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An Effective Product Recommendation System for E-Commerce Website Using Hybrid Recommendation Systems

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Abstract: E-Commerce websites are the major emerging trends in the current scenario, which facilitates online product selection, purchase and sales. Nowadays E-commerce websites have better popularity and advent nature, so numerous count of users wish to share their opinions about their experience in the form of making reviews, ratings and blogs. A lot of Recommender System (RS) have followed the above mentioned factors for finest product suggestion to the users. Although, the results are best and reliable, the e-commerce system should take extra considerations on the related/similar product analysis. The personalization can't be determined with only product similarity, this also need to be identified by their personalized features and interest. So, the proposed system performs effective product recommendation and increases the customer satisfaction.
Keywords: Electronic Commerce, Item-Based Collaborative Filtering, DEMOGRAPHIC ANALYSIS, Collaborative Filtering.

I. INTRODUCTION

Electronic Commerce is well known by e-commerce, which is a type of business model that enables an organization to sell their products electronically using web [1]. Online shopping websites are increased the popular ecommerce sites are Amazon, Flipkart, eBay etc., every site has its unique recommendation system, which will find similarities between the products using user shopping history.

A. RECOMMENDATION SYSTEM AND TECHNIQUES:

Recommendation systems (RS) are the most important factor in ecommerce and several applications; the RS utilizes data mining techniques and tools to predict user's preference by utilizing their previous shopping information's and selecting products among the tremendous amount of available items for the users [2]. A recommendation system obtains the interest and preference of consumer and performs recommendations accordingly, so it is broadly used in every ecommerce websites. Recommender Systems have the potential to help and improve the quality of the decisions consumers make while searching for and selecting products online. With the tremendous growth of e-commerce, due to the huge nature of the information, the data overload problem has created. So, the users are not able to effectively get items on the ecommerce websites or web. In the electronic world, RS has introduced the need for information filtering techniques that are use to help users by filter out information in which they are interested in.

Recommendation systems are one of the approaches applied for the ecommerce recommendation system which is based on providing possible items of interest to a user instead of the user to go searching for them. RS changed the way as the websites communicate with their users. Instead of providing a static feel for the users, in product searching, this provides potential suggestions which increases communication to provide a higher experience. This also reduces the problem of stock unavailability. RS recognize recommendations autonomously for individual users based on their previous search, shopping histories, profiles, rating and other reviews given to item and this also considers the other users behavior too. List of recommendations in given in fig 1.0. The branches of RS are described below.

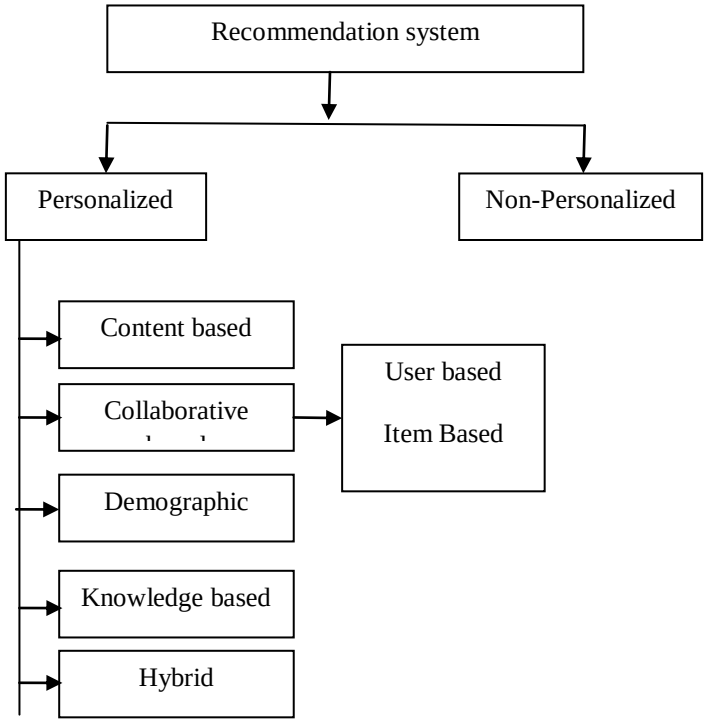

Fig: 1.0 recommendation system types

i. PERSONALIZED RECOMMENDATION:

In RS, the personalized recommendation system allows the application to perform users profile analysis and result customization. This also performs the recommendation in any format that is relevant to each and every user based on the user's implicit and explicit behaviors. Personalized recommendation engines are classified into five types. This depends on their approach to the recommendation system [3] such as Content-Based Filtering, collaborative filtering, item based and demographic recommendations.

