International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

Product Recommendation Systems based on Hybrid Approach Technology

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Abstract: *Product recommendation in E-Commerce in a widely applied technique which has been shown to bring benefits in both product sales and customer satisfaction. This paper presents the method of e-commerce recommendation system based on hybrid approach. This hybrid approach was introduced to cope with a problem of conventional recommendation systems.*

Keyword: Recommendation Systems, Hybrid Approach, E-commerce.

1. INTRODUCTION

In this paper, we are going to study about recommendation systems. Recommendation systems are typically used by companies, especially e-commerce companies like Amazon.com, to help users discover items they might not have found by themselves and promote sales to potential customers. A good recommendation system can provide customers with the most relevant products. This is a highly-targeted approach which can generate high conversion rate and make it very effective and smooth to do advertisements. So the problem we are trying to study here is that, how to build effective recommendation systems that can predict products that customers like the most and have the most potential to buy.

Based on the research on some existing models and algorithms, we make application-specific improvements on them and then design three new recommendation systems, Item Similarity, Bipartite Projection and Spanning Tree. They can be used to predict the rating for a product that a customer has never reviewed, based on the data of all other users and their ratings in the system. We implement these three algorithms, and then test them on some existing datasets to do comparisons and generate results.

Hybrid recommendation systems are mix of single recommendation systems as subcomponents. This hybrid approach was introduced to cope with a problem of conventional recommendation systems. Two main problems have been addressed by researchers in this field, cold-start problem and stability versus plasticity problem. Cold-start problem occurs when learning based techniques like collaborative, content-based, and demographic recommendation algorithms are used. Their learning stages are based on users' information, in most cases a user has to input their ratings or preferences manually and therefore the collection of this kind of information is hard to be achieved. Stability/plasticity problem means that it is sometimes hard to change established users' profiles which have been established after a given period of time using the systems. The former problem can be solved with the hybrid approach because different type of recommendation technique like knowledge based algorithm can be less affected by the problem. One of the solutions for the latter problem is temporal discount, which make older ratings with less influence.

Therefore, various hybrid recommendation techniques have been introduced and tested. Four major recommendation techniques constructing hybrids are collaborative filtering (CF), content-based (CN), demographic, and knowledge-based (KB). Unlike the first three which make use of learning algorithms, KB exploits domain knowledge and makes inferences about users' needs and preferences. Hybrid recommendation systems can produce outputs which outperforms single component systems by combining these multiple techniques. The most common hybridizing methodology is combining different techniques of different types, for example, mixing CN and CF. However, it is also possible to mix different techniques of the same type, like naïve Bayes based CN plus kNN based CN. Also, mixing same type of techniques with different datasets can be possible.

Hybrid approaches can be implemented in several ways: by making content-based and collaborative-based predictions separately and then combining them; by adding content-based capabilities to a collaborative-based approach (and vice versa); or by unifying the approaches into one model. Several studies empirically compare the performance of the hybrid with the pure collaborative and content-based methods and demonstrate that the hybrid methods can provide more accurate recommendations than pure approaches. These methods can also be used to overcome some of the common problems in recommender systems.

We have used two algorithms:

A. Content based filtering algorithm
B. Time Sequence Collaborative Filtering Algorithm

Time sequence-based recommendation algorithm adds time sequence information into existing information model. This algorithm helps us to learn changing data over time. Using recommendation system users identify one or more items as per their interest.

In content based algorithm, the recommenders suggest other items that are similar, based on comparison of item features or user features. Content-based filtering methods are based on a description of the item and a profile of the user's preference. In a content-based recommender system, keywords are used to describe the items and a user profile is built to indicate the type of item this user likes. In other words, these algorithms try to recommend items that are similar to those that a user liked in the past (or is examining in the present). In particular, various candidate items are compared with items previously rated by the user and the best-matching items are recommended. Description of items in terms of attributes for example, Directors, Actors. Description can also be stated via keywords which refers the user profile for example, in the restaurant the cuisines recommended to the customer would be dynamically generated based on his choices like French, Italian, Indian according to his profile stated. If customer is Indian, Indian cuisines will be recommended to him.

