Recommendation system in E-commerce websites: A Graph Based Approached

Ms. Shakila Shaikh
Computer engineering dept. TCET
Thakur college of engineering and technology
Mumbai, India
shakilashaikh48@gmail.com

Dr. Sheetal Rathi,Asst Prof. Prachi Janrao
Computer engineering dept. TCET
Thakur college of engineering and technology
Mumbai, India
sheetal.rathi@thakureducation.org

***Abstract*—this paper is regarding the lack of semantic factor in recommendation systems and describes the different recommendation techniques that are being employed in the current e-commerce website. Recommendation system can be broadly classified into three categories: content-based, collaborative, and hybrid recommendation approaches. Content based systems consider the properties of the items to be recommended. For instance, if a Amazon user has purchased many romantic novels, then content based recommendation system recommends novels in the database as having the "romantic" genre. Collaborative filtering systems recommend items based on similarity measures between like minded users and/or items. The items recommended to a user are those preferred by similar users. This paper also emphasizes the need for semantics in current recommendation system to recommend products accurately. This also describes various limitations that are present in the current recommendation methods and suggests possible solutions that can improve current recommendation system used in e-commerce websites. It also includes a survey on popular e-commerce websites such as Amazon, Ebay, Flipkart Snapdeal and Paytm by rating them on different parameters and doing their comparative analyses This paper also focuses on how graph algorithm can be used to improve recommendation in e-commerce websites. The proposed system compares flickr.com recommendation of images with the proposed method. The method incorporates semantic recommendation using overlap technique based in graph.**

.

***Index Terms*—Content-based; Collaborative filtering; hybrid recommendation; item recommendation, Overlap, Graph algorithm.**

I. INTRODUCTION

Recommendation in e-commerce means providing the users with products and services they are interested in. Recommendation system in e-commerce has become extremely popular in the recent years. E-commerce websites use different techniques to provide users with better experience in online shopping. With new technology and improved techniques e-commence is able to provide users product and services based on their interest. Different techniques such as content based , collaborative based and hybrid based are used to give users a better shopping experience[1]. Different ecommerce websites follow these techniques or combinations of these techniques. This paper also includes a survey on famous e-commerce websites based on parameters such as accuracy of recommendation products, recommended products, semantic recommendation, speed and variety of products recommended, etc.

II. RELATED WORK

Recommendation in e-commerce website is a general term for providing users with products and services (queries, novels, policies, movies, images, books, Web pages, etc.) relevant to their taste. In this section, we review several methods related to recommendation, including collaborative filtering, content based filtering, query suggestion techniques, and hybrid recommendation.

A. Collaborative Filtering

Collaborative filtering systems recommend items based on similarity measures between users and/or items. Neighborhood-based and model-based are two types of collaborative filtering. The most analyzed examples of neighborhood based collaborative filtering include user-based approaches and item-based approaches [2][6][9]. User-based recommendation works by recommending items that are liked by the like minded users, and item-based recommendation works by suggesting items based on similar properties. Recently, several matrix factorization methods have been used for collaborative filtering [8]. These methods are used to combine the user-item rating matrix using low-rank approximations algorithm, and use it to make better predictions. The combination of users and item matrix gives a better recommendation than either of them.

B. Content based filtering

In content based filtering the properties of the product or services are utilized for recommendation. The properties of a product or services under consideration are analyzed and are matched with other properties of the products present in the database [11]. The similar property products are than displayed as the recommended products. Content based filtering has wide application in e-commerce websites. Sites such as amazon , eBay, snapdel,flipkart utilized content based filtering effectively to recommend product to the users.

978-1-5090-1560-3/17 $31.00 © 2017 IEEE
DOI 10.1109/IACC.2017.180

C. Query Suggestion

In order to recommend relevant queries to Web users and make surfing of net easy , a technique called query suggestion has been used by some prominent commercial search engines, such as Yahoo!, Bing, Ask, and Google. Query suggestion predicts the interest of an active user by analyzing information from similar users or items [5]. Query suggestion helps by narrowing down the scope of the search. Query suggestion helps to suggest full queries that have been used by previous users . This helps in preserving query integrity and coherence. Query suggestion is actively applied in e-commerce websites , when a user want to search for a particular product he is suggested with set of queries below the search field which the other users have previously searched. Query suggestion have been applied in websites like amazon ,Flipkart. Snapdeal,etc . this helps in providing users with better surfing experience[7].

