Methods of Recommender System: A Review

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Abstract—**There are number of users and items in any type of recommender system. There are numerous information on internet and so many visitors on websites which add some challenges for generating recommender system. A recommender system extracts the user preferences or interests from the related data sets so there is low information overload. Therefore, new recommendation system is required which will provide more quality recommendations for huge data sets. So, for these types of issues we have discovered several techniques of recommendation techniques which are three types such as: Content-based filtering, Collaborative filtering and Hybrid filtering. This paper also analyzes different algorithms in each type of recommender system.**

Index Terms—*Recommender system, Collaborative filtering, Content-based filtering, Hybrid filtering*

I. INTRODUCTION

Now a days, the amount of information that we are retrieving and using have become increased rapidly. Data mining is the process of mining relevant data from the large amount of data. It is the procedure of discovering and finding the appropriate pattern from the huge amount of data sets. The main aim of data mining process is to bring out appropriate and related information from the huge amount of data sets and convert it into comprehensible structure. One of the sub parts of data mining is recommender system [1]. On internet, there are many options for items or anything, so there is need to filter and efficiently gives the information. Recommender systems solve these by analyze through the huge amount of data to discover users with personalized content and services [2].

II. BACKGROUND

A. Recommender system

Recommender systems are the software tools and methods for discovering suggestions/ recommendations for items which is useful to the users. The suggestions are related to the various decision-making processes, like what items to buy by user, what movie they watch, what music to listen or what news to read. Many recommender systems have been developed for different applications. The main aim of recommender system is to provide right items to right users. It has the capacity to suggest whether a individual user would prefer an item or not based on users past history and profile [1].

Recommender system emerged as an individualistic research area when researchers begun to focus on different recommendation problems [3]. The aim of generating recommender system is to decrease the information overload by recovering the most relevant information and services from a large amount of data, so that giving individualized services [4]. There are three commonly used recommendation techniques which are content-based filtering, collaborative filtering and hybrid filtering technique. Each recommendation algorithms have their own profits and drawbacks.

With the development of these recommendation techniques, more and more recommender systems have been performed and many real-world recommender system applications have been generated. The applications of recommender system include recommending news, tour, articles, movies, music, books, documents and involve the areas of e-commerce, e-learning, e-governing and e-business services [4].

B. Challenges and issues of recommender system

Following challenges and issues are found in the recommender system [1][3].

- Changing user preferences:
  Recommender system is the mainly based upon the user interest and profile. The user's attraction and preferences are change after some time so; changing user preferences is one of the main challenges in recommender system.

- Sparsity:
  There are large amount of users and items but there are almost always users rated just a few items. Techniques of recommender systems create neighborhoods of users using their profiles which are generated from their interest. If the user has generated just small number of items then its hard to conclude his/her taste and he/she could be related to false neighborhood. Sparsity is issue of the small number of information.

- Scalability:

With the growth of numbers of the users and items, the system needs more resources for processing information and giving recommendations.

- Synonymy:
  Synonymy is the likelihood of very nearer items to have dissimilar names or entries. Most recommender systems find it hard to make distinction between nearer related items such as the difference between the baby wear and baby cloth.

- Privacy:
  In order to receive the most accurate and correct recommendations, the system must acquire the most amount of information possible about the user, including demographic data and data about the location of a particular user.

III. RECOMMENDER TECHNIQUES

To analyze and understand the main applications of recommender system of different areas, this section gives the information about the main three recommender system methods are as follows: content-based filtering, collaborative filtering and hybrid filtering technique.
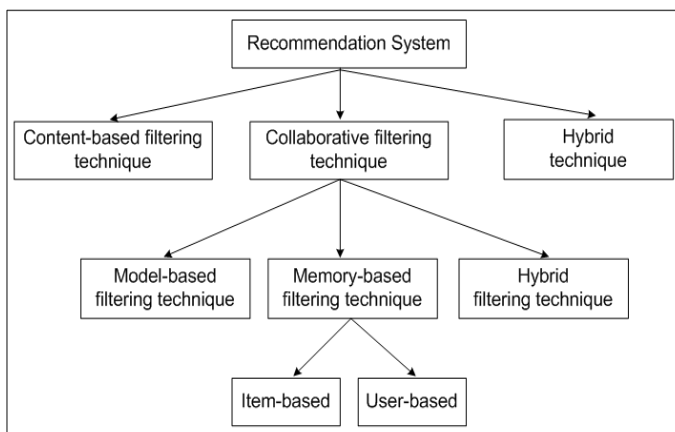