2. RELATED WORK

Recommendation Systems have been widely used in e-commerce. Many domains such as book, electronic products, music, movies etc. uses recommendations. In last few years, rapid development of information technology, an increasing number of books are available on ecommerce websites. Recommendation system helps user to find relevant books.

Recently many scholars have made significant progress in recommendation systems. Lu et al. proposed content based filtering and collaborative filtering recommendation methods. Antonio Hermando et al proposed a proposed a prediction method of collaborative filtering recommendation based on collaborative filtering for rating of users based on Bayesian probabilistic model.

Kouki et al. designed hybrid probabilistic extensible hybrid recommendation method, which could automatically learn and make predictions. Typical model based collaborative filtering includes the clustering techniques based collaborative filtering, probabilistic method based collaborative filtering and matrix based decomposition collaborative filtering.

The ratings of related items usually calculated in process of recommendation, but related time sequence behavior information easily recommendation, but related time sequence behavior information is easily ignored. Many authors and proposed the recommendation algorithm based on time sequence information for this problem.

Time sequence based recommendation algorithm adds time sequence into the existing recommendation model. This algorithm enables the model to learn the data changing over time. Hence the accuracy of recommendation results would be improved. Time sequence algorithm is newly introduced and hence if it is combined to the existing algorithm, result achieved will be accurate and efficient. Hence, current scholars use hybrid approaches like same.

Gao.et.al developed an improved collaborative filtering recommendation also with time adjusting. A real time stream based recommendation algorithm was proposed based on collaborative filtering. Some authors also add time sequence information into feature vectors of product.

III. RECOMMENDATION SYSTEMS

In order to analyze e-commerce RS developments, we must first review the main state-of-the art recommendation techniques such as content based, collaborative filtering-based, and hybrid

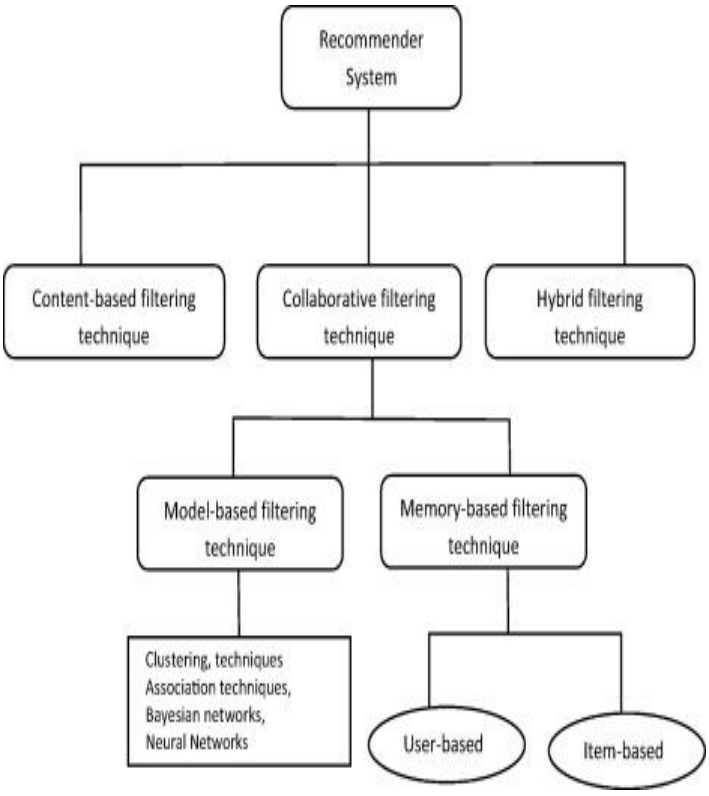

Fig 1. Recommender Systems

A. Content-based filtering recommendation technique

Content-based (CB) filtering recommendation technique recommends items similar to the items the user purchased in the past. (Adomavicius & Tuzhilin, 2005) The bottleneck of the CB recommender techniques is to analyze the content

of the items preferred by a particular user to determine the user's preferences. Usually, two techniques are used in order to generate recommendations. 1) Using traditional information retrieval methods, such as cosine similarity measure, Tf-Idf, LDA. 2) Using advanced machine learning methods, such as Naïve Bayes, vector support machines, decision trees. Content-based filtering recommendations have three major limitations (Li & Karahanna, 2015): overspecialization, when a recommender is not able to recommend unexpected, yet suitable items; eliciting user feedback, where the recommendation quality can be improved only with user's more historical data. For example, if a user purchases or views products or provides feedbacks to products.