C. Hybrid recommendation

With so much data being collected in the recent years and keeping in mind the ever changing taste of the users it is not possible to recommend products based only on content or collaborative recommendation system [3]. That is the reason why most of the users prefer to surf e-commerce sites where integration of both the methods are involved. Most of the ecommerce have adapted to the hybrid recommendation system. These recommendation system can be a combination of collaborative, content based, click through analyses, query suggestions, etc [12][13].

III. ARCHITECTURE

The general architecture of the recommendation system is given in Fig. 1. E-commerce website interacts with the web user, while interacting with the web users it recommends products to the users based on the liking. The information about the liking of products can be analyzed by using click through analyses. The system than search for other users click through patters from the data ware house. The matching profile click through analyses is provided as recommended products in the form of you may also like recommendation on e-commerce sites. Warehouse stores content of the website this includes products and product catalogue, users, and the usage logs generated by the web server. The matching profiles to an active user which are used to suggested products or services are called recommenders or like minded users. Recommendation engine generates the recommendations of the users by considering parameters such as their profiles, products profiles, click through analyses, recommenders profile, etc. The recommendation module is the algorithm which constantly evolves by learning the users behavior. The users liking can be analyzed from the feedback provided the users knowingly or unknowingly. Clicking of the suggested product, analyzing the similar products, history searched on the site, the products previously brought, etc are all feedback collected by the feedback module [4]. This feedback is taken every time the user is surfing and are used for recommending better relevant products for the users. The recommendation engine combines the data from feedback module, recommendation module to provide a better feedback to the users. As shown in the figure.1 we use one feedback function in the second search for improving recommendations. The first search is executed and while executing these searches it calculated similar items by using several recommendation algorithms which utilizes information from web warehouse. These warehouses contain the user profile and item profile as well as recent purchases information from the website. The output of the algorithms is combined in one recommendation engine which is used to dynamically select recommendations. When the user is visiting for the second time system continuously gather and evaluate user reactions from the previous visit which helps in recommendations with the help of feedbacks.

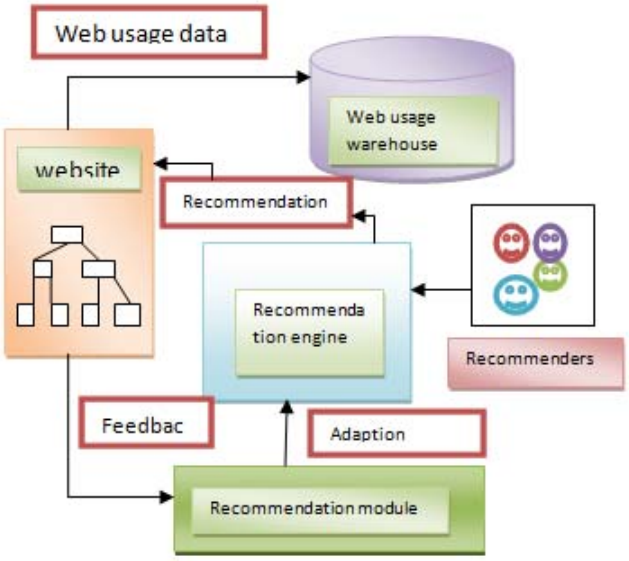

Fig. 1. General Recommendation Model Units

IV. SURVEY

Content-based recommendation systems analyses properties of the items recommended. Predicts recommendation based on how similar the items are to those that user liked in the past. E.g. In a novel recommendation application, a novel may have author, rating, genre, and subject matter, etc. The user's interest or preference is also represented by the same set of features, called the user profile [11]. Collaborative filtering systems works by recommending items based on similar properties between users and/or items .The items recommended to a user are those preferred by similar users.Collaborative filtering (CF) is the most studied and also the most widely-used recommendation approach in practice. key characteristic of CF: it predicts the items for a user based on the items previously rated by other like-minded users. Hybrid recommendation systems are comparatively better than the content based and collaborative systems. Hybrid systems integrate the different content and collaborative system to eliminate the drawbacks of both the recommendation systems. A survey on different e-commerce website was conducted. Various parameters were considered. Based on the responses from various users of these websites a competitive analyses is made. The survey includes 5 e-commerce websites, they are

Amazon, eBay, Paytm, Flipkart and Snapdeal. The competitive analyses are presented in the form of chart. The different parameters that were considered for the survey are number of products recommended, accuracy in recommendation of products, semantic recommendation, speed at which the products were recommended, number of unnecessary products recommended, etc. Based on the survey it is found that e-commerce websites amazon and flipkart has almost the same ratings for different parameters considered. They are better in terms of speed, recommendation, suggestion of associated product and variety of recommended product is more. Rest of the websites lack considerably in semantics and accuracy of recommendation.

