Personalize Recommendation Approach for Web Search in E-Learning

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Abstract— Nowadays, new technologies and the fast increase of the Internet have made access to information easier for all kind of people, building new challenges for education when utilizing the Internet as a tool. One of the best examples is how to personalize an e- learning system according to the learner's requirements and knowledge level in a learning process. This system should adapt the learning experience according to the goals of the individual learner. In this paper, we present a recommender E-Learning approach which utilizes recommendation techniques for educational data mining specifically for identifying e-Learners' learning preferences. E-Learning recommendation system helps learners to make choices without sufficient personal experience of the alternatives, and it is considerably requisite in this information explosion age. In our study, the user-based collaborative filtering method is chosen as the primary recommendation algorithm, combined with online education. We analyze the requirement of a web based E-Learning recommendation system, The proposed system is based on four modules, A student Profiling Module takes Students all Personal and Academic Information, Behavioral Activity analyzer module is use to identify learners learning preferences and all activities which is done at the time of web surfing by student and a recommendation module which pre-processes data to create a suitable recommendation list and predicting the student interest domain.

Keywords: E-Learning, recommender system, collaborative filtering, Student profiling, Classification, Knowledge Point (KP)

I. INTRODUCTION

Technology Enhanced learning is the application of information and communication technologies for teaching and learning [1]. Recommendation Systems (RS) are software tools based on machine learning and information retrieval techniques [2] that provide recommendations for potential useful items to someone's interest. Most of the modern E-Learning systems are still producing the same educational resources in the same way to learners with various profiles [3]. In general, to enable personalization, existing systems use one or more type of knowledge (learning process knowledge, learners' knowledge, learning materials knowledge, etc.) and personalization in E-Learning systems involve adaptive course delivery, adaptive collaboration support, adaptive interaction and content discovery [12]. Due to a large amount of learning resources on the web, it is difficult to find learning resources associated to learner request [4].E-Learning recommender systems intend to recommend a sequence of items to learners, that is, to recommend the most efficient or effective paths within Large learning resources to achieve a specific competence. This paper presents a recommender system for e-Leaning personalization based on learners learning activities and performance. It means personalization approach for giving learning resources for active learners in the E-Learning system. This system recommends some learning resources based on learner's profile, level of knowledge, and some other learner's activities. Also, the system provides the ability to track learner achievement based on practical tests and exercises and observe the learner's performance in order to supervise and support the learners, now a day's commercial search engines often place sponsored advertisements in the form of CPM (Cost per thousand viewers), CTR (Click-through rates), CPC (Cost per click), or CPA (Cost per action) over relevant items which also distract students from choosing the right sources of content from the returned search results, because of this the student will not get the required knowledge and it take the unwanted links because of this it get confuse.

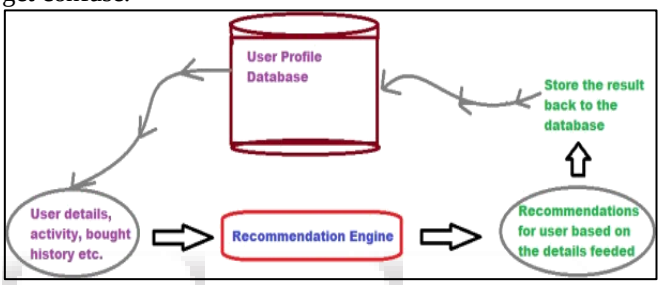

Fig. 1: General flow of recommendation system

II. RECOMMENDATION SYSTEM

This work is based on a recommendation system, it is a subclass of information filtering system that seeks to predict the "rating" or "preference" a user would give to an item. Recommender system envelops a class of methods and calculations which can propose "relevant" things to clients. In a perfect world, the proposed things are as pertinent to the client as would be engage, so the client can draw in with those things: YouTube recordings, news stories, online items, etc.

Items are ranked according to their relevancy, and the most relevant ones are shown to the user. The relevancy is something that the recommender system must determine and is mainly based on historical data. If you've recently watched YouTube videos about elephants, then YouTube is going to start showing you a lot of elephant videos with similar titles and themes.

Recommender systems are generally divided into two main categories:

1) Collaborative filtering
2) Content-based systems.

III. CLASSIFICATION OF RECOMMENDATION SYSTEMS IN E-LEARNING

This section presents a classification of Recommendation systems in E-Learning taking into account several factors. First, Subsection reviews the preprocessing techniques, features and models used in order to represent the search results. Next, Subsection presents the most popular clustering algorithms employed to group the web pages related to each individual with the same name. Following

that, main part of Recommendation systems that take into account the actual recommended links which show as a result respective a search.

The phase of Recommendation systems in E-Learning systems consists of representing the search results in order to treat them automatically in a correct way.

A. This phase is usually composed of the following steps: Preprocessing:

In this step, the search results are processed from their original format by means of several techniques.

