International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Recipe Recommendation System Using NLP, Deep Learning

Ashmitha B M[1], Aleena Tom[2], Amal Mathew Paul[3] , Abhiroop M P[4] ,Aswathy T S[5]

[1]DEPT OF CSE(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)& VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI,KANNUR,KERALA
[2]DEPT OF CSE(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)& VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI,KANNUR,KERALA
[3]DEPT OF CSE(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)& VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI,KANNUR,KERALA
[4]DEPT OF CSE(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)& VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI,KANNUR,KERALA
[5]DEPT OF CSE(ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)& VIMAL JYOTHI ENGINEERING COLLEGE,CHEMPERI,KANNUR,KERALA

Abstract - In the field of culinary the food and recommendation have a significant role and development. In modern year the use of large-scale datasets, Machine learning techniques and also the personalized health and nutrition were growing prioritized day by day. Literature review includes four various research papers consisting the aspects of recipe recommendation system in an innovative way, that containing user preference elicitation [1],personalized meal planning [3], image to recipe generation [4], and recipe representation learning [2].These papers make highlight of the importance of user focused design, large data combinations, and adaptable in every users and enhance accuracy also the accessibility of food recommendation system. With the use of developed machine learning models, such as collaborative filtering [3],vision transformers [4] and graph neural networks [2].In these mechanism it provides custom solutions for healthy habitual eating and improve the user pleasure. Upcoming research technology includes the IoT methods and adjusting techniques to multiple culture and religious dietary plans. Here introducing the possibility of culinary methods to maintain the dietary plan and being well.

***Key Words*:** Image to recipe generation, recipe representation learning, collaborative filtering, graph neural networks.

1.INTRODUCTION

The area of culinary and recipe suggestion witnessed remarkable progress in present years, created through the possibility of vast datasets, expansion of machine-learning techniques and main target upon customized health and nutrition. Overall, this contains the summary of the four current research papers, all of them follows specific aspects about recipe recommendation system, includes user choice evaluation, dynamic food plan, image to recipe conversion and also ingredients design learning. Simultaneously, particular surveys focus on importance of client-friendly pattern, corporation of compound knowledge and also the usage of latest machine-learning techniques for enhance the accuracy, exactness and operation of recipe recommendation system.

Late generation obtain noticed curious improvement in the range of culinary and food recommendation system, guided through the openness based on huge dataset, alternation in machine-learning and concentrate over customized health and nutrition. Integration of the aspects of four research papers, each have various facet of recipe suggestion systems, working for designing user choices, customized meal planning, image to recipe conversion and understanding recipe design. The above-mentioned studies were generally delivering the value of design system in user's soul, care of multifaced data, and working leading machine learning methods to glow up strength as well as logic of recipe recommendation system.

2. LITERATURE REVIEW

The paper "FIRE: Food Image to Recipe Generation" explores an innovative approach combining vision and natural language processing models to create recipes from food images. The method utilizes three key components: Bootstrapping Language-Image Pretraining for generating food descriptions, Vision Transformer for ingredient identification, and Text-to-Text Transfer Transformer for creating standardized cooking instructions. The system is trained on the Recipe1M dataset and aims to maximize the probability of accurate ingredient prediction through a detailed mathematical framework. Despite its capabilities in generating end-to-end recipes with accurate pairing of ingredients and instructions, the approach faces challenges such as difficulties in recognizing overlapping ingredients, potential errors in cooking procedures, and computational intensity. The research represents a significant advancement in culinary AI, with opportunities for further improvement in ingredient recognition, matching technology, and quantity prediction.

The study "Recipe Representation Learning with Networks" introduces an innovative embedding model called Recipe-to-Vector that organizes recipe information within a network structure. This model incorporates textual, structural, and nutritional information through a refined neural network module that includes Textual Convolutional Neural Networks, Inner-Ingredients Transformer, and Graph Neural Networks. The Textual CNN captures patterns from cooking instructions, the Inner-Ingredients Transformer identifies relationships between different ingredients, and the Graph Neural Network maintains text and structural relationships through Node-level and Relation-level Attention mechanisms. While this approach offers advantages in recipe categorization and recommendation by interconnecting complex ingredients and implementing graph neural networking mechanisms, it faces challenges including expensive computational requirements, dependency on structured data, and difficulties handling rare ingredients or insufficient combinations in visualized data. Nevertheless, Recipe-to-Vector represents a significant improvement in food AI with opportunities for future upgrades in culinary applications.