Content-based recommendation method: The Content-based recommendation method is based on the information about item content and ratings a user has given to items. This technique combines these ratings to profile of the user's interests based on the features of the rated items. The recommendation engine then can find items with the preferred in the past as illustrated in Fig 2.0. The recommendations of a content-based system are based on individual information and ignore contributions from other users.

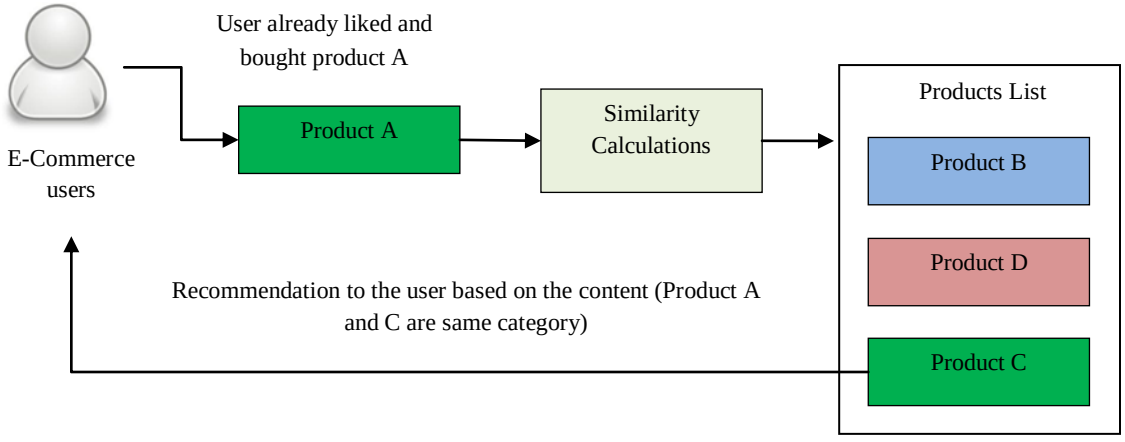

Fig. 2.0 Content-Based Recommendation

In the content based filtering mechanism, it doesn't need data of the others and it doesn't create cold start and sparsity problems. This is very useful when there are new and unpopular items on the list. However, the content analysis is necessary to determining the features of the products. The technique depends not only on the quality of the item and also on the homogeneity of the stock, so the products can be categorized easily. Another drawback of this technique is, the similarity computation is limited to the item features.

Collaborative Filtering: Collaborative filtering technique based on user's history in the form of rating given by the user to an item as their information source [4]. It can be accomplished by making relation between the users or between items. Collaborative filtering is categorized into three types: user-based, item-based, and model-based.

User-based Approach: user based approach makes recommendation based on the interest of the user having the similar taste. It correlates user as per the rating given to the items. From the Fig. 3.0, first user related to third user instead of second because the rating given by third user is quite similar to the first one. That's why item 3 is recommended to the user as it's the only remained item.