B. Feature selection:

The main goal of this step is to select suitable features to distinguish different individuals with the same name correctly.

C. Representation model:

In this step, the search results are represented by means of a certain recommended links. On the one hand, these models assign a value to each feature representing its importance with respect to the web page it belongs to, or to all the search results retrieved by the search engine. On the other hand, these models allow the comparison of web pages by means of behavioral operations.

IV. COMPARISON OF CLUSTERING ALGORITHM

Learning Method	Loss Function	Number of clusters: Predetermined or Data-dependent	Cluster shape: isotropic or anisotropic?	Parameter Estimation Algorithm
K-means	Within-class squared distance from mean	Predetermined	Isotropic	K-means
Gaussian Mixture Models (identity covariance)	$-\log P(X)$, (equivalent to within-class squared distance from mean)	Predetermined	Isotropic	Expectation Maximization (EM)
Single-Link Hierarchical Clustering	Maximum distance between a point and its nearest neighbor within a cluster	Data-dependent	Anisotropic	Greedy agglomerative clustering
Spectral Clustering	Balanced cut	Predetermined	Anisotropic	Run Laplacian Eigenmaps followed by K-means or thresholding eigenvector signs

Table 1: comparison of clustering Algorithm

V. EXISTING WORK

A. Application Research on Personalized Recommendation in distance education [1]

Personalized recommendation in distance education, and presents multiple recommendation algorithms which reflect the latest achievements of research on personalized recommendation service. In this research, the collection of user's interest information and user modeling, item matching have made up the core content of recommendation system.[1]

The limitations of this survey are, it is less accuracy and efficient in finding user's interests in personalized recommendation. It research on how often and how to update user model so that it can provide accurate recommendation results to users. This research fails to express the basic resource in a standard method and improve the shared degree of recommendation in an open system.

B. E-commerce Personalized Recommendation System Based on Multi Agent [2]

Multi-Agent to E-commerce personalized Recommender System, and design E-commerce personalized Recommender System based on MAPRS (Multi-Agent Personalized Recommendation System). Off-line recommendation and on-line hybrid recommendation are used to construct the core recommender model under the intelligent control. This research presents the function and design ideas of various components of the system.

This survey has limitations of Security and User profile classification problem. This may require dealing with the user's privacy. The creation of full User profile is difficult

C. A Graph-Based Taxonomy of Recommendation Algorithms and Systems in LBSNs [3]

The Exploitation of geographic hierarchy is mostly seems to exploit geographic hierarchy information. That is, there is a universal system which defines a geographic hierarchy. This research is to seek for recommendation algorithms in LBSN (Location-based Social Networks) [3], which are able to provide more accurate and justifiable recommendations. Moreover, during the past decade many different websites and many algorithms were introduced to provide suggestions close to user needs. This survey presented 43 recommendation algorithms in LBSNs and compared 16 real-life LBSNs,

This Survey have a limitation of, exploration of geographic hierarchy it have to consider the location factor and time factor correctly, if the correctness of this two factor is mess then the resultant recommendation is fails [3]

D. Personalized Image Recommendation for Web Search Engine Users [4]

This research is develop for personalized search system is being proposed alternate query generator is used to capture all the senses of the main query and assist the user with alternate queries[2]. It proposes personalization based profile, click history and last action performed by user is used to improve the ranking of search result. It proposed personalize system architecture in two layers: 1) data presentation layer 2) Data collection layer.

The limitation of this Survey is it creates the language gap between the user and search engine.

E. Personalized Attraction Recommendation System for Tourists through Check-In Data [5]

PTIS (personalized recommendation system) is contributing to the sustainable growth and development of tourism industries. In that an approach to analyze user interests and perform personalized attraction recommendations using check-in information extracted from Facebook services. This information is directly useful for user attraction preference analysis and significantly benefits tourism industries. Our approach differs from existing approaches presented in the literature by overcoming the cold-start problems by collecting information from individual users and Friends available in Facebook. Here, close Friends are identified based on three factors: affinity score, edge weight, and time delay.

The limitation of this survey is, it fail to provide the accuracy, and time requirement [5]

F. Application of Fuzzy Logic for user Classification in Personalize Web Search [6]

User interest based classification in a personalized Web search using the fuzzy model delivered the acceptable rate of classification results. Heuristic based approach is incorporated in this model, so it enhances the accuracy of the classification of the user interest. The fuzzification functions are playing a major role for handling uncertainty data in such trend environment. The fuzzification is performed based on specific membership function and the selection of a specific membership function is based on the nature of the search data. Therefore caution has to be exercised during the membership function selection process. The same model shall be drawn-out using Artificial Neural Networks (ANN) [6]

The limitation of this survey is the collected user data in time-spent and scrolling speed. It resembles triangular and trapezoidal membership functions respectively. Based on this we cannot predict the correct prediction of the user interest.

