Comparison of Various Technique of Recommendation Systems

Krishna Pandya[1], Shital Pathar[2]

[1]Mtech Student, [2]Assistant Professor

[1]Computer Science and Engineering,

Parul institute of Engineering and Technology, Vadodara, India.

Abstract: Day by day, Word becomes digitalize and rapid growth of information. Nowadays, some observe that users more prefer online stores rather than conventional methods. User have a huge number of data available, so it is difficult to find the best option for them. This is an overloaded problem faced by a user. So, this problem is solved by prioritizing, filtering and efficiently delivering relevant data/items. Recommender System is a software that gives very useful guidance for an item or service selected by the user. A recommendation system is a tool that facilitates the user by providing his personal information. The aim of this paper introduce to the different types of a recommender system which are mainly classified into three categories: collaborative filtering RS, content-based RS and hybrid RS. We also discuss the challenges that are facing during the application of the recommendation system. In this paper, we also compare each method and describe a limitation of each method.

Keywords: Machine Learning; Recommendation system; Content Based; Collaborative Filtering; Hybrid Recommendation system.

1. Introduction

The recommendation system is a subclass of information filtering based on user history and preference. Recommendation systems (RS) are helpful for users to find new items or services, such as books, music, transportation, and movies, even people. Recommendation systems also play an important role in decision-making, helping users to maximize profits or minimize risks. [2] It is widely used in many information-based companies such as Google, Twitter, LinkedIn, and Netflix. As the Recommendation systems field developed, researchers studied the use of algorithms for machine learning (ML), and the area of artificial intelligence (AI).

Recommendation systems are powerful tools that recommend the best option to the user based on their supervised and unsupervised information. Supervised information like rating, viewing a wish list, cart data, history and unsupervised information like review, comment, and feedback.[3] It personalizes a recommender system information tool that attempts to predict items (like movies, music, books, websites, or news articles) out of a large database on a user interested in it. A recommender system is a very useful daily life of humane bean. It makes user life easy & reduce overhead problem and many confusions. The recommendation system is an essential part of the everyday life of humane bean. For example, online shopping site Amazon.com and online movie rental company Netflix recommend the items based on the user's history & trends on the site. Some Social networking services like Facebook & News recommend a system like Google news is working on hybrid recommendations [14]. There are also interests-based or rating based social networking site which provides users with recommendations of books, job, and research paper [15]. Recommendation system also works on user history and base on that it recommends the most suitable items and advertisement accordingly. Recommendation systems are very helpful for online marketing and job seekers.

1.1 Technique of Recommendation System

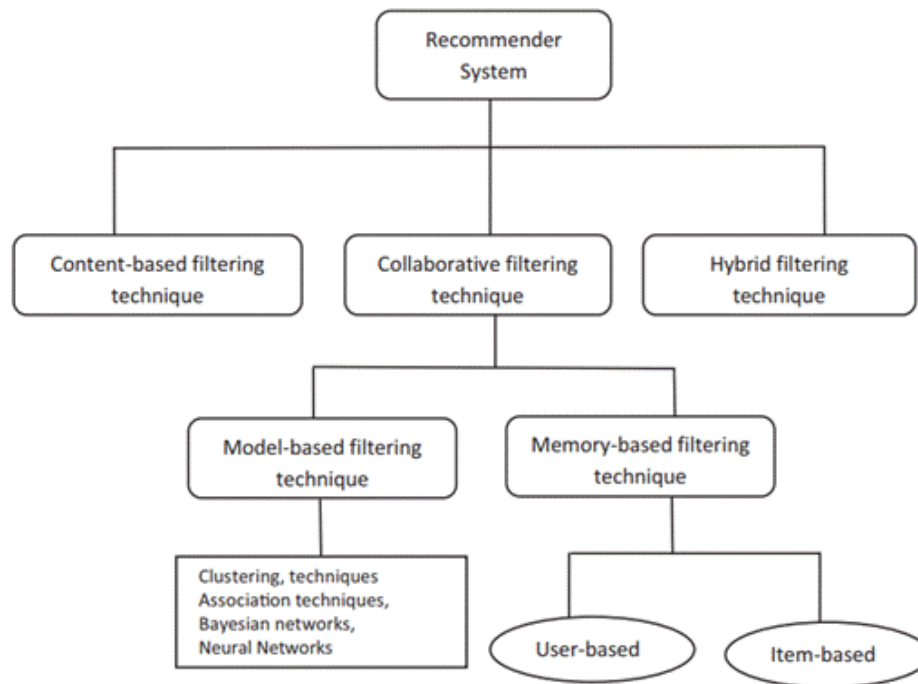There are main three types of recommendation system technique as given below.

