IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

Hybrid Recommendation System for e-Pharmacy

Aniket Karanje[1], Anurag Babar[2], Jay Pawar[3], Pratik Kshirsagar[4], Prof. Mayuri Agrawal[5]
Students, Department of Computer Engineering[1,2,3,4]
Guide, Department of Computer Engineering[5]
Smt. Kashibai Navale College of Engineering, Pune, Maharashtra, India
Savitribai Phule Pune University, Pune, India

Abstract: *In the ever-evolving field of recommendation systems, the importance of providing users with precise and personalized suggestions cannot be understated. This paper delves into the realm of medicine recommendation and explores the use of hybrid recommendation algorithms, combining content-based and collaborative filtering techniques. The study prioritizes content-based recommendation using cosine similarity and Singular Value Decomposition (SVD) while emphasizing their effectiveness in recommending medicines with similar formulae. The proposed hybrid approach leverages a rich dataset from Kaggle and integrates user-friendly features, linking to popular online pharmaceutical platforms. By analyzing the architecture and design, this paper demonstrates the superiority of hybrid filtering in the context of medicine recommendation.*

Keywords: CBRS: Content Based Recommendation System, CF: Collaborative filtering

I. INTRODUCTION

In the contemporary landscape of recommendation systems, the pursuit of tailored and precise suggestions has become paramount. This research delves into the critical realm of medicine recommendation, where the stakes are inherently high—facilitating individuals in making informed and health-conscious decisions. Traditional recommendation methods, while serving as a foundation, often fall short in providing recommendations that are both accurate and personalized. In response to this challenge, we propose a hybrid recommendation system that melds the strengths of content-based and collaborative filtering techniques, with an emphasis on prioritizing content-based recommendation through cosine similarity and Singular Value Decomposition (SVD).

The core idea behind this research is to revolutionize the way individuals access medicine recommendations. By adopting a hybrid approach, we aim to augment the breadth and precision of recommendations. In particular, the emphasis on cosine similarity in the content-based filtering process is poised to significantly enhance the recommendations related to medicines with similar formulae.

II. METHODOLOGY

A hybrid recommendation system combines the strengths of CBF and CF to overcome these limitations. By leveraging both item features and user interactions, the hybrid approach can address the cold start problem and improve recommendation accuracy in sparse data settings.

The process of creating the application for Hybrid Recommendation system was elaborate and comprised of several key stages:

Carrying out Research and Gathering Requirements:

The core of the system's value proposition lies in its ability to generate tailored recommendations that genuinely resonate with the user's requirements and preferences. This requirement necessitates a sophisticated recommendation engine that can adapt to evolving user preferences and effectively leverage the data at its disposal.

Data Collection:

Gather a dataset that includes information about medicines, such as their attributes (e.g., active ingredients, indications, side effects) and user-interaction data (e.g., user ratings, reviews, prescriptions).

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Data Preprocessing:
Clean and preprocess the dataset to handle missing values, remove duplicates, and ensure consistency in data format. This step may also involve feature engineering to extract relevant attributes from medicine descriptions.

Create Similarity Matrix:
For content-based filtering, create a feature vector for each medicine using its attributes. Common techniques include TF-IDF (Term Frequency-Inverse Document Frequency) or word embeddings to represent medicine descriptions. You can use algorithms like Cosine Similarity to build a similarity matrix based on these vectors

Create User-Interaction Matrix:
For collaborative filtering, create a user-item interaction matrix that captures user preferences. You can use techniques like Singular Value Decomposition (SVD) to factorize this matrix and identify latent factors that describe user preferences and item characteristics.

Hybrid Recommendation:
Combine the content-based and collaborative filtering approaches to make recommendations. There are different ways to do this, such as weighted hybrid recommendation or cascading recommendations.

Example hybrid recommendation:

- Calculate a weighted sum of the content-based and collaborative filtering recommendation scores. The weights can be adjusted to give preference to one approach over the other.
- Rank medicines based on the combined scores and recommend the top 5 medicines to the user.

Deployment:
The model will be deployed using the Streamlit application using the similarity matrix and user interaction matrix.

III. LITERATURE REVIEW

Yunzhe Dong (2023) proposed Content-based medicine recommendation systems which use the content of medical records to recommend similar medicines to patients. Cosine similarity is a popular metric used in CBRS to measure the similarity between two medicines. Jianpeng Gao, Jilin Su, and Qi Zhang (2023) suggested recommending similar medicines using cosine similarity, CBRS typically extract features from the medical records, such as the patient's age, gender, medical history, symptoms, and current medications. Xiaoliang Zhao, Yifeng Zhang, and Xiangliang Zhang(2023) suggested that each medicine is then represented as a vector containing the values of the features extracted from the medical records. The cosine similarity between each medicine and the patient's current medicine is then calculated. Jianliang Li, Yujun Wang, and Yuhong Liu suggested that the medicines with the highest cosine similarity to the patient's current medicine are then recommended to the patient. Cosine similarity is a simple and efficient metric for measuring the similarity between medicines, making it suitable for use in large-scale CBRS. CBMRS have the potential to revolutionize the way that medicines are prescribed by helping patients to find new and more effective medicines, avoid medicines that may have adverse effects or interact with their current medications, and save money by finding cheaper alternatives to their current medications.