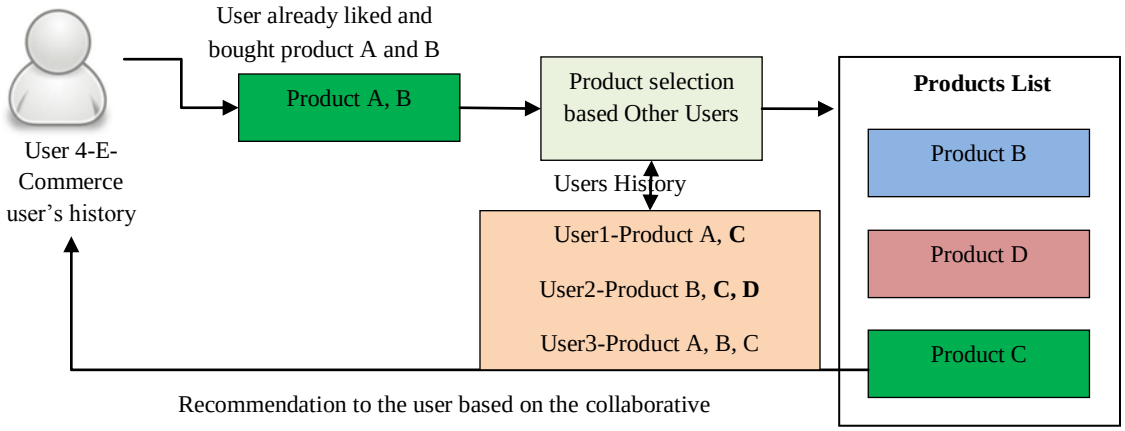

Fig. 3.0 User-Based Collaborative Filtering

The collaborative filtering based recommendation system doesn't require the prior knowledge about the product descriptions and features; rather it completed independent in nature. So, different types of ecommerce sites can use this approach for new recommendations. Unlike the prior content based approach it evaluates the quality of the products and it expressed through user ratings and reviews. Collaborative filtering techniques are able to perform recommendations to the individual based on their others preferences. Although the technique is good, the quality of the recommendations depends on the size of the previous rating dataset. It also generates gray sheep problem and privacy issues.

Item-based: Item-based Approach is based on the items as the user rated items similarly are probably similar. From Fig. 5, 2nd and 3rd user rated item 1 and 3 so it assumes that item 1 and 3 are become similar. As 1st user like item 1, item 3 is recommended.

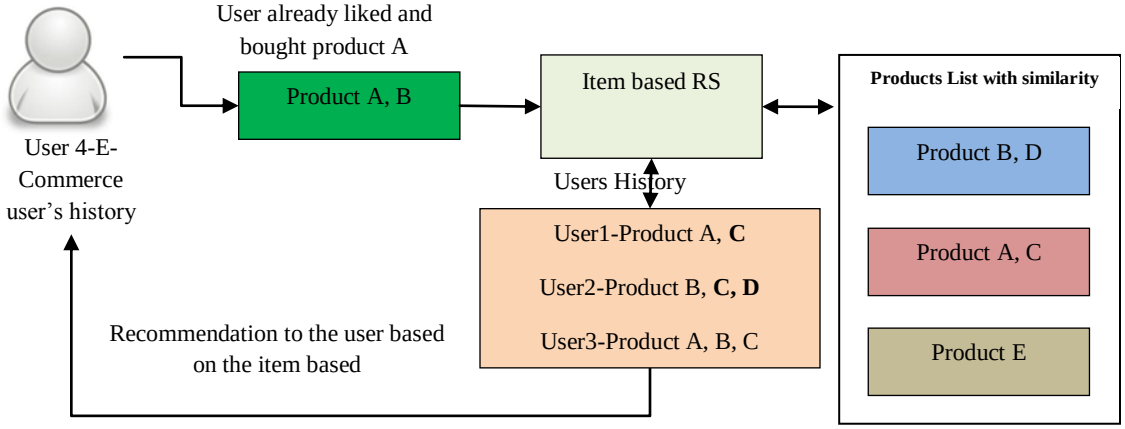

Fig. 4.0 Item-Based Collaborative Filtering

Demographic: Demographic recommendation technique uses information about user only. The demographic types of users include gender, age, and knowledge of languages, disabilities, ethnicity, mobility, employment status, home ownership and even location. The system recommends items according to the demographic similarities of the users.

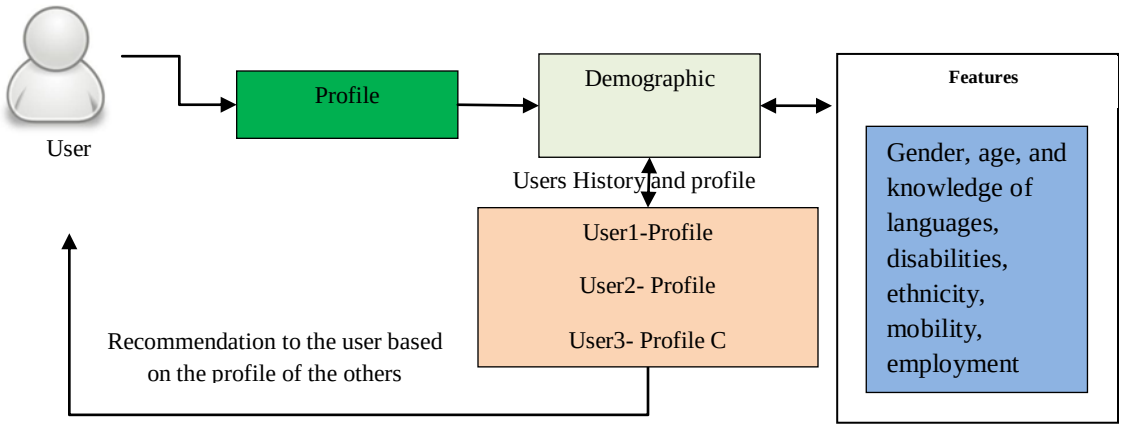

Fig. 5.0 Item-Based Collaborative Filtering

The demographic recommendation system is not fall on the user item ratings and it gives suggestions before the user rated any product. It doesn't need item features and as like collaborative, this also domain independent. The collection of user and item ratings creates privacy issues.

