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A Novel Approach for Recommending Items based on Association Rule Mining

Vasundhara M. S.
M.Tech student, Computer Science Department
Visvesvaraya Technological University, Belgaum
GSSSIETW Mysore, India

Gururaj K. S.
Associate Professor and Head, Information Science Department
Visvesvaraya Technological University, Belgaum
GSSSIETW, Mysore, India

ABSTRACT
Currently online shopping has become a trend. People prefer to go for online shopping rather than going out and shopping for themselves as it provides an easier and quicker way to purchase items of their choice with quick transactions. Recommendation systems are widely used for recommending products to the end users in their interested fields. In the existing system, most recommendations are given to the users based on the browsing history which may or may not be of user's interest and also the quality of the recommended items may not be guaranteed. This paper aims to find the efficient approach using Data Mining concept called Association Rule Mining with content-based and collaborative filtering in order to recommend the only relevant information to the buyers. The items are recommended for the buyers based on the content of buyers past buying history and opinion of other users in order to find out the quality of the item. Association Rule Mining is used for extracting the useful information from the transaction dataset and produce efficient and effective recommendation based on buyer's interest thus satisfying the buyer in better way. Similarly for music and videos the recommendation is based on the keywords set by the Business Entity using Feature-based recommendation system.

Keywords
Association Rule Mining, Pattern Discovery, Knowledge-based Filtering, Data Mining.

1. INTRODUCTION
Currently online shopping has become a fashion. Customers are interested in purchasing different products online as it is easy, convenient and gives wide variety of products on single platform. Customers can sit at home and shop with convenient and order products. Another advantage of online shopping is that the recommendations are given for the already purchased products, which will help the customers to shop in their interested fields. Many shopping websites provide recommendations based on their own

recommender system. These recommendations provided may be relevant or irrelevant to the customers.

The recommender system provides recommendations to ease the users search and buy more attractive products and increase vendors' profit [11]. The recommendations are given based on the analysis of the purchase patterns of the customers. The frequently purchased products are clustered as frequently purchased products and recommended for the customers. The Web Usage Mining (WUM) which provides relevant information to the buyers is used [5]. It stores the user's behavior on the Internet, processes that data for generating recommendation when user logs in next time.

By acquiring the knowledge gained from the analysis of the user's navigational patterns with other information we can fulfill the requirements of customers by customizing through web personalization [15]. The need for web personalization is to improve the usability and user retention by predicting user needs. This is achieved from the knowledge gained by analyzing the purchasing patterns, contents searched, individual interest and the user profile data, we can predict user needs or the relevant information for the customer. User profile contains demographic information (such as user personal details etc.) for each user of a Web site, as well as information about users' interests and preferences through registration forms [6].

This work presents a new approach for recommending products to the buyers by combining the features of Content Filtering [1], Collaborative Filtering [2], Keyword-based Filtering [7] and Association Rule Mining [8] to produce efficient and effective recommendations.

2. RELATED WORKS

2.1 Content-based Filtering

The Content-based recommendation system recommends products to the buyers based on the content of the buyers past purchase history [1]. Purchase history gives the content of the overview of the product, in which buyer is generally interested in from the different types of products. Fig 1 shows Content-based Filtering Algorithm. It is used for separation of items based on the buyer's area of interest. Like other system, content-based filtering also has some limitations like finding the quality of the item. For example, content-based filtering cannot differentiate between good article and bad article if both of them are using the same terminology.

By applying Content-based filtering algorithm the recommendations are given. The items are recommended based on the contents of purchased items using the Dynamic User Profile [6]. Each time the user logs-out, the items are categorized and stored in the web profile of the user in browser

side thus reducing the performance problems and the recommendations are built offline.

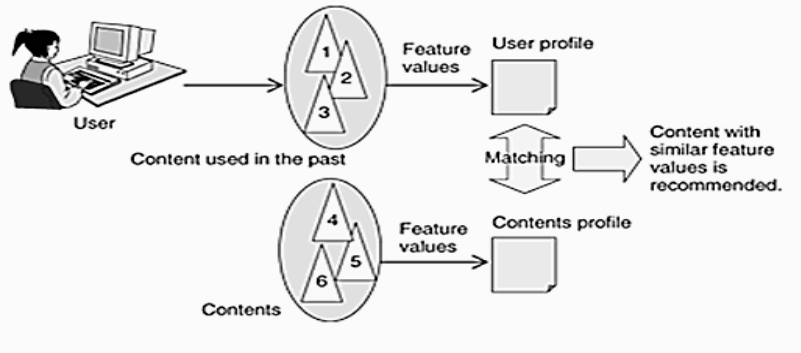

Fig 1: Content-based Filtering

2.2 Collaborative-based Filtering

Content-based filtering cannot differentiate between good article and bad article if both of them are using the same terminology. To overcome this problem Collaborative-based Filtering system is used because it is based on opinion of the other users. Collaborative-based filtering works by creating a user profile [2]. A new user is matched with the user profile to find neighbors, who had similar taste like the new user.