VI. PROPOSED SYSTEM ARCHITECTURE

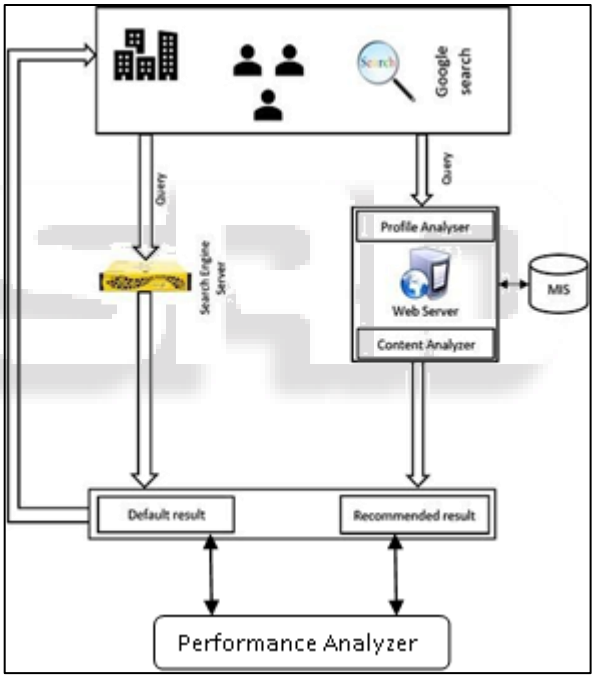

Fig. 2: System Architecture

Sr. No.	Author Name & Title	Approach used	Techniques and algorithms used	Advantages	Disadvantages
1.	Bamshad Mobasher, Honghua Dai, Tao Luo, Miki Nakagawa. ” Improving the Effectiveness of Collaborative Filtering on Anonymous Web Usage Data”.	Collaborative Filtering approach	Profile aggregation clustering	Fast results show because of clustering, Scalability problem solved.	Gray Sheep problem and cold star problems
2.	Yoon Ho Cho, Jae Kyeong Kim, Soung Hie Kim.	Collaborative Filtering approach	Decision tree induction and Association rule mining	Overcome the problem of sparsity and scalability.	Gray Sheep problem and cold star

	"A personalized recommender system based on web usage mining and decision tree induction. Expert Systems with Applications".				problems occurs.
3.	Feng Hsu Wanga, Hsiu-Mei Shao. "Effective personalized recommendation based on time-framed navigation clustering and association mining. Expert Systems with Applications".	Collaborative Filtering approach	Hierarchical bisecting clustering and Association rule mining	Improve prediction quality.	Gray Sheep problem and cold star problems occurs.
4.	Harita Mehta, Shveta Kundra Bhatia, Punam Bedi and Dixit V. S. "Collaborative Personalized Web Recommender System using Entropy based Similarity Measure".	Collaborative Filtering approach	Entropy based similarity measure	Improve prediction quality	only for the trustworthy customers
5.	Shiva Nadi, Mohammad Hossein Saraee, Ayoub Bagheri. "A Hybrid Recommender System for Dynamic Web Users, International Journal Multimedia and Image Processing".	Content base filtering approach	Rating techniques is used	Improve prediction quality	Gray Sheep problem
6.	Olfa Nasraoui and Chris Petenes. "An Intelligent Web Recommendation Engine Based on Fuzzy Approximate Reasoning".	Web usage mining	Fuzzy approximation reasoning techniques	Improve recommendation	Scalability problem
7.	Baoyao Zhou, Siu Cheung Hui and Kuiyu Chang. "An Intelligent Recommender System using Sequential Web Access Patterns. Cybernetics and Intelligent Systems".	Web usage mining	sequential pattern mining technique and user pattern matching techniques	Improve prediction quality using recommendation rules generation method	Scalability problem
8.	Sumathi, C., P., Padmaja Valli, R., and Santhanam, T. Automatic Recommendation of Web Pages in Web Usage Mining".	Web usage mining	Two components offline component and online component. The offline component involves Data Preprocessing, Pattern discovery and Pattern Analysis. The online component involves current user's profile to the aggregate usage profiles.	Improve prediction quality and solve Scalability problem	Gray Sheep problem

VII. ALGORITHMS USED:

A. Collaborative Filtering Algorithm: -

In recommendation system Collaborative filtering technique is very important. It uses only the rating data across big dataset. In collaborative filtering different types of customers rates 'n' items or have similar behaviors so collaborative filtering will rate or act on other items similarly. Collaborative filtering technique use already available information from log servers related to user interest to predict user interest to different active (new) users which might like active (new) user. To handle the increasing number of users and items, to make effective commendation in a short time period and also to deal with other problems like cold star problem, synonymy, data noise, collaborative filtering algorithms must deal with highly sparse data [7][16].