Fig 1: Classification of the recommender system [2]

A. Content-based filtering technique

In the content-based filtering technique recommendation to the users are given by only single user's behavior and data. Item description and particular user's profile play an important role in the content-based filtering technique [5]. When documents like web pages, news, articles and restaurants are recommended then content-based filtering technique is used in the system [2].

The basic concept of content-based recommender systems are given below. First is to analyze the description of the items preferred by a particular single user to decide the preferences that can be utilized to describe these items. These preferences are stored in a user profile. Second is to compare each items attributes with the user profile so that only related items which have a high degree of similarity

with the user profile will be recommended to that particular user [4].

B. Collaborative filtering technique

In collaborative filtering technique recommendation will be given to the user based on the particular user's behavior and other similar user's behavior. Collaborative filtering technique builds the data sets of user's preferences and according to that recommendation will be given to the users [2].

A remarkable role plays by a collaborative filtering technique in the recommendation system in the various applications so it became most extensively used approach to design the recommendation system. In this technique recommendation to the active user is given by the comparing of other similar users preferences and interests who have rated the similar items which was rated by that active user [5].

Collaborative filtering systems review more than one common item to generate set of users, which affect the results of recommendation. Applications of collaborative filtering contain very large data sets. The collaborative filtering algorithm is mainly classified in three types such as memory-based, model-based and hybrid methods [1].

1) Memory-based filtering technique

The items those were already rated by the user before play a relevant role in searching for a neighbor that shares opinion with him. Once the neighbor or the group of user is discovered, different algorithms can be used to combine the interest and preferences of neighbors to find recommendations of items. From the effectiveness of this technique, it achieved big success in real life applications [2].

Memory-based algorithms use the whole data set to compute the recommendation to the users. Generally, they use similarity measures to select users or items that are similar to the active user. Then, the recommendation is calculated from the ratings of these neighbors or groups [6]. Memory-based filtering technique mainly classified in two types such as user-based and item-based filtering technique.

a) User-based filtering:

User-based filtering technique computes the sameness between users not between items. It finds similarity between users by comparing their ratings on the same item and then predicted rating for that item then gives the recommendation according to that similarity to the users [2].

b) Item-based filtering:

Item-based filtering technique computes recommendation using the similarity between items and not between users. From the user-item matrix, it calculates how similar the retrieved items to the targeted item, then it selects the K most similar items and their corresponding similarities are also determined and recommendations to the user are given [2].

2) Model-based filtering technique

Model-based filtering technique cannot use whole dataset but generate the model from the dataset and from this model recommendation are given to the user. This technique uses the previous rating of users to learn a model for improving the performance of collaborative filtering technique [2].

The model learning process can be done using the data mining or machine learning techniques. Examples of these techniques are singular value decomposition, dimensionality reduction technique, clustering, decision tree and association rule mining. It resolves the sparsity problems associated with recommendation systems [2].

a) Association rule:

It bring out the rule based on the datasets of user-item which is use for giving recommendation to the uses. It extracts the rules that predict the occurrence of items based on the presence of all the other items in the transaction [2].

b) Clustering:

A cluster is a collection of data objects which are most similar to each other and they are comes under a same cluster and dissimilar to each other are in other cluster [2]. The similarity between data objects are calculated by some methods like pearson correlation, minkowski distance. This algorithm partition a set of data into clusters for discovers meaningful groups [7].

c) Decision tree:

This technique is based on the three graphs, which is generated by the analyzing the set of training examples for which class labels are known. Then they are apply for classify the unseen examples. This technique is more interpretable method than other classification methods [2].