Figure 1. Classification of Recommender System

A. Content-Based recommend Systems

Content-based recommend systems work on the history of the user. It recommends new item based on what user search on past or most highly rated items on the past by the users [16]. It does not recommend those items that are never high rated nor interested by any user. For example, if a person gives a high rate movie "URI", then this algorithm will recommend movies based on the same genre. YouTube video suggestion also works in the same approach. TF-IDF algorithm works on a content-based recommendation system

B. Collaborative Filtering Recommendation System

Collaborative Filtering recommender system recommend the result based on the filtering in which one user's similar test and like base on their rated item [16]. Its filter group of people in which all are to gather the same agreeable. For example, the concept of a mutual friend on Facebook is work on this approach. It a way of filtering or calculative item though the sentiment of other people.

Collaborative Filtering have main two type techniques as shown below
 1. Memory-based
 In this method remember past rating which given by a user to the item and compare every neighbor base on that find the most similar user and item[11]. Then based on the nearest neighbor prediction rating of an item. This method every useful and gives the best result for offline data. But it very time-consuming method because every item rating compares which neighbor rating. Memory-based collaborative filtering further classify into two categories 1.user base CF 2.Item base CF following given detail description of this category of memory base CF with real-time example.
   A. User base CF
 Recommendations are made by finding users with similar tastes [1]. Jane and Tim both liked Item 2 and disliked Item 3; it seems they might have similar tastes, which suggests that in general Jane agrees with Tim. This makes Item 1 a good recommendation for Tim. This approach does not scale well for millions of users.
   B. Item base CF
 Recommendations are made by finding items that have similar appeal to many users. Tim and Sandra are two users who liked both Item 4. That suggests that, in general, people who liked Item 4 will also like item 1, so Item 1 will be recommended to Tim. This approach is scalable to millions of users and millions f items.

 2. Model-based
 The model-based filtering technique works on feature selection and train models using that feature to make recommendations. This technique uses the previous rating of users to learn a model for improving the performance of the collaborative filtering technique [11].
 The model learning process can be done using data mining or machine learning techniques. Examples of these techniques are SVD, PCA, K-Means clustering, decision tree, and association rule mining.

C. Hybrid Recommendation system

Since Collaborative and Content base recommendation system both has a certain advantage as well as a limitation as an example Collaborative recommendation not good for a new user or item and content base recommendation is not recommended different test of user, So one more approach called hybrid recommendation system, make a combination of two or more approach and reduce the limitation each approach (i.e. Google News). [13]. [13]

2. Related Work

D Deger Ayata, Yusuf Yaslan, and Mustafa E. Kamasak[1] made an emotion-based music recommendation system in which they use signals from wearable physiological sensors(WPS) for analysis emotion of the user. A wearable computing device uses for categorized the emotion of a user which is integrated with a galvanic skin response (GSR) and photoplethysmography (PPG) physiological sensors. This information of a user's emotions is added into any collaborative or content-based recommendation engine as further information. Then emotion recognition issue is considered as arousal and valence prediction from multi-channel physiological signals. Decision tree, random forest, support vector machine, and k-nearest neighbor algorithms machine learning algorithm are used for feature fusion. The results of the recommendation system are checked emotion recognition accuracy.

Rahul Katarya, Om Prakash Verma[2] presented movie recommendation systems that aim is to make a recommender system using data clustering and computational intelligence. In this paper, they use movie lens data set in a process of algorithm first create a similar user cluster using k means clustering then use a cuckoo search optimization algorithm. Dataset can be partitioned into homogeneous groups based on some similar or un-similar metric by a clustering algorithm. At the end k-means algorithm result applied a cuckoo search algorithm for finding the best result, Cuckoo search optimization. This system work on a hybrid recommendation system in which they use two algorithms to make a more accurate result of the system. Hybrid recommendation has been used to overcome the limitations of content-based recommendation systems and collaborative recommendation systems. For evolution parameter check using mean absolute error (MAE), standard deviation (SD), root mean square error (RMSE) and t-value.