B. Collaborative filtering based recommendation technique

Collaborative filtering (CF) based recommender systems recommend an item for a particular user based on the items previously preferred by otherusers. (Adomavicius & Tuzhilin, 2005) There are two types of CF technique:

1) Memory-based algorithms (such as, item-based and user-based CF approaches) recommendations are generated based on the preferences of the nearest neighbors. (Al-shamri, 2014). In the item-based CF approach, a user receives recommendations that are similar to those he rated in the past. While in the user-based CF approach, recommended items are based on the similar users. The similarity between users or items can be calculated byPearson correlation coefficient, cosine similarity measures. (Al-shamri,2014). Empirical results prove that; item-based CF algorithm outperforms user-based approach. (Alqadah et al., 2015)

2) Model-based algorithms such as Matrix Factorization algorithms such as SVD, tensor factorization, Restricted Boltzmann machines, Bayesian networks make recommendations by exploring latent features of user ratings or by building a model in order to predict the most preferable item which a user may wish to purchase. (Alqadah et al., 2015) CF based techniques are widely used in building e-commerce RSs. (Zhao et al., 2015) However, CF has problems such as cold start, scalability and data sparsity. (Guo et al., 2014) Data sparsity refers to the condition of low percent of rated items over the whole number of items. Cold start problem means the condition where there are new users or item with little historical behavior.

C. Hybrid recommendation techniques

Each RS techniques has its own limitations; it is difficult to solve all issues with one method. (Zhao et al., 2015) Therefore, Hybrid recommendation techniques emerged. Hybrid recommendation techniques combine two or more recommendation methods, such as CB and CF based techniques in order to avoid certain limitations such as cold-start problem, while improving RS performance. (Adomavicius & Tuzhilin, 2005) There are different ways to create a new hybrid RS: weighted, switching, mixed, feature combination, cascade, feature augmentation and meta-level. Hybrid filtering is usually based on probabilistic methods such as neural networks, Bayesian networks, clustering, latent features (e.g. SVD), genetic algorithms. (Beladev et al., 2016) Although Hybrid approaches are solution for many existing RS techniques, (Quieroz et al., 2016) more information and effort is required to implements this technique.

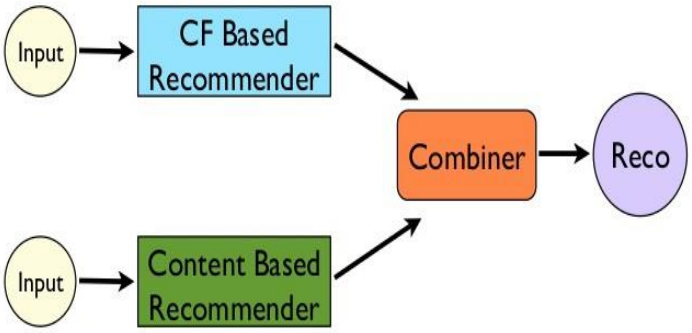

Fig 2. Hybrid Recommendations Architecture

3. E-COMMERCE

Recommender systems are being used by an ever-increasing number of E-commerce sites to help consumers find products to purchase. What started as a novelty has turned into a serious business tool? Recommender systems use product knowledge—either hand-coded knowledge provided by experts or "mined" knowledge learned from the behavior of consumers—to guide consumers through the often-overwhelming task of locating products they will like.

4. CONCLUSION

We have proposed a novel method for product recommendation. The greatest advantage of this method is that it combines time sequence information and contents features for the accurate results. As we know in recommendation systems we can recommend the product depend on the satisfaction of the customer. Also we can recommender the customer in this method of hybrid approach by looking of the similarity for what he has purchased so that we can predict.

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