International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 12 | Dec - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Meal Recommendation System Using Machine Learning

Tejas Nahar, Shubham Pingale, Vidit Nandoskar, Niraj Kashid

Dr. Deepti Varshney *Professor, Dr. D. Y. Patil School of Engineering & Technology, Via Lohegaon, Charoli Budruk, Pune – 412105*

Abstract-In this study, we propose a unified meal recommendation system designed to enhance the dining experience for hotel guests by suggesting meals that satisfy their daily calorie needs and dietary preferences. The findings indicate that this hybrid approach has significant potential to recommend meals accurately while aligning user preferences with their behavioral patterns. This solution provides a practical and scalable way for hotels to encourage healthier and more enjoyable dining experiences through personalized meal suggestions. By merging content-based and collaborative filtering techniques, the technology addresses the varied preferences of guests, ensuring an enriched culinary experience throughout their stay.

Keywords: K-Nearest Neighbour Algorithm, Content based Filtering, Collaborative based Filtering cosine similarity

1.Introduction

The field has recently gained much attention, given the huge potential benefits related to the improvement of dietary habits, enhancement of user satisfaction, and response for specific nutritional needs. With technology playing an ever-increasing role in everyday life, these meal-recommendation systems are gradually becoming an indispensable tool in personalized nutrition and lifestyle management. By applying machine learning, meal recommendation systems parse information on user preferences, dietary constraints, and behavior in order to offer tailored suggestions aimed at helping the users reach their particular goal-be it weight control, health improvement, or something as simple as gastronomic novelty.Machine Learning will allow such systems to process large volumes of data, including user feedback, food attributes.

2.Objective

To implement a System Which is used to give Meal Recommendations by taking into consideration a Person's BMI data and help him to choose Food which is more beneficial for him. To collect user feedback, ratings, and reviews to continuously improve the Recommendation System and adapt to changing customer preferences.

3. Literature Survey

Paper1:- A new social system based on **Human-Behavior-Based Personalized Meal Recommendation and Menu Planning,** The paper's focus is on using human behavior patterns, such as eating habits, preferences, and lifestyle factors, to create personalized meal recommendations and menu plans. The system utilizes machine learning algorithms to analyze user-defined data, such as dietary preferences, health goals and contextual factors like time and activity levels, to suggest meals. Its approach focuses on improving user satisfaction and encouraging healthier eating by taking into account the needs and behaviors of its users.

Paper2:- The paper **"A Novel Time-Aware Food Recommender System Based on Deep Learning and Graph Clustering"** by Mehrdad Rostami and Mourad Oussalah introduces a food recommendation system that incorporates temporal factors, such as time of day and seasonality, to enhance meal suggestions. The system combines deep learning techniques with graph clustering to model complex relationships between users, meals, and time, offering more accurate and contextually relevant recommendations.

Paper3:- 2022 study by Megh Shah and Dhairya Vyas developed a **"Diet Recommendation System"** using K-nearest neighbor and support vector machine algorithms. This system offers dietary advice for weight management and health regimens, though it requires a well-structured input format and consideration of health-related factors.

Paper4:- The paper by M. Prema Sundari and C. **"A Food and Therapy Recommendation System for individuals with Autism Spectrum Disorder"** (ASD) is provided by Yamini. By suggesting specific food items and activities that meet individual preferences, the system aims to enhance ASD patients' overall health. This is done through an app-based system. The system aims to improve the physical and mental health of individuals with ASD by considering both diet and therapy options in conjunction with treatment. This is an integrated approach. According to the paper, individuals with ASD can receive tailored guidance in managing their symptoms.

Paper5:- "**A Food Recommender System Considering Nutritional Information and User Preferences**" that takes into account both the food and user preferences for personalized meal recommendations. The system endeavors to optimize dietary choices by considering aspects such as nutritional information, calorie content, and user preferences like taste and adherence to certain foods. By incorporating these components, the system empowers users to make informed and healthier food choices that complement their lifestyle and health goals. Better nutrition can be promoted through the use of food recommendations with greater efficiency.

4.Mathematical Model

a) Q: Set of States
Define the states the system can operate in. Let:

$$Q = \{q0, q1, q2, q3, q4\}$$

Where:

q0: BMI Calculation
q1: Feature Extraction (e.g., extracting user dietary preferences)
q2: User Preference Analysis
q3: Meal Recommendation Generation
q4: Recommendation Display

b) Σ: Input Set
Define the inputs that transition the system between states. Let:

$$\Sigma = \{b, p, f, r\}$$

Where:

b: BMI value
p: User dietary preferences and restrictions
f: Feature set for meal recommendation
r: Results from preference analysis

c) δ: Transition Function
Define the transition function $\delta: Q \times \Sigma \rightarrow Q$ that describes state changes.

Let:

δ (q0, b) =q1: After calculating BMI, transition to Feature Extraction.