The idea is to recommend based on opinion of the like-minded users. Recommendation can be based on overall top selling items or past buying history. Two main categories of CF are User-based and item-based algorithms [3]. In User-based algorithm it uses user profile to generate recommendation. It forms a set of users (neighbors) who has similar history and apply different algorithms to produce top-N recommendation to the active user [4]. In item-based algorithm it provides recommendation by first forming a user rating model as categories and then produce recommendation to the user. This algorithm looks into the set of items the user has rated and computes similarity to the item i and then selects k- most similar items to the set of items to which user has rated. The recommendation is computed by taking the weighted average of the target user's rating on these similar items. The similarity between two items is measured by computing the cosine of the angle between the two vectors. The similarity between two item-sets i and j is, computed as follows:

$$sim(i,j) = \cos(\vec{i},\vec{j}) = \frac{\vec{i}.\vec{j}}{||\vec{i}||2.||\vec{j}||2}$$

Where "." denotes the dot product of two vectors and i, j are two item sets. Fig 2 shows the Collaborative-based Filtering

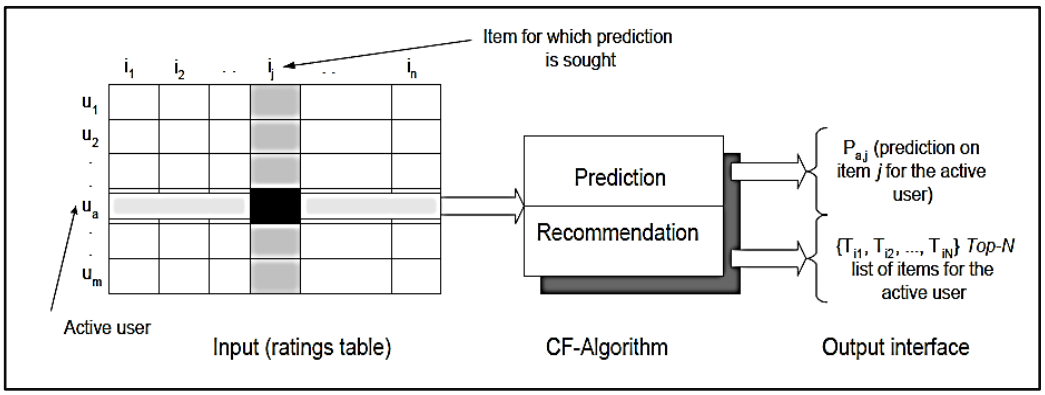

Fig 2: Collaborative Filtering Process

The result is presented by applying item-based collaborative filtering which gives both quality and performance result. The algorithm generates recommendation model by analyzing the similarities between various items in the dataset and then recommend.

For large number of items, recommending items based on the rating is a difficult task. To overcome this we apply the hybrid algorithm [12]. Here we combine the features of content-based filtering and collaborative-based filtering algorithms for efficient and effective recommendation. For example: we apply content-based filtering technique on the content of the item and filter them. Based on the obtained result, we apply collaborative filtering technique for filtering items based on the ratings and final recommendations are given.

The basic presumption is that there is enough historical data for measuring similarity between products or users which is not true. But for the products with frequently changing patterns, it is difficult to give recommendation using content-based filtering and collaborative-based filtering techniques.

2.3 Feature-based Top-N Recommendation Algorithm

As enough historical data are not available for recommending items with frequently changing patterns, we use Feature-based filtering which uses the keywords set by the business entity for recommendation [7]. Based on the number of keywords matched to the target item the top-N recommendations are given. Here the recommendation is done based on the type of the item the user has purchased. The keywords of the item which are frequently bought are considered for recommendation. For example, if a person buys music-CD with keywords like singer name, album name, etc. the system recommends the most nearest or related CD based on the keywords and rating given by the user [10]. For frequently changing product catalogs, we first find the similar product set based on the keywords of new item then

find recommended products for that set using recommendation model and produce top-N recommendation [9]. Fig 3 shows the Feature-based recommendation.

