people's profiles, the algorithm combines the user's recipes in a way that is both recommended and customized.
7. Recipe page display: To return to the results of the filtered recipes, a different Recipe Page would be supported. The combination of recipes would be handled first with a substantial collection of ingredient lists, guidance, or optics and estimated calories.
8. Save recipe to saved list: A simple, personalized recipe saver is already in action within the system. It would be simple to find your favorite recipes accessible.
9. Recipe Details: Through the Recipe Details section, customers can access a wide range of information about each recipe. Along with user- generated content and hints, this feature contains more information as well.
10. Take User Feedback: The system seeks feedback from the user on the recipe viewed and tried by the user. On the one hand, this feedback loop allows the algorithm to revise and enhance its recommendations. The other, though, is an essential mechanism for continuing growth.
11. Recommendations for Other Users: Based on the input from all user, the system recommends recipes to other users.

This collaborative functionality empowers users to experiment with recipes that are both new and established while fostering a spirit of community.

V. Implementation

1. General

In the context of suggesting recipes, a recommendation system provides customized recipe options that match each user's specific preferences. Users have the ability to use different filters to refine their search, choosing recipes based on factors like preferred ingredients, ingredient quantity, cooking duration, and dietary limitations such as vegan or gluten-free. This filtering function enables users to swiftly discover recipes that fit their individual tastes and everyday habits.

Through the use of machine learning algorithms, the system can constantly adapt and improve based on user behavior and previous interactions. This ongoing learning enhances the accuracy of the system, allowing it to offer more relevant suggestions over time. Additionally, users have the option to provide feedback on recommended recipes, which helps further develop the system's understanding of their preferences.

The recommendation system goes beyond simple filters to offer more detailed choices like calorie count, nutritional plans, and cuisine preferences. This allows users to adjust their selections to meet specific health objectives or cultural tastes. Users also have the option to bookmark their preferred recipes for quick access, helping them create a personalized collection of favorite dishes. This high level of customization ensures that the recommendation system not only improves convenience and efficiency but also enhances a unique cooking experience tailored to each user's preferences.

2. Factors implemented

1. User Preferences: The system collects information form users which could include dietary preferences, ingredients restrictions like number of ingredients required, ingredient allergies, cuisine preferences, cooking time, calorie count and other relevant information. This input helps personalize the recommendation.

2. User Profiling: Based on information provided by user, the system creates a profile that represents the user’s preferences and constraints. This profile include data such as saved recipes, cooking habits, allergies, nutrition plan.

3. Filtering: The system provides filter features which include cuisine preferences, cooking time, ingredient availability, calories count and dietary restrictions.

4. Ranking: The system ranks the recommended recipes based on their ratings and relevance to the user’s preferences.

5. Data Representation: Recipes in the system are represented in a structured format. These representations capture various attributes of the recipes, such as ingredients, cooking methods, cuisine type, and user ratings.

6. Presentation: The system recommends recipes that are presented to the user through user interface in the form of website.

7. Feedback: The system collects feedback from users such as liked or disliked recipes. This feedback is used to improve accuracy of future recommendation.

VI. Results

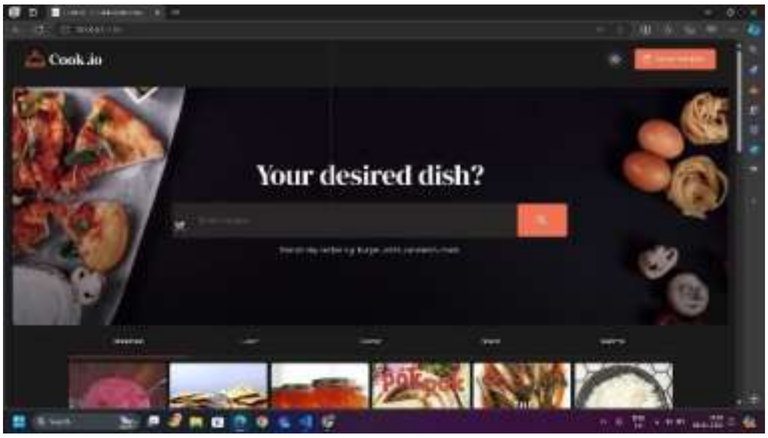

Fig. 1 User Interface Home Page

Fig. 1 depicts the sleek and user-friendly design of Cook.io, a popular online platform that specializes in recipe generation. This interface is designed to be intuitive, allowing users to seamlessly explore a wide variety of recipes and meal inspirations. The layout features clear navigation and interactive elements, facilitating a smooth browsing experience for both amateur cooks and seasoned chefs. Users can easily search for specific recipes, filter by dietary preferences, and even save their favorite dishes for future reference.