Sunita B. Aher, L.M.R.J [3] proposes a Course Recommendation System that recommends the course to the student using a collaborative recommendation type algorithm. In a collaborative recommendation system recommended it bases product on a similar user. This system recommended a course to a new user and a new course to the student based on a cluster similar user and item. They use the k-means clustering and association algorithm which is a hybrid recommendation system forgive the best result of the system. Weka data mining software. Association can compare result rules use to find the best recommendation course for students and make a more effective system.

Maryam Khanian Najafabadi, Azlinah Mohamed, Choo Wou Onn [4] make a movie recommendation system uses movie lens data set in which use graph-based structure for overcome a limitation of collaborative recommendation system and ranking problem. Graph-based models make associations between users and items. In which node as user and edge as a relation between a user in which page rank algorithm used for top n item for user preference. The result of this system compares with the collaborative system existing algorithm evolution using recall, precision, f-measure and MAP metrics.

Ming He, Bo Wang, And Xiangkun Du[5] propose HI2Rec, which unifies large data to learn the user's and items vector representations for top-N recommendation to address the cold start, sparsity problem. They take the movie-related data out by Linked Open Data. Then knowledge graph model embers use real-word data of user like age, pin code, gender with a vector. Preliminary recommendation list generate are used by that vector. An accuracy recommendation list is generated by collaborative filtering. They compare the result of HI2Rec and state-of-the-art recommendation models in which HI2Rec improvements result.

Xishan Zhang, Jia Jia, Ke Gao, Yongdong Zhang, Dongming Zhang, Jintao Li, and Qi Tian.[6] et. al. shows a Clothing recommendation based on user location-oriented. In this research work, they use a hybrid recommendation system multi-label convolutional neural network join with the support vector machine (mCNN-SVM) approach correlations between location attributes and clothing attributes. The main purpose of this research is to give the best cloth recommendation to the user base on their travel location. Travel location attributes can be like cultural heritage, natural beauty, and national representation. Here CNN use for extract clothing attribute, and SVM use for find a correlation between cloth and location. System accuracy check based on the result of an item which cloth can wear in which place.

H. Kim, G. Y. Kim and J. Y. Kim [7] they develop a smartphone-based mobile system that comprehends two core modules for recognizing human activities and then subsequently recommending music as per their usage. In the stated method,In this research work use deep residual bidirectional gated recurrent neural network for high accuracy. To augment the performance of tempo-oriented music classification, an aggregate of dynamic classification using a long-term modulation spectrum and sequence classification using a short-term spectrogram is taken into deliberation. The relationship between the identified human activities and the music files indexed by tempo-oriented music classification that help to music recommendation. The result of comprehensive experiments on actual data confirms the accuracy of the proposed activity-aware music recommendation framework. They present an effective music recommendation system using human activity as measured by real-time accelerometer sensor data on smartphones.

Xiwang Yang, Chao Liang, Miao Zhao, Hongwei Wang, Hao Ding, Yong Liu, Yang Li, and Junlin Zhang[8]. et. al. created hybrid recommender systems with the use of two algorithm matrix factorization and nearest neighbor. Social voting recommendation is using by using social networks and group connecting information. They work on a collaborative filtering type of recommendation. For calculating social voting they use user social networks and group connecting information that make popularity base recommendation. They can reduce the cold Start problem using this social network information. NN-based models recommend that social network data influence group affiliation data. MF model use to find hot voting recommendations and use both algorithms to make a hybrid system using social and demography data of users.

R. Zhang and Y. Mao, [17] this paper poses a new model family said to be Markovian. On one side, MFMP models, such as time SVD++, are finely capable of capturing the temporal dynamics in the dataset, and on the other side, they do has a clean probabilistic formulations, conceding them to enable a wide spectrum of collaborative filtering problems. Time-stamped rating data have predicted rating by SVD++ and MFMP two algorithms. The practically experimented studies using MovieLens dataset compare with the exiting system algorithm is SVD++.

Zan Wang, XueYub, NanFeng, ZhenhuaWang[10] proposal, a movie recommendation system based on a hybrid model-based collaborative filtering which makes use of the make better K-means clustering coupled with genetic algorithms (GAs) to partition transformed userspace is proposed. Item ploys principal component analysis (PCA) data reduction technique to dense the movie population space, which could reduce the computation complexity in intelligent movie recommendations. The tested results on the Movielens dataset compare accuracy with the existing system.

3. Comparison Of Recommender System Type

In table 1 we shown comparison between various recommendation systems technique.