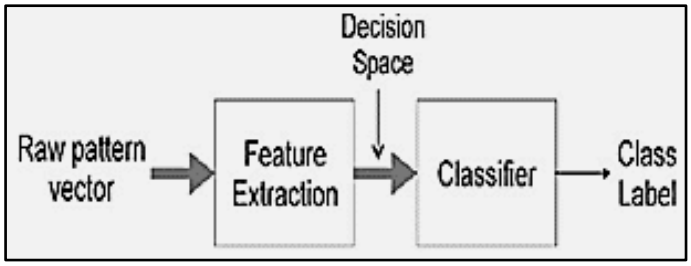

Fig 3: Feature-based recommendation Algorithm

Fig 4 shows the top-N recommendation. The recommendation is done based on the combined features of item. If the user is viewing product on web page then recommendation is given based on that product. If one or more products are there in cart, then recommendation is done based on selected products.

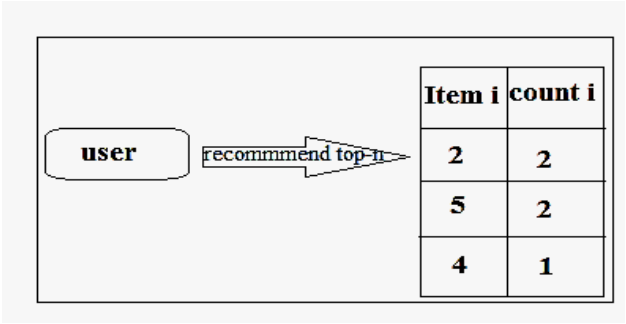

Fig 4: top-N recommendation

3. ASSOCIATION RULE MINING

Association Rule Mining (ARM) [8] is the most current data mining technique designed to group objects together from large databases aiming to extract the interesting correlation and relation among huge amount of data. Association Rule Mining helps in generating strong rules by considering few parameters (measures). Based on this, we set the confidence and support values for generating more efficient and effective recommendations. The confidence specifies the number of chapters to be matched between A and B [13]. The support specifies the number of recommendation to be given to the user.

4. MAJOR TABLES USED IN BOOK SELLING WEBSITE

From the user profile, all the stored information are extracted to find the required information for recommendation. Few major tables are shown below.

Table 1: Item Details

Field Name	Description
Item_ID	Item's ID
Item_Name	Item's Name
SubCategory_ID	Item's Sub_Category ID
Item_Image	Item's Image
Item_Cost	Cost of the Item
Item_Details	Details of the Item
Quantity	Quantity of the Item
Keywords	Item's Keywords

Table 1 shows the Item Details. The Item Details table stores all the details of the Item.

Table 2: Transaction Details

Field Name	Description
Transaction_ID	Transaction ID
Email_ID	Email-id of the customer
Transaction_Date	Date of transaction
Dispatched_Date	Date of dispatch
Status	Status of order

Table 2 shows the Transaction Details. The Transaction Details table stores all the Transaction details of the Item.

Table 3: Rating.

Field Name	Description
RatingId	Rating ID
Item_ID	Item's ID
Email_ID	Email-id of the customer
Rating	Rating of the Item
PostedDate	Date of rating posted

Table 3 shows the Rating. The Rating table stores all the rating of the Item.

Table 4: Cart Details.

Field Name	Description
Cart_ID	Rating ID
Item_ID	Item's ID
Email_ID	Email-id of the customer
Quantity	Quantity of the Item

Table 4 shows the Cart Details. The Cart Details table stores details that are present in the cart.

5. METHODOLOGY

The purpose of this recommendation system is to recommend Items to the buyer that suits their interest.

This system has the following steps:

1. Find out the category and subcategory of the Item that the buyer has bought earlier from the buyer's web profile.
2. From the transaction database find all those transactions whose category and sub category (if there is any) is the same as found in step1.
3. For content-based recommendation- Perform content based filtering on category / subcategory found in step1, to find out the items that are much similar to the books that the buyer has bought earlier based on the content from the buyers past history record and apply association rule on those transactions and find out the Items that the buyer can buy afterward. Adjust the support and confidence parameters to get stronger rules.
4. For collaborative-based recommendation- perform same as step 3 by applying collaborative based filtering.
5. For content and collaborative-based recommendation- on the result of step 3 perform item based collaborative filtering and find out the list of items in the descending order of recommendations and apply association rule. In this step system actually evaluate the quality of the recommending books based on the rating given to those items by the other buyers.
6. For feature based recommendation- perform same as step 3 by applying feature based extraction process.
7. Arrange the intersection result in the descending order of recommendations as given by the previous steps.