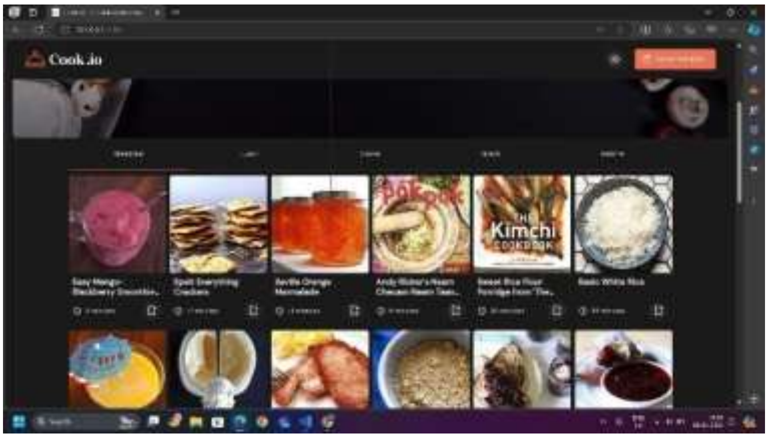

Fig. 2 All Recipes Page

Figure 2 showcases a recipe page from Cook.io, which dynamically fetches and displays recipes from an external API. The page features an extensive and diverse selection of dishes, ranging from elaborate main courses to quick and easy desserts. This array of recipes is continuously updated, providing users with a wide variety of meal ideas, catering to different tastes and cooking skill levels. The interface is designed to be user-friendly, allowing for easy navigation through the various types of cuisine and dish categories.