δ (q1, p) =q2: Use dietary preferences to proceed to user Preference Analysis.

δ (q2, f) =q3: Analyse user preferences to generate suitable meal recommendations.

δ (q3, r) =q4: Display the generated meal recommendations to the user.

d) q0: Initial State

The system starts in q0, the BMI Calculation state.

e) F: Final State

The system ends in F={q2}, the Meal Recommendation Generation state.

5.Materials and Algorithms

Data collection:

The collection of data involves analyzing user interaction and meal characteristics.me. The data is derived from user profiles, app usage, and surveys. Machine learning models are trained on individualized meal recommendations using data analysis and preprocessing.

Data preprocessing:

Begin by cleaning and preprocessing the dataset to address any missing values and maintain data consistency. It's also essential to standardize the portion sizes of each food item. Detecting and treating outliers is a crucial step in data preprocessing, as they can significantly impact both statistical analysis and the training process of a machine learning system, potentially reducing accuracy.

User Input:

The user interface design enables users to enter their daily calorie needs, weight, and height. Based on this input, a calculation is performed within the dataset.

Feature Engineering

Pull out helpful details from the data set such as what's in the food, what kind of food it is, and any diet labels like low-carb or high-protein. We also figure out things like how much protein, and fat are in each food, as a percentage.

Content based Filtering

A meal recommendation system uses content-based filtering to suggest meals based on user ratings or preferences. It recommends comparable meals based on the characteristics of the meal, such as its type (of origin), ingredients (includes new or leftover items), calorie content, or dietary restrictions. The system will suggest other Italian dishes that are either vegetarian or similar to them if the user likes vegetarian food

Collaborative Filtering

The use of collaborative filtering involves analyzing the preferences and behaviors of various users to create personalized meal recommendations. It recognizes patterns in user behavior, such as ratings, clicks, or purchases, and establishes a user's preferences by considering the preferences of similar users. Two main methods of searching are collaborative filtering: user-based filter, which suggests meals based on similar tastes from other users, and item-Based collaborative filters, where individuals identify common items they enjoyed together. Both options have significant overlap

K- Nearest Neighbors

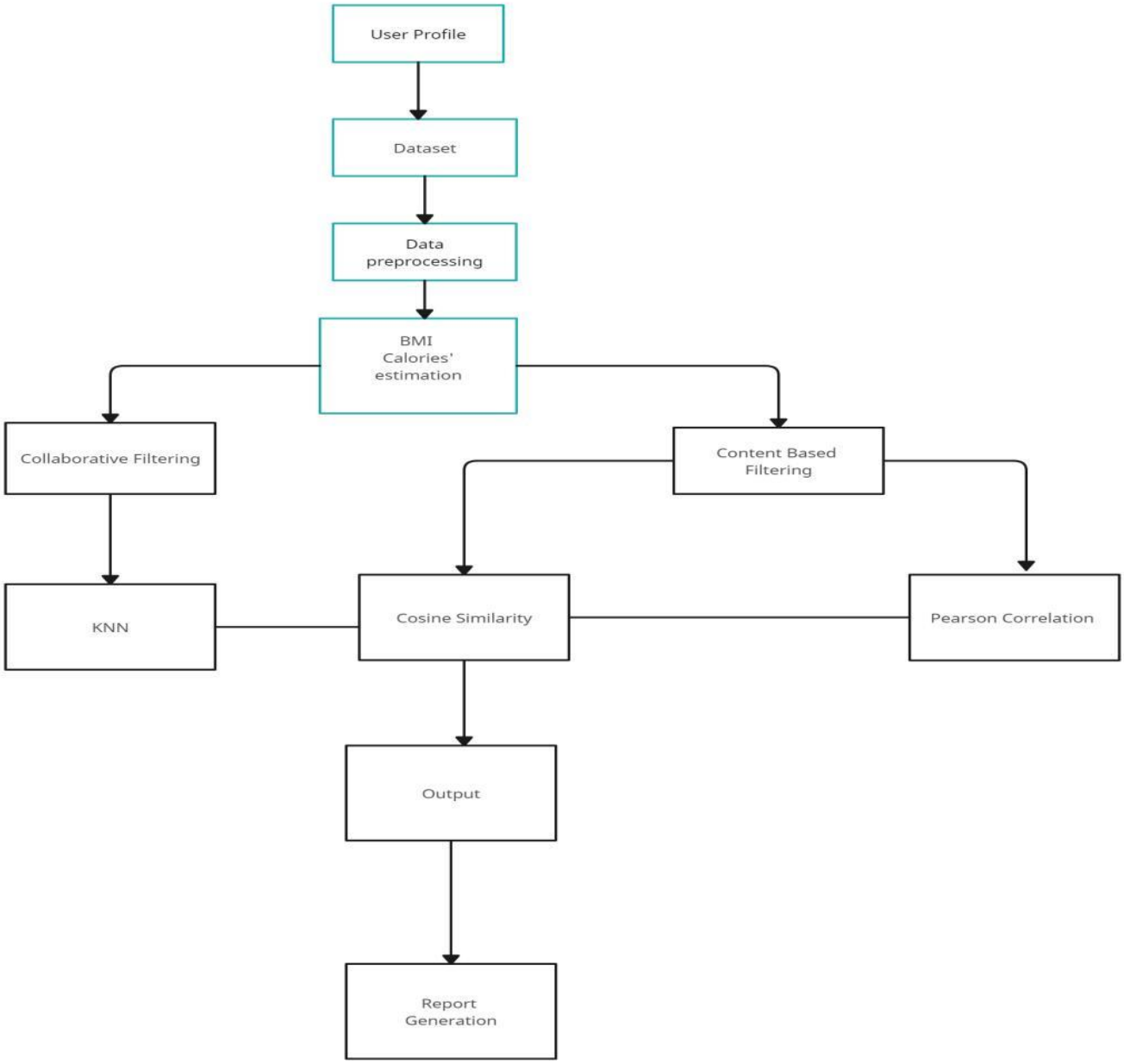
We were able to adapt K-Nearest Neighbors (KNN) into this computer as collectively filtering methodology. Under KNN umbrella, we can identify and recommend similar users or snacks according to historic interaction data. This makes meal recommendations more personalized. Also in the same way, we can use KNN in item-oriented collective filtering systems. By similar meals we mean that are had frequently together or foods with complementary characteristics consumed by hundreds of people. For instance, you previously ate a certain dish, and we suggest what you eat from now on may be just as good.