Outcome of the step 7 is the final recommendations for the buyer.

All these steps are performed when the buyer is offline and the results are stored in the buyer's web profile. When the buyer comes online next time

the recommendations will be generated automatically. This Item recommendation system is represented by block diagram as shown in Fig 5.

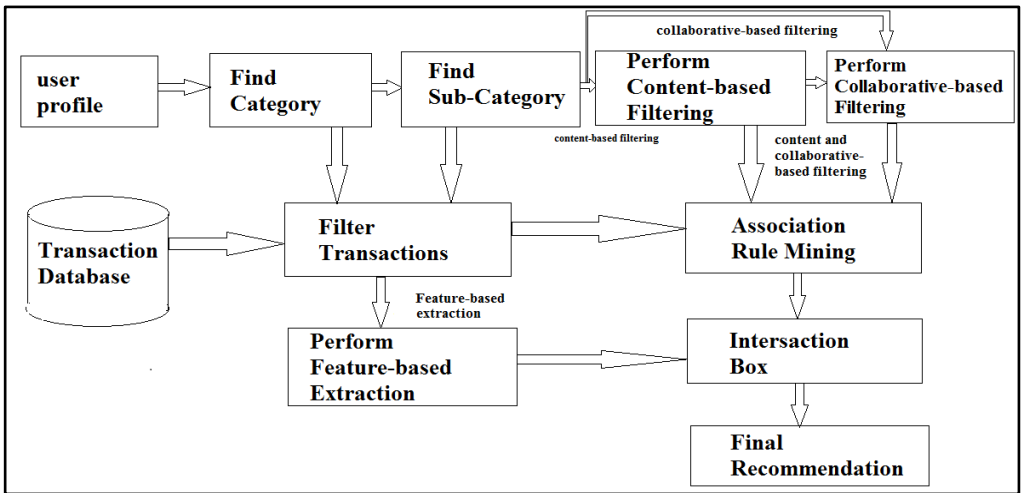

Figure 5: Block diagram of Recommendation system

6. RESULT

The existing system considers only the content-based filtering and collaborative-based filtering techniques for recommendations of items. But the drawback is that giving recommendations for frequently changing patterns like movies and music are difficult. Also the browsing history was considered, which gives irrelevant recommendation for the user. In our proposed system we consider the purchase history for recommending products for the users. Along with content-based filtering and collaborative-based filtering techniques we use feature-based extraction for recommending other Items like music, videos etc. and Association Rule Mining for better recommendation by specifying support and confidence values. Table 5 shows the set of Items present.

Table 5: Item-set

Item				
I11	I12	I13	I14	I15
I21	I22	I23	I24	I25
I31	I32	I33	I34	I35
141	142	143	144	145
151	152	152	154	155

Table 6: Users Browsed Items

Users	Browsed Items									
User1	I11	I12	I25	I32	I15	141	142	143	144	145
User2	I21	I22	I23	I24	I25	I12	152	152	I32	145
User3	I31	145	I33	I34	I35	I12	145	I11	I22	I24

In Table 6 we can see that user1, user2 and user3 has browsed so many Items. In existing system if we recommend items based on browsing then all the above Items will be recommended.

Table 7: Purchased Items

Users	Purchased Items		
User1	I11	I22	I24
User2	I12	I22	145
User3	I12	145	I11

In our existing system, if we recommend based on purchase history from table 7 then only 5 Items i.e. I11, I22, I12, I24 and I45 will be recommended for new user.

7. CONCLUSION

The recommender system benefits the user by enabling them to find items they like. The item based recommendation produces recommendation based on the content of the item purchased and matches to the dynamic user profile. Item-based technique allows collaborative-based filtering algorithm which produces high quality recommendations and the feature-based recommendation system increases the recommendations of user's interest. Hence we combine the features of Content-based and Collaborative-based filtering for recommendation. Also we are using associative model which gives a stronger recommendations for the users' choice.

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