Knowledge-Based Filtering: Knowledge based recommendation system is based on the explicit knowledge about item classification, user interest and recommendation standard (which item should be recommend in which feature) [6]. It is an alternative approach to the collaborative filtering and content-based filtering.

Hybrid approach: Hybrid approach is a combination of all above types [5].

NON-PERSONALIZED RECOMMENDATION:

Non-personalized recommendation system recommend items to consumers based on what other consumers have said about the product in an average. That is, the recommendations are independent of the customer, so all customers get the same recommendation.

The Recommender systems are based on both personalized and non-personalized; however, analyzing and suggesting products need some historical information's and features of the item. It shortens customers' product searching time in online shopping, which improves the business online. In order to serve customers instantly and efficiently, it is essential to recognize each customer's unique and particular needs and recommend a personalized shopping list based on their interest and preferences. Finding effective recommendation system is also a major challenge.

II. LITERATURE SURVEY

There are different approaches and techniques were developed by the researchers for effective product recommendations.

Jianfeng Hu [6] proposed product recommendation based on the collaborative filtering, in specific user based collaborative filtering, which starts by finding a set of customers who have purchased and rated similar items with the target users purchasing history. Items from these similar customers, and the ratings from other similar users are being aggregated by the algorithm proposed ,to predict the ratings from this user. In User to user collaborative filtering, it suggests items based on similarities of customers ,which starts by finding a set of customers who have purchased and rated similar items with the target users purchasing history.

J. Ben Schafer, Joseph Konstan, JohnRiedl [7] proposed demographic based recommendation system. This includes past buying behavior along with their personal profile for predicting their future buying behavior, the advantage of this approach is it will adopt to the different domains and different types of customers. But the extraction of previous user buying behavior may generate privacy issues. Unavailability of the historical data may create further issues.

Steven AShaya [8] proposed Intelligent/ knowledge based product recommendation system. Intelligence contained in processing elements and subjective product information received from consumers or input to the systems as part

of their initial setup are being used to recommend the products. From this approach, Customer requirements are learnt from searching key words than only from purchase records.

YH Cho, JK Kim, SH Kim [9] suggests a personalized recommendation methodology, which able to get further effectiveness and quality of recommendation. The methodology presented in this paper is based on different types of data-mining approaches such as web usage mining, decision tree, association rule mining and the product taxonomy etc.,In this paper, the customer preference and the product association are automatically learned from click-stream, which is also known as web log. It considers both purchase behavior as well as visiting patterns for product recommendations. It avoids the poor recommendations by applying decision tree concepts. With the use of explicit knowledge form the marketers, the product recommendations are updated. Finally this approach is well defined for the accurate RS.

Hwang, San-Yih, et al [10] studies the dynamic Web service selection problem in a failure-prone environment, which aims to determine a subset of Web services to be invoked at runtime so as to successfully orchestrate a composite Web service. The matching service can be a single service or composition of registered services. This recommended system automates personalization on the web, enabling individual personalization for each customer based on demographics.

III. PROPOSED SYSTEM

The proposed system developed a new recommendation system based on the two RS; one is collaborative and demographic analysis for effective product recommendation on the ecommerce application. Item based collaborative filtering is a technique of finding similar items for a given item in a list of items present in the database. This technique uses the method of finding the neighbourhood of items that are similar to the item that is selected by the user. This neighbourhood is formed by finding some similarities between each item and the other items in the present system. In systems that have more users than items, item-item models resolve these problems. Rating distributions per item, not per user is used in ten-item based filtering. An item's average rating usually doesn't change quickly as each item tends to have more ratings than each user with more users than items. Thus a more stable rating distribution in the model is built, so there is no necessity that the model has to be rebuilt often. At the time product rating by the user, the user will get the similar products after evolving their personal profile as well as the item and other users feature dataset. So this implies the user can get the other related products as well.