V. Result and Analyses

Most of the e-commerce websites and search engines lack semantic and sentiment recommendation property [14]. The site under consideration is flickr.com which is a search engine .The proposed system uses overlap semantic method to integrate recommendation and semantics. In the proposed system images are recommended to the users based on the query fired. The images data set is stored in the graph format, images form the nodes and the semantic relation between them is depicted by the overlap technique forms the edges. The tag of the images which are provided by the user are stored in an array as nodes. The overlap value which is calculated for the semantically related images are stored as distance in an array. The graph algorithm which creates a sub graph of the selected images from the data set related to the query used for recommendation. Insert images in dataset along with tags, Store tags as nodes and connect the nodes with one another with the help of overlap formula.

$$\text{Overlap}=\frac{N(p\cap q)}{min(N(P),N(q))} \quad (1)$$

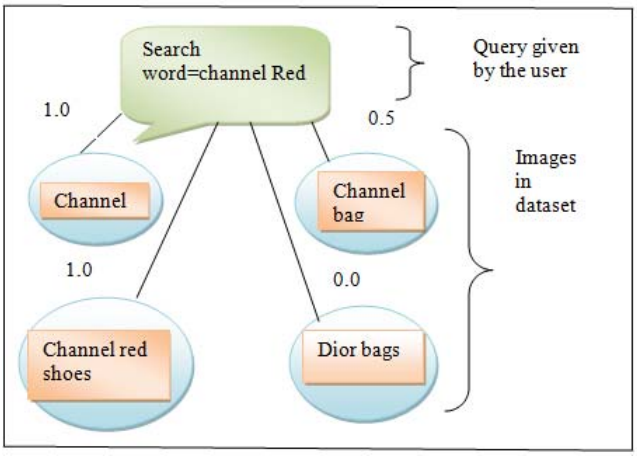

Fig. 2. Example: Working Model

Overlap (*channel* red & node 1)=1/min(2,1)=1/1=1,Overlap (*channel* red & node 2)=1/min(2,2)=1/2=0.5,Overlap (*channel* red & node 3)=2/min(2,3)=2/2=1,Overlap (*channel* red & node 4)=0/min(2,2)=0.Node 1 and 3 have equal values so display them first recommended image. Node 2 has value 0.5 display it as second recommended image. Node 4 has value 0 so discard it. The output of the system is compared with the flickr image search, the comparative result of proposed system and the flickr image search is given below:

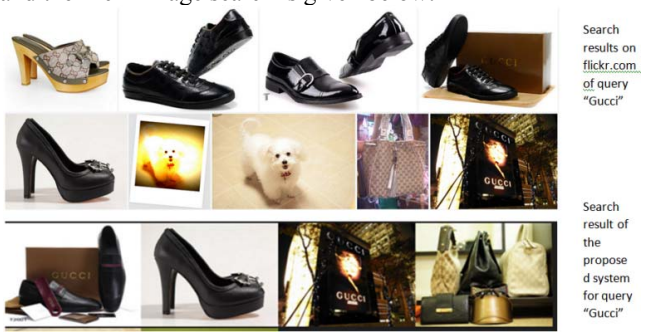

Fig. 3. Search results for query "gucci"

The first two rows in the above figure are the result given by the flickr.com for the query "Gucci". As shown in the results the pictures of dog are also given as output for the given query. The semantic recommendation is not followed by the flickr.com. This drawback is removed by introducing semantic recommendation in the proposed system. The proposed system recommends images to the users based on semantics. Images are stored in the database along with the tags provided by the users. The semantic correlation is calculated using overlap on the given tags. The images which are stored in the database form a graph of the recommendation based on the correlation value. The given query "Gucci" is mapped semantically with the tags present in the database using overlap formula. The semantically matching tags along with correlation value are calculated. Only those images are considered for recommendation whose correlation value more than 0.4.The tags with more than 0.4 correlation are considered and corresponding images are given as output.

Conclusion

Recommender systems made progress over the last few years. Different techniques such as content-based, collaborative, and hybrid methods were proposed. In this survey, we reviewed various limitations of the current recommendation methods and have concluded that integration of semantic in recommendation techniques can provide better recommendation. These methods include, among others, the better modeling of users and items information stored in the database, taking into consideration of the extra information such as feedback, multicriteria ratings into the recommendation process. The proposed system is able to successfully integrate recommendation and semantics. The proposed model proves that recommendation can be improved if semantic factor while recommending product or services is integrated in the system.