d) Regression:

When there are two or more variables thought to be systematically connected by a linear relationship then and then regression method will be used. For examining associative relationship between dependent variables and one or more independent variables it is strong process [2].

e) Bayesian classifier:

This technique is based on definition of conditional probability and byes theorem. It is consider each attributes and class label as random variables. The most common used Bayesian classifier is naïve bays classifier [2].

f) Matrix technique:

This technique is used for suggest the unknown values within the user-item matrices. One of the major used techniques is correlation based K-nearest neighbor. It is depend only on the large historical rating datasets of user and items [2].

3) Hybrid filtering

Hybrid filtering technique will be used by combining two methods for giving the recommendation or suggestions to the active users. For the combining the techniques there are different ways such as individually implementation of techniques and then combining them output, use model-based technique with the memory-based filtering technique [2].

C. Hybrid filtering technique

Hybrid filtering technique merges different recommendation techniques for greater system optimization to avoid some limitations and problems of technique. The idea behind the hybrid filtering technique is to combine the two techniques which will give better and more effective recommendations than single algorithm because disadvantage of one algorithm will overcome by another algorithm [2].

A hybrid recommendation technique combines the best feature of two or more techniques into one hybrid technique. The common approach in the existing hybrid recommendation techniques is to merge the content-based technique with other recommender techniques to avoid cold-start, sparsity and scalability problem [4].

In hybrid filtering technique two or more recommendation filtering techniques combine with several ways to create new hybrid system. There are various ways to combine two or more methods in the hybrid filtering technique. Some advantages of hybrid algorithm are that it overcomes the problem of other techniques like cold start problem, new user problem, scalability and disadvantages are it is complex and expensive in implementation [1][2].

IV. COMPARISION BETWEEN DIFFERENT ALGORITHMS

After the survey of different methods or techniques in recommender system here is the comparison of that different methods or techniques. From the survey collaborative filtering technique is most commonly filtering technique used in recommender system. It has more profits over other techniques.

In the recommender system there are three filtering techniques for giving the suggestions/recommendations to the user about items which are not yet seen by user. Comparison between different recommendation techniques is shown in table 1.

TABLE I.   COMPARISION BETWEEN RECOMENDER TECHNIQUES

Recommender system methods	Content-based filtering	Collaborative filtering technique	Hybrid filtering
Number of users	Based on single user	Based on many users having similar interest	Combination of content-based and collaborative filtering
Advantages	User independence, Transparency	Improve recommendation performance	Overcome cold start, sparsity problrm

Disadvantages	Limited content analysis, New user	Data sparsity, Scalability, Synonymy	Increased complexity, expensive in implemetation

Collaborative filtering technique has more advantages over other techniques. The main advantage over content-based filtering technique is that it improves the performance of the recommender system and gives better recommendation because it also considers other similar users interest and past history of that similar users for giving the recommendation/suggestions to the user.

TABLE II. COMPARISION BETWEEN COLLABORATIVE FILTERING TECHNIQUE

Collaborative filtering techniques	Memory-based filtering	Model-based filtering	Hybrid filtering
Advantages	Easy implementation	Better sparsity and scalability, Improve recommendation performance, Not require so much memory and cpu time	Improve sparsity
Disadvantages	Performance decrease when data are sparse, require lots of memory and cpu time	Loose useful information for dimensionality reduction technique, Expensive	Increased complexity, expensive in implementation

V. CONCLUSION

In this paper, we have made literature review of different methods of recommender system. From the review of different methods, it has been observed and concluded that collaborative filtering algorithm has more advantages over other technique of recommender system. Each of these different algorithms has its own profits and drawbacks. User-based algorithms are more accurate than item-based algorithm but it is not scalable. Survey on different recommender system is mainly focused on finding the ways to improve the recommendation performance, accuracy, efficiency. To improve the quality of recommender system some hybrid approaches are used but it has some disadvantages. They are more complex and expensive in implementation.

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