Algorithm: Proposed Recommendation System

Input: Item and customer dataset

Output: Product suggestion

Steps:

1. Read Product catalogue Pd. For each item in product catalogue, Pdi
2. Read customer data Cd. For each customer Ci who purchased Pdi
3. For each item Pdi purchased by customer Cdi
4. Calculate similarity between Pdi and Cdi
   Sim(Pdi, Cdi)
5. Display recommended products filtered

Proposed algorithms

The similarity value calculation between users in the same category by means of interpersonal and intra personal as well as product based is important task in RS. The system proposed the effectiveness of RS model with consideration of individual preference, interpersonal influence and intra personal influence. The system considers the independence of user interest in the e commerce domain. It means this can recommend items based on user interest at a certain extent this also utilizes user's association with the items to train the hidden feature vectors in boosting algorithm, especially for the existing and more expecting users. The system also considers the Interest

circle inference technique. As per the boosting algorithm this segments the social network into several sub-networks and each of them correspond to particular item collection. To overcome the classification users who has a few rating records from the ulog then the ratings of their associated user's interest in the same category to link user interest products.

A. Individual Interest measure:

Due to the individuality especially users with huge rating records in e shopping domain, users usually choose products all by themselves with little influence others. To provide the product recommendation without affecting individuality for experienced users, the system proposed an optimal personalized recommendation system. The significance of user and item depends on the relevance of user interest *Tu* and item topic *Ti* to a certain domain this takes several attributes such as product category, company name, price and offers. This denoted the relevance of user T's personal interest to the category of item *i* in the RAS model by *RASu,i*

$$RASu,i = Sim(Tu,Ti).$$

This performs the similarity measure by fine filtered attributes. The derived products should satisfy the personal interest and as well as social influence without affecting their attribute consideration.

B. RE-ORDER LEVEL

An action to replenish that particular inventory stock is triggered by a level of inventory called as the Re-Order Point (ROP). The forecast usage during the replenishment lead time plus safety stock are normally used for this calculation. It was assumed that there is no time lag between ordering and procuring of materials in the Economic Order Quantity(EOQ). When the inventory level drops to zero, the reorder level for replenishing is triggered. The stock level bounce back, because instant delivery by suppliers, By using the Reorder point technique we can only determine when to order; we cannot address how much to order when an order is made.

Reorder Level = Lead Time in Days × Daily Average

Reorder Level Formula

Since every item may have a different usage rate, and may require differing amounts of time to receive a replenishment delivery from a supplier, the reorder point can be different for every item of inventory, For example consider the following scenario, a company can choose to buy the same product from two different suppliers; if one day is required for one supplier to deliver an order and three days are required for another supplier , then the company's reorder point for the former supplier would be when there is one day's supply left on hand , otherwise three days' supply for the latter supplier.

C. DEMOGRAPHIC ANALYSIS

To develop an understanding of the age, sex, and racial composition of a population and how it has changed over time, we use a technique called as Demographic analysis. It can be used to analyse any kind of dynamic living population, i.e., the population that changes over time or space (see population dynamics). The study of the size, structure, and distribution of these populations, and spatial or temporal changes in them in response to birth, migration, ageing, and death are encompassed by the technique of demography. Earth's population up to the year 2050 and 2100 can be estimated by demographers based on the demographic research of the earth. This technique gives quantifiable characteristics of a given population and also basic demographic processes of birth, death, and The similarity value calculation between users in the same category by means of interpersonal and intra personal as well as product based. These are the important task in RS. Our system proposed the effectiveness of proposed model with consideration of re-order and demographic approaches along with interpersonal inspiration and intra personal inspiration. The system considers the independence of user interest in the e shopping domain. It means this can recommend items based on user interest at a certain extent this also utilizes user's association with the items, especially for the existing and more expecting users.migration.

Step 1: For each item in product catalog, I1

Step 2: For each customer C who purchased I1

Step 3: For each item I2 purchased by customer C

Step 4: For each item I2

Step 5: Compute the similarity between I1 and I2

Execute Function(Re-Order)

Execute Demographic(Data)

Step 6: Display Recommended products filtered

PROPOSED ALGORITHMS

CONCLUSION

Through the proposed work, the customers can be assured with a better satisfaction as the related products are suggested as soon as they select a product to purchase as the recommendation algorithm contains various techniques of finding the similar products. Also the availability issue has been resolved which increases the customer satisfaction as they will never encounter the "out-of-stock" issue. This not only enhances customer's fulfillment but is also an improved way of marketing the products. This measures individuality of rating items with the reference of experienced users with various factors. At present the personalized recommendation model in the literature takes interpersonal relationship and user's historical rating records. In the proposed, the system takes the area information and other attributes to recommend more personalized and real-time items to the users.

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