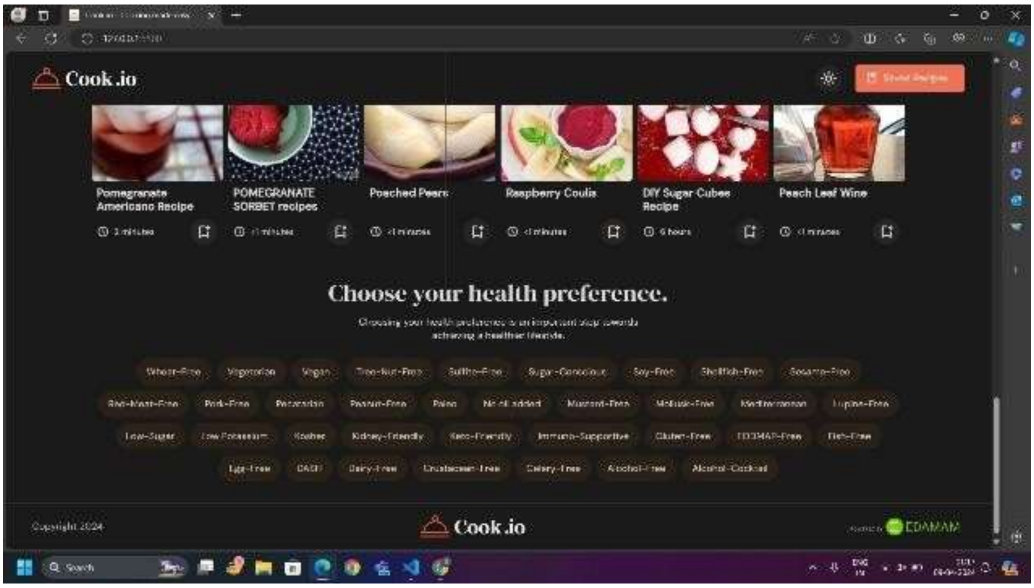

Fig. 3. Diet Preferences

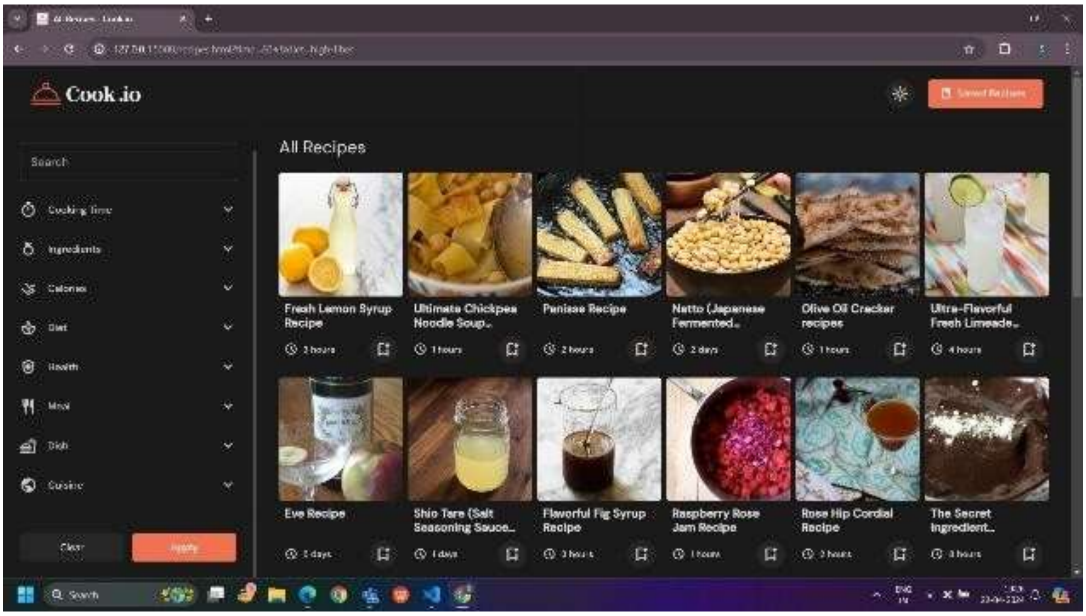

Fig. 4 Recipe Filters

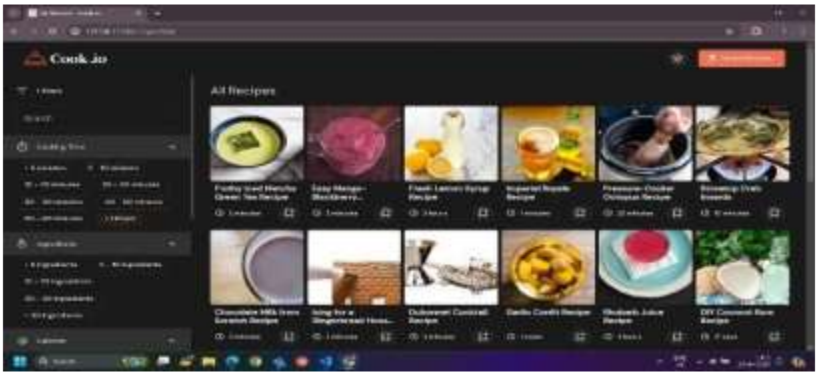

Fig. 5 Recipe Filters

Figures 3, 4 ,5 in the Cook.io interface demonstrate an intuitive system for exploring a vast collection of recipes. Through these figures, users can access a variety of search and filtering options that streamline the recipe selection process. Whether someone is looking for vegetarian dishes, quick meals, or specific cuisine types, the interface's filtering capabilities provide an efficient way to narrow down choices. This targeted search experience enhances user satisfaction by allowing individuals to find recipes that closely match their preferences and dietary needs.

VII. VIII.

Fig. 6 Recipe Details Page

In fig. 6 Cook.io presents its recipe details page, providing full information on the selected recipe. Here, users could find all the necessary directions with a detailed description of how to cook a certain dish and the approximate time needed for this. Moreover, dietary information, such as nutrition facts and suitability for a particular diet, could be seen. Due to such detailed presentation, users become more interested in the application and could make their choices or start their cooking experience with confidence.