	Model based CF Recommendation	User based CF Recommendation	Item based CF Recommendation	Content based Recommendation	Hybrid Recommendation
Working	Predict users' rating of unrated items	Calculating Similarities score between user	Calculating similarities between item	Work on user past history	Combine more than one technique
Advantage	• Great starting point	• No knowledge about user features needed • Serendipitous recommendation	• No knowledge about item features needed • Serendipitous recommendation	• No need for data on other users. • No cold start and sparsity. • Able to recommend users with unique taste, new and unpopular items.	Overcome Limitation of Content base filtering and collaborative filtering
Disadvantage	• Expensive Model building Lose useful • Information for Dimensionality reduction Technical.	• New user Cold start • Data sparsity • Scalability • User Data Privacy	• New item Cold start • Data sparsity • Scalability • Time Consuming for huge item	• Limited content • Analysis Over specialization	• Increased complexity • Increased expense of implementation
Techniques	• Association rule • Clustering • KNN • Decision Tree • CNN • Regression	• Correlation Based • Pearson correlation • Cosine based	• Correlation based • Cosine Based • Pearson correlation	• TF-IDF Term Frequency and Inverse Document Frequency	• Combination of Collaborative and content based filtering Techniques

4. Result

Here we compare result of different hydride recommendation system which is use combination of more than one algorithm.in first step they create cluster for near neighborhood then find best optimizing result. This result get using movielens dataset Following table show MAE of different algorithm

Table 2: MAE Result of Different Algorithm

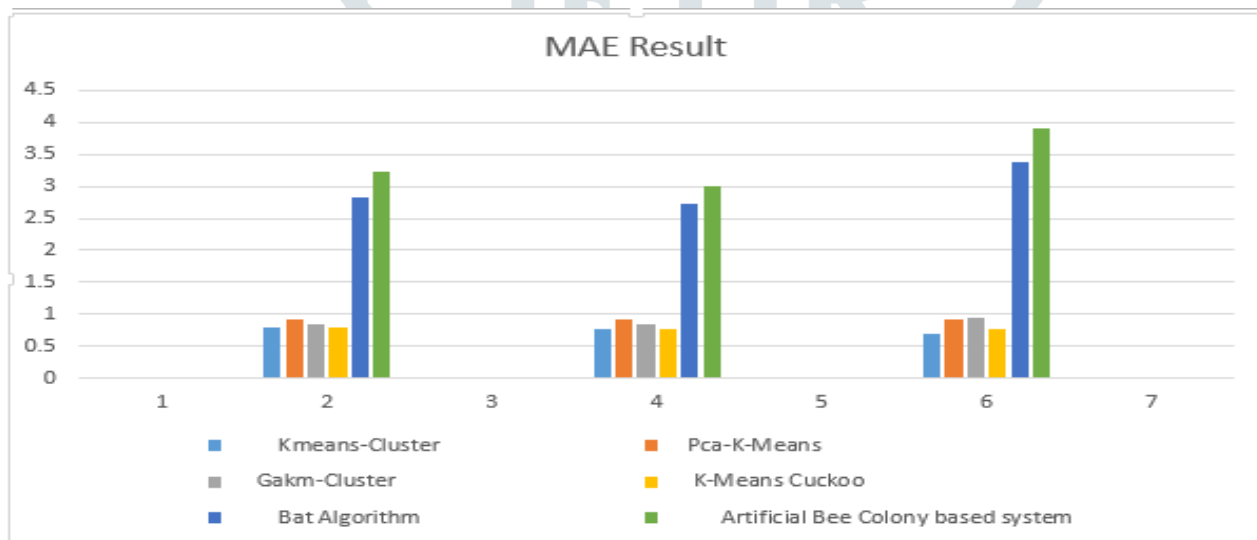| Number of Cluster	MAE of Kmeans-Cluster[2]	MAE of Pca-K-Means	MAE of Gakm-Cluster	MAE of K-Means Cuckoo	MAE of Bat Algorithm [22]	MAE of Artificial Bee Colony based system
8	0.80	0.92	0.85	0.80	2.82	3.23
16	0.77	0.92	0.85	0.78	2.74	3.01
32	0.69	0.93	0.94	0.76	3.37	3.90

.

Fig 2:- MAE of different Algorithm

5. Conclusion

In this paper, we described different recommendation techniques which are being used in recommendation systems. We have also surveyed the existing recommendation systems with their advantages and limitation. Further we have compared the mentioned different recommendation systems on the basis of their advantages and disadvantages. We can draw the conclusion that many of the papers on recommendation system are based on Content based filtering approach or collaborative filtering approach. There is a clear scope of research in other recommendation system and as the hybrid recommendation system gives better system performance. Recommendation evolution parameter is accuracy, precision, confusion matrix.