Recommendation Engine:

The meal recommendation system incorporates machine learning algorithms to provide personalized recommendations for food items by analyzing user input and output data. It incorporates methods such as content-based filtering, which suggests meals based on a user's preferences, and collaborative filterers, who predict preferences influenced by similar users or meals.

User Interface:

Machine learning models are utilized in a meal recommendation system to create user-friendly UI experiences that offer personalized meal recommendations. By connecting users to the UI, this recommendation engine can provide personalized meal options and gather information for future improvements.



6.Data Flow Diagram

The diagram tells us the process flow of the backend where the Content Based Filtering and Collaborative filtering run in parallel on datasets

8.Conclusion

In conclusion, our meal recommendation system marks a substantial advancement in delivering customized and enjoyable dining experiences. By blending content-based and collaborative filtering methods, we effectively utilize meal attributes and user behavior to offer personalized meal suggestions. Our model has proven its ability to boost user engagement and satisfaction, adapt to changing preferences.

9.References

[1] Islam, T., Joyita, A. R., Alam, M. G. R., Hassan, M. M., Hassan, M. R., & Gravina, R. (2023). "Human-Behavior-Based Personalized Meal Recommendation and Menu Planning Social System". IEEE Transactions on Computational Social Systems, Vol.10,No.4, 2099-2110.

[2] Rostami, M., Oussalah, M., & Farrahi, V. (2022). "A Novel Time-Aware Food Recommender-System Based on Deep Learning and Graph Clustering". IEEE Access, Vol.10, 52508–52524.

[3] Shah, M., Degadwala, S., & Vyas, D. (2022). "Diet Recommendation System based on Different Machine Learners". International Journal of Scientific Research in Computer Science, Engineering and Information Technology, Volume 8, Issue 3, May-June 2022

[4] Yera, R., Alzahrani, A., & Martínez, L. (2017). "A Food Recommender System Considering Nutritional Information and User Preferences". IEEE Access, 6, 45845–45856.

[5] Premasundari, M., & Yamini, C. (2019). Food and Therapy Recommendation System for Autistic Syndrome using Machine Learning Techniques. In Proceedings of the 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), Coimbatore, India, 20–22 February 2019, pp. 1–6.

[6] Chavan, P., Thoms, B., & Isaacs, J. (2021). A Recommender System for Healthy Food Choices: Building a Hybrid Model for Recipe Recommendations using Big Data Sets". In Proceedings of the 54th Hawaii International Conference on System Sciences (HICSS), pp. 3774–3783.

[7] J. E. Purnomo and S. N. Endah, "Rating Prediction on Movie Recommendation System: Collaborative Filtering Algorithm (CFA) vs. Dissymetrical Percentage Collaborative Filtering Algorithm (DSPCFA)," IEEE, 06 February 2020.

[8] L. V. Nguyen, Q.-T. Vo, and T.-H. Nguyen, "Adaptive KNN-Based Extended Collaborative Filtering Recommendation Services," Big Data Cogn. Comput., vol. 7, 2023, p. 106.

[9] B. Hssina, "Recommendation system using the k nearest neighbors and singular value decomposition algorithms," IJECE, vol. 11, no. 6, December 2021.