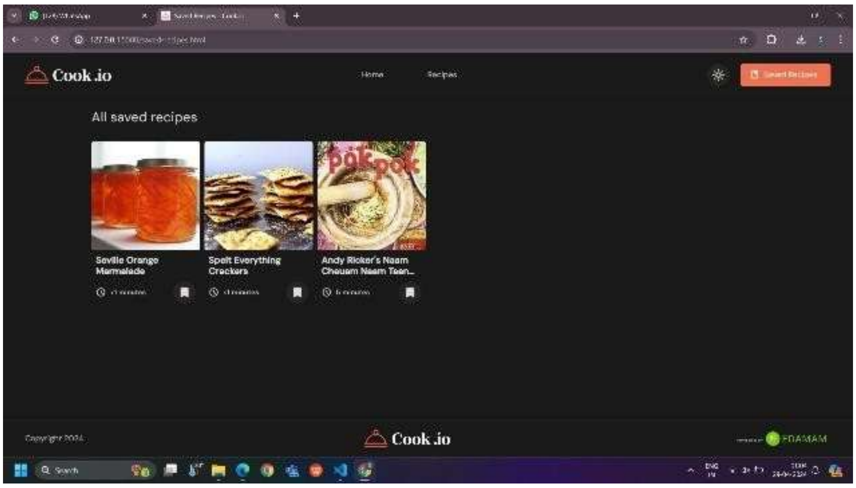

Fig. 9 Saved Recipes Page

The fig. 9 is a visual depiction of the recipes that users have saved. It helps to illustrate how users may sort or organize their saved recipes based on their tastes, interests, diet preferences, and kitchen experience. This is a major benefit as it eases access to a user's choice of foods or even recipes that they have not yet tried. Cook.io, through this system, aims to ease the lives of the users through simulating the possibility of accessing users' choice of foods.

IX. Conclusion

Building an ideal IPA recipe recommendation system is a complex process that applies a set of techniques, including machine learning, natural language processing, and data analytics. The task for the system is to provide a person who uses it with personalized and preference-based recipe suggestions. For this purpose, a combination of collaborative and content-based filtering is used, along with data augmentation via external APIs. The user interface instrumental when it comes to enabling usage with minimal or no deviation from the system. The system must be as reliable as possible; therefore, continuous testing, including pairs like unit and user acceptance testing, is needed. Besides, regular updates, model retraining and other features are related to continuous and high technology readiness.

X. References

The following research papers were used while working progressively on this project.

[1]Rodrigues, M.S., Fidalgo, F., & Oliveira, Â. (2023). "RecipeIS—Recipe Recommendation System Based on Recognition of Food Ingredients." *Applied Sciences*.
[2](2021). "Recipe Recommendation With Hierarchical Graph Attention Network."
[3]EPJ Data Science (2018). "On the predictability of the popularity of online recipes."
[4]Drozdzal, M., Giro-i-Nieto, X., & Romero, A. (2019). "Recipes for Success: Data Science in the Home Kitchen."
[5]Cheng, J. & Shen, Y. (2011). "Recipe recommendation using ingredient networks."
[6]Pan, L., Pouyanfar, S., Chen, H., Qin, J., & Chen, S.C. (2017). "DeepFood: Automatic multi-class classification of food ingredients using deep learning."
[7]Shirai, Y., Kobayashi, W., Takei, K., Yoshizawa, K., & Sato, N. (2017). "Inverse cooking: Recipe generation from food images."
[8]Li, D., & Zaki, M.J. (2020). "Reciptor: an effective pretrained model for recipe representation learning."
[9]Ueda, M., Takahata, M., & Nakajima, S. (2011). "User's food preference extraction for personalized cooking recipe recommendation."
[10] Trattner, C., & Elsweiler, D. (2019). "An evaluation of recommendation algorithms for online recipe portals."
[11] Bharam, A., Baldota, K., Jagtap, A., Pansare, A., & Bamane, S. (2021). "Indian Cuisine Recipe Recommendation based on Ingredients using Machine Learning Techniques."
[12] (2020). "A Review: Recommendation System of Indian Cuisine Recipes using Content-Based Approach."
[13] (2019). "Recommendation of Indian Cuisine Recipes based on Ingredients."
[14] (2022). "Recipe Recommendation by Ingredients Detection."
[15] Yang, L., Hsieh, C.K., Yang, H., Pollak, J.P., Dell, N., Belongie, S., Cole, C., & Estrin, D. (2017). "Yum-me: a personalized nutrient-based meal recommender system."
[16] "HDSR. (2020, July 30). Recipes for Success: Data Science in the Home Kitchen. https://hdsr.mitpress.mit.edu/pub/wjrl1qsq/release/3
[17] Clickworker. (n.d.). AI in the Food Industry is Transforming the Business.
[18] ResearchGate. (n.d.). Data Quality Considerations for Big Data and Machine Learning: Going Beyond Data Cleaning and Transformations.
[19] Gartner Inc. (2017, March 30). IBM Watson Chef Brings Artificial Intelligence to Cooking.