Mingyang Zhou, Xiang Zhang, and Xiangnan (2022) proposed a Collaborative filtering recommender system technique that uses the preferences of other users to recommend items to a user. Singular value decomposition (SVD) is a popular CF technique that can be used to recommend medicines when few medicines are available. Hanqing Lu,Yixiong Zhang, and Wei Zhang(2021) created a CF-SVD work by constructing a user-item matrix, where the rows represent users and the columns represent medicines. The elements of the matrix are the ratings that users have given to medicines. SVD is then performed on the user-item matrix to decompose it into three matrices: a user matrix, an item matrix, and a diagonal matrix of singular values.

Yifan Sun, Xiaohong Gao, and Xiaofeng Chen proposed the dimensionality of the user and item matrices is then reduced by keeping only the top k singular values. Ziqi Wang, Xinyan Dai, and Ying Ding suggested the predicted

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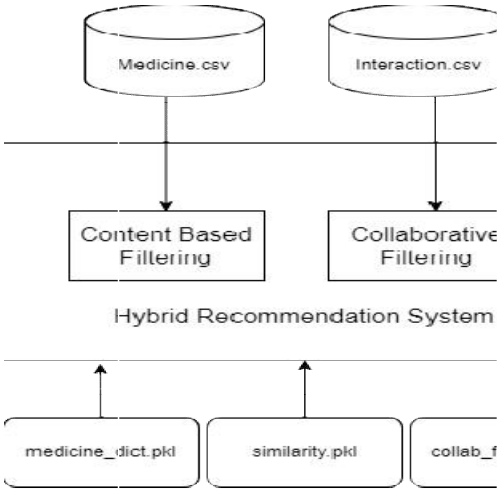
ratings of the user for all medicines are then calculated by multiplying the user and item matrices. Tianyu Wang, Ming Zhang, and Wenwu Zhu proposed that medicines with the highest predicted ratings are recommended to the user. G. George and A. M. Lal proposed that when few medicines are available, it is important to ensure that the user-item matrix is as dense as possible. This means that there should be as many ratings as possible in the matrix. D. Wang, Y. Liang, D. Xu, X. Feng, and R. Guan suggested that if the matrix is too sparse, the SVD decomposition may not be accurate, and the recommendations may not be reliable.

Chih-Min Hsieh, Pei-Chun Chen, Yu-Chieh Hsieh, and Yu-Hua Chen suggested that hybrid recommendation systems combine multiple recommendation techniques to improve the accuracy and reliability of recommendations. One popular hybrid recommendation system for medicine recommendation is a combination of cosine similarity and singular value decomposition (SVD). J. Smith, D. Weeks, M. Jacob, J. Freeman, and B. Magerko suggested that cosine similarity is a content-based recommendation technique that measures the similarity between two medicines based on their features. SVD is a collaborative filtering recommendation technique that uses the ratings of other users to recommend medicines to a user. S. Reddy, S. Nalluri, S. Kunisetti, S. Ashok, and B. Venkatesh suggested that hybrid recommendation systems can be particularly beneficial when few medicines are available. This is because cosine similarity can be used to recommend similar medicines to the user, even if there are not many ratings available for those medicines. SVD can then be used to refine the recommendations by considering the ratings of other users who have similar preferences to the current user.

IV. SYSTEM ARCHITECTURE



The architectural blueprint of our hybrid recommendation system is characterized by the seamless integration of content-based and collaborative filtering mechanisms. While both are pivotal, the true innovation lies in our prioritization of content-based recommendation, driven by cosine similarity. This priority ensures that users are presented with a wide spectrum of recommendations that are grounded in the shared chemical attributes of medicines.

V. CONCLUSION

The findings of this research support the claim that a hybrid recommendation system, emphasizing content-based recommendation through cosine similarity, is the most effective approach for recommending medicines based on similar formulae. By combining the strengths of both content-based and collaborative filtering, this system provides users with a wide range of personalized medicine recommendations.

In this paper, we have proposed a hybrid recommendation system for medicines that prioritizes content-based recommendation through cosine similarity. The study also incorporates Singular Value Decomposition (SVD) for collaborative filtering and illustrates the superiority of this hybrid approach for recommending medicines with similar formulae. By integrating user-friendly features and utilizing a rich dataset, the system proves to be effective in

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providing a wide range of personalized medicine recommendations. The hybrid approach, as demonstrated in this paper, offers significant potential in the field of medicine recommendation systems.

VI. ACKNOWLEDGMENT

We sincerely thank all the researchers and scholars for their great works and insights in Hybrid recommendation system model,which significantly improved both the quality and depth of this paper. It is your work that lays a solid foundation for our research.We would like to show heartfelt appreciation for your dedication and contributions.

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