References

1) Deger Ayata , Yusuf Yaslan, and Mustafa E. Kamasak," Emotion Based Music Recommendation System Using Wearable Physiological Sensors", IEEE TRANSACTIONS ON CONSUMER ELECTRONICS, VOL. 64, NO. 2, MAY 2018.
2) Rahul Katarya,Om Prakash Verma"An effective collaborative movie recommender system with cuckoo search" Egyptian Informatics Journal, 18 October 2016.
3) Sunita B. Aher , L.M.R.J. Lobo," Combination of machine learning algorithms for recommendation of courses in E-Learning System based on historical data" Knowledge-Based Systems 51 (2013) 1–14.

4) Maryam Khanian Najafabadi, Azlinah Mohamed, Choo Wou Onn,An impact of time and item influencer in collaborative filtering recommendations using graph-based model, Information Processing & Management, Volume 56, Issue 3, 2019

5) M. He, B. Wang and X. Du, "HI2Rec: Exploring Knowledge in Heterogeneous Information for Movie Recommendation," in *IEEE Access*, vol. 7, pp. 30276-30284, 2019. doi: 10.1109/ACCESS.2019.2902398

6) Xishan Zhang, Jia Jia, Ke Gao, Yongdong Zhang , Dongming Zhang, Jintao Li, and Qi Tian,"Trip Outfits Advisor: Location-Oriented Clothing Recommendation" IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 19, NO. 11, NOVEMBER 2017.

7) H. Kim, G. Y. Kim and J. Y. Kim, "Music Recommendation System Using Human Activity Recognition From Accelerometer Data," in *IEEE Transactions on Consumer Electronics*, vol. 65, no. 3, pp. 349-358, Aug. 2019. Lior Rokach and Slava Kisilevich "

8) X. Yang *et al*., "Collaborative Filtering-Based Recommendation of Online Social Voting," in *IEEE Transactions on Computational Social Systems*, vol. 4, no. 1, pp. 1-13, March 2017. doi: 10.1109/TCSS.2017.2665122.

9) Initial Profile Generation in Recommender Systems Using Pairwise Comparison" IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS, VOL. 42, NO. 6, NOVEMBER 2012.

10) Zan Wang , XueYub, NanFeng , ZhenhuaWang ," An improved collaborative movie recommendation system using computational intelligence" Journal ofVisualLanguagesandComputing25(2014)667–675

11) M.B. Vivek, N. Manju and M.B. Vijay "Machine Learning Based Food Recipe Recommendation System" Springer Nature Singapore Pte Ltd. 2018.

12) Joseph Coelho, Paromita Nitu, and Praveen Madiraju"A Personalized Travel Recommendation System Using Social Media Analysis" 2018 IEEE International Congress on Big Data.

13) Ran Wang,Chi-Yin Chow, Yan Lyu ,Victor C. S. Lee,Sam Kwong,Yanhua Li , and Jia Zeng "TaxiRec: Recommending Road Clusters to Taxi Drivers Using Ranking-Based Extreme Learning Machines" IEEE TRANSACTIONS ON KNOWLEDGE AND DATA ENGINEERING, VOL. 30, NO. 3, MARCH 2018

14) R. Baral, S. S. Iyengar, X. Zhu, T. Li and P. Sniatala, "HiRecS: A Hierarchical Contextual Location Recommendation System," in IEEE Transactions on Computational Social Systems, vol. 6, no. 5, pp. 1020-1037, Oct. 2019

15) Kumar, P. Tanwar and S. Nigam, "Survey and evaluation of food recommendation systems and techniques," 2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, 2016.

16) Zhang, M. Yang, J. Lv and W. Yang, "An improved hybrid collaborative filtering algorithm based on tags and time factor," in Big Data Mining and Analytics June 2018.

17) R. Zhang and Y. Mao, "Movie Recommendation via Markovian Factorization of Matrix Processes," in *IEEE Access*, vol. 7, pp. 13189-13199, 2019.

18) M. He, B. Wang and X. Du, "HI2Rec: Exploring Knowledge in Heterogeneous Information for Movie Recommendation," in *IEEE Access*, vol. 7, pp. 30276-30284, 2019.