References

[1] G. Shani and A. Gunawardana, "Evaluating recommendation systems," Recommender systems handbook, Springer, 2011, pp. 257–297.

[2] Yi Cai, Ho-fung Leung, Qing Li, Huaqing Min, Jie Tang, Juanzi Li,"Typicality-Based Collaborative Filtering Recommendation", *IEEE Transactions on Knowledge & Data Engineering*, vol.26, no. 3, pp. 766-779, March 2014, doi:10.1109/TKDE.2013.7.

[3] Hao Ma, Irwin King, Michael Rung-Tsong Lyu, "Mining Web Graphs for Recommendations",*IEEE Transactions on Knowledge & Data Engineering*, vol.24, no. 6, pp. 1051-1064, June 2012, doi:10.1109/TKDE.2011.18

[4] H. Cao, D. Jiang, J. Pei, Q. He, Z. Liao, E. Chen, and H. Li, "Context Aware Query Suggestion by Mining Click- Through and Session Data," KDD '08: Proc. 14th ACM,10.1145/1401890.1401995

[5] S. Varma, M. Jain, D. Sharma and A. Beniwal, "Refined and diversified query suggestion with latent semantic personalization," *2015 IEEE UP Section Conference on Electrical Computer and Electronics (UPCON)*, Allahabad, 2015,pp.1-6. doi: 10.1109/UPCON.2015.7456725

[6] S. Parameswaran; E. Luo; T. Nguyen, "Patch Matching for Image Denoising Using Neighborhood-based Collaborative Filtering," in *IEEE Transactions on Circuits and Systems for VideoTechnology* ,vol.PP,no.99,pp.11doi:10.1109/TCSVT.2016. 2610038

[7] J. Jiang, J. Lu, G. Zhang and G. Long, "Scaling-Up Item-Based Collaborative Filtering Recommendation Algorithm Based on Hadoop," *2011 IEEE World Congress on Services*, Washington, DC,2011,pp.490-497. doi: 10.1109/SERVICES.2011.66

[8] H. Ma, I. King and M. R. Lyu, "Mining Web Graphs for Recommendations," in *IEEE Transactions on Knowledge and Data Engineering*, vol. 24, no. 6, pp. 1051-1064, June 2012. doi: 10.1109/TKDE.2011.18

[9] M. V. V. R. Murali Krishna Rao, "A collaborative filtering recommender system with randomized learning rate and regularized parameter," *2016 IEEE International Conference on Current Trends in Advanced Computing (ICCTAC)*, Bangalore, India,2016,pp.1-5. doi: 10.1109/ICCTAC.2016.

[10] J.L. Herlocker, J.A. Konstan, L.G. Terveen, and J.T. Riedl, "Evaluating Collaborative Filtering Recommender Systems," ACM Trans. Information Systems, vol. 22, no. 1, pp. 5-53, 2004.

[11] P. W. Yau and A. Tomlinson, "Towards Privacy in a Context-Aware Social Network Based Recommendation System," *Privacy, Security, Risk and Trust (PASSAT) and 2011 IEEE Third Inernational Conference on Social Computing (SocialCom), 2011 IEEE Third International Conference on*, Boston,MA,2011,pp.862-865. doi:10.1109/PASSAT/SocialCom.2011.87

[12] Sungjoon Park, Sanggil Kang and Young-Kuk Kim, "A channel recommendation system in mobile environment," in *IEEE Transactions on Consumer Electronics*, vol. 52, no. 1, pp. 33-39,Feb.2006. doi: 10.1109/TCE.2006.1605022

[13] R. L. Rosa, D. Z. Rodriguez and G. Bressan, "Music recommendation system based on user's sentiments extracted from social networks," in *IEEE Transactions on Consumer Electronics*, vol. 61, no. 3, pp. 359-367, Aug. 2015. doi: 10.1109/TCE.2015.7298296

[14] K. Bedjou, F. Azouaou and L. Berkani, "Semantic recommendation of web services in the context of on-line training," *ISKO-Maghreb: Concepts and Tools for knowledge Management (ISKO-Maghreb), 2014 4th International Symposium*,Algiers,2014,pp.1-8. doi: 10.1109/ISKO-Maghreb.2014.7033468