The paper "Healthy Personalized Recipe Recommendations for Weekly Meal Planning" presents SHARE, a recommendation system that establishes a filtering approach for personalized diet planning. The system employs three key methodologies: Collaborative Filtering, which identifies users with refined dietary tastes and analyses their ratings on food items while normalizing to remove biases; Content-Based Filtering, which evaluates recipe components and allocates them based on user preferences by extracting key features such as nutritional and dietary elements; and Knowledge-Based Filtering, which provides recipes in accordance with medical and nutritional advice for users with specific health conditions such as diabetes or cardiovascular diseases. The SHARE model offers numerous advantages, including personalization of dietary choices, real-time preference updates, and health-aware recommendations. However, it also faces limitations such as computational complexity, dependence on user involvement, and challenges in handling unique or specially designed diets. Despite these constraints, SHARE provides a dynamic tool for automated, customized, and health-related meal planning.

The study "Interplay between Food Knowledge, Nudges, and Preference Elicitation Methods Determines the Evaluation of a Recipe Recommender System" examines how to enhance user usability in recipe recommendation systems by combining machine learning-based content filtering with knowledge-based preference elicitation. The research implements Content-Based Filtering, which uses Term Frequency-Inverse Document Frequency to analyse recipe ingredients and determine similarities using cosine similarity metrics, primarily serving novice users who search recipes based on previous preferences. Additionally, it incorporates Knowledge-Based Filtering, which employs a more sophisticated retrieval process where users provide specific health-relevant information such as Body Mass Index, dietary plans, and cooking experience, which is then mapped to recipe elements using pre-determined rules. The study highlights that while content-based filtering offers ease of use but lacks dietary flexibility, knowledge-based filtering leads to healthier choices but requires greater user effort. This research emphasizes the need for flexible, user-specified recommendation designs that can serve both casual and health-conscious users, suggesting that future research should focus on developing more effective nudging techniques to increase user engagement with knowledge-based recommendations.

Table -1: Comparison table

Sl no.	Paper Title	Year	Proposed solution	Drawbacks
1	FIRE: food image to recipe generation.	2024	BLIP model generates food titles, Vision Transformer extract ingredients ,T5 encoder decoder for step-by-step instructions.	Struggles with ingredient accuracy,high resources and rare regional dishes.
2	Recipe representation learning with networks.	2021	SincNet, ResNet (Residual Network), Reccurent neural networks.	Needs large labeled data, is computationally intensive, and may not generalize to new ingredients.
3	Healthy personalized recipe recommendations for weekly meal planning.	2023	Collaborative Filtering (CF),Content-Based Filtering (CB),Dynamic Adaptation Feedback,Health-Oriented Personalization.	By using the official health guidelines, it may benefit from more diverse and specific datasets for different health conditions.
4	The interplay between food knowledge, nudges, and Preference elicitation methods determines the evaluation of a recipe recommender system.	2023	Experiment, surveys, SEM analysis, user evaluation.	Requires user adaptation, complex implementation, higher effort for beginners, and limited universal effectiveness.

3. CONCLUSIONS

Proposed Recipe Recommendation System addresses key demanding situations identified inside the reviewed studies, such as consumer choice elicitation, personalized meal planning, photo-to-recipe technology, and representation learning. By merging machine learning and deep learning methods, this challenge affords a modern technique to recipe pointers. The involvement of superior photo-to-recipe models and textual content-based ingredients input guarantees flexibility for customers, allowing personalized and dynamic recipe pointers. Features such as nutritional content ingredient analysis, vegetarian and non-vegetarian options helps user selections and provide numerous nutritional desires. Traditional systems usually focus on basic recommendations, this project remarks on human centered design by integrating data from different sources e.g. Computer vision and natural language processing to setup better ingredient detection and recipe analysis. Moreover, the project focus on healthier eating habits, efficient meal preparation and minimal food wastage along with the growing demand for sustainable and health-conscious in culinary solutions. Choosing this project allows us to contribute meaningfully to the sector of meals computing by means of combining innovative technology and sensible packages. Its attention on adaptability, inclusivity, and personalization gives a big gain over traditional systems. Furthermore, this project demonstrates real-world applicability and societal impact, making it a really perfect choice for addressing modern-day challenges in dietary planning and promoting overall well-being.

REFERENCES

[1] El Majjodi A, Starke AD, Elahi M, Trattner C. The Interplay between Food Knowledge, Nudges, and Preference Elicitation Methods Determines the Evaluation of a Recipe Recommender System. InIntRS@ RecSys 2023

[2] Yijun Tian, Chuxu Zhang, Ronald Metoyer, and Nitesh V. Chawla. 2021. Recipe Representation Learning with Networks. In Proceedings of the 30th ACM International Conference on Information & Knowledge Management (CIKM '21). Association for Computing Machinery, New York, NY, USA, 1824–1833.

[3] Zioutos K, Kondylakis H, Stefanidis K. Healthy Personalized Recipe Recommendations for Weekly Meal Planning. Computers. 2023 Dec 20;13(1):1.

[4] Chhikara P, Chaurasia D, Jiang Y, Masur O, Ilievski F. Fire: Food image to recipe generation. InProceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision 2024 (pp. 8184-8194).