Basically collaborative filtering techniques are divided into three parts: -

1) Memory-based collaborative filtering technique
2) Model-based collaborative filtering technique
3) Hybrid recommendation technique

1) Memory-based collaborative filtering technique:

The memory base collaborative filtering technique is use complete dataset related to user-item dataset. Memory-based collaborative filtering algorithms generally use rating matrix to store user-item database to generate recommendation. Mostly in memory base collaborative filtering technique use neighbors item datasets to find the interest of user, which use in future for all the ratings by referring to users or items whose ratings are similar to the other user or items.

2) Model based collaborative filtering technique:

The main drawback of memory base collaborative filtering technique is it use complete dataset related to user item datasets and because of that this system is not work as fast as other collaborative system and also occurs scalability problem when generate real-time entries in recommendations system database. To overcome those problems, model-based recommendation systems are introduced by researchers. In Model-based recommendation systems use some small datasets called model. This model is design using extracting some information from the huge database related to particular parameter/attribute and uses this model every time without using huge database, because of that models increases both speed and scalability of recommendation system. The design and progress of models permit the system to recognize somewhat complex patterns based on the training data, and then issue recommendations for the collaborative filtering tasks for testing data or real-world data, based on the fitted models. A model-based collaborative filtering algorithm includes Bayesian models, cluster-based collaborative filtering and regression-based methods to solve the shortcomings of memory-based collaborative filtering algorithms.

3) Hybrid recommendation technique:

A hybrid collaborative filtering is more popular because it improves quality of web page recommendation or user interest recommendation. Hybrid Collaborative Filtering systems combine Collaborative Filtering with other recommendation techniques, to make better predictions or recommendations of web pages to new users . The hybrid recommendation techniques are basically divided into two parts first that include all preprocessing methods and second that includes all rule finding. Because of that hybrid recommendation system improves the predication scalability and quality.

B. Groupization Algorithm:

The purpose of re-ranking the returned search results into a custom sequence and prioritize them in a way that is more pertinent to the group members based on member similarity and level of preference. The motivation behind using this technique is to improve the ranking of the Web search results thereby making it more relevant [7] [12]

C. Fuzzy Rules:

Fuzzy rules are use to find out to the dynamism of students learning behaviors through Web search, their behaviors and interests can only be interpreted within a fuzzy setting. With the help of this fuzzy rule technique it classifies students into four levels: low, low medium, medium and high [7] [13] [14].

VIII. CLASSIFICATION OF THE BEST RECOMMENDATION SYSTEMS ALGORITHMS IN THE STATE-OF-THE-ART:

System	Features	Model	Trai ning req.	Algorithm
Collaborative	Probabilisti c	Item based	Yes	KNN, Naïve bias
	Non- Probabilisti c	Network based	Yes	Deep NN
Content based	Content driven	-	Yes	Base line Bayesian Network
Item based	Corrective intelligent	corrective	No	CBRT, K means
Social filtering	Content filtration	Combined	No	Conditional Decision tree

IX. EXPERIMENTS AND DISCUSSION:

In order to determine the students' preference towards the links displayed in each search results, we monitored their links selections. The total number of clicks on the Google returned links and the recommended links of each experimental student. When comparing one to other, it was observed that the number of clicks identified on the recommendation links increases while the number of clicks on Google returned links decreases. This exhibits an inverse relationship between recommendation links and the Google returned links when compared chronologically among the groups. One possible reason for the high number of clicks on the links displayed by Google is due to the student's familiarity with Google as compared to the recommended links section. The exciting obtained from this experiment shows that there is an incremental interest to select the recommended links. As in the earlier part of this paper, as the

participations of each group increases, their browsing histories also become richer hence making it possible for the proposed system to recommend links that were personalized to their process.

The survey results also indicate that the highest percentage of students who perceived the proposed system to be useful were those from group four with 52% strongly agree and 48% agree. When searching for relevant learning materials the student's perception about the ease of use of the system this suggests that the personalized group-based recommendation approach was able to make the process of searching for learning materials using the Web search engine more effective thereby less exhaustive. In other words, it offers better support and promotes successful collaborative Web based learning attitude.

X. CONCLUSION

E-Learning environment represents a significant role in today's education. With the expansion of available learning resources, giving personalized resource recommendation is an important functionality for today's E-Learning systems. Hence, the recommendation systems are one of the best tools to deal with the problem of overload information which will assist users to find optimal interested items.

We proposed recommendations for E-Learning personalization system, which takes the learner's learning activities into account and applies content-based filtering, collaborative filtering, and educational data mining methods for recommendations. With help of this recommendation system we predict the student interest that is helpful for future use. We calculate the Knowledge Point based on this we classified the student into different categories, on that categories we take an action on the particular student.

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