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Application domain of recommender system:a survey

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***Abstract*—nowadays recommender systems have attracted the attention of many researchers. Actually, today's world is dependent to this scope. Recommender systems emerged to help users to find the items that match their interests and preferences. Due to the lake of an appropriate survey for showing the applications of recommender systems, principles and fundamentals of recommender system are described and some of its most important applications that are essential for the contemporary life are expressed in this paper. Moreover, advantages and disadvantages of recent provided systems have been discussed in order to achieve high performance recommendation systems. In general, the recommender systems are divided into two individual and group types. Both types of systems have been considered in this paper. In addition, the latest techniques in the field of recommender systems are described and analyzed. The results of this survey can be used as a basic reference for improving and optimizing existing systems.**

- ***Keywords-Recommender system; explicit specification; implicit detection; filtering.***

I. INTRODUCTION

In the present age, we face with mass of data and information. Sources of information can be derived from World Wide Web [1], dealing sites with many clients such as eBay [37] or sites with millions of products likes Amazon [38] and etc. This amount of information will be added each day, which is known as information overload [2]. Information overload and selection method (to select among many fields like products) are considered as a challenge, the choice should be made by a customer, and sellers need to find interests and preferences of their customers in many cases, which is a complicated process [3]. Recommender systems emerged to help users to find items that fit their interests and preferences.

Due to the lake of an acceptable survey that shows the applications of recommender systems, in this paper, we tried to express some essential applications for present age life. Moreover, advantages and disadvantages of the last presented systems are expressed to introduce a solution for providing systems that improve disadvantages. This paper focuses on the application domains such as movies, tourists, shopping, etc, which have the most impact on everyday life in the present age. According to the prior studies, recommender systems are in the form of individual and group systems [3, 4 and 18].Since making recommend to the group in some domain of applications has become a challenge, a great effort has been made to make suggestion to the group systems in recent years. Examples of group recommender systems have been presented in this paper. For consecutive years has been worked on recommender systems and particularly their applications in daily life and has been tried to improve their preference. Some applications of these systems that up to now have been improved are: news [5, 6, and 7], TV shows [8], movies [9, 32, and 33], photos [10], digital library [11, 12], tourist [13, 34], shopping [14, 31], Ecommerce [3, 15, 17].Due to the extent of this scope only a few of the application domains mentioned.

Due to the wide application of recommender systems, only seven essential applications have been studied. This paper is organized as follows. The next section describes the necessary background, and three important methods of filtering are expressed. Section 3 studies some of applied papers in the field of recommender systems, and their advantages and disadvantages of these systems are briefly discussed.

II. BACKGROUND

In this section, due to the technical and basic concepts used in this paper some of concepts may be incomprehensible to the readers, so in this section has been tried to explain these concepts that the reader can understand concepts better.

A. Content-based Filtering

These filtering techniques have recommend items for user based on previous assessed items description, and these techniques have been used widely to make recommends based on previous assessed items. This filtering method works with presentation items based on their characteristics content. First user information collects and user profile forms based on preferences that already have been rated. the main difference of collaborative filtering (CB) is that the useless recommends creates by other users' information and suggestions creation is based on users profiles concepts and items[3, 19 and 21]. Some benefits of this method are that it is not being faced cold start problem, because during adding new item also its properties are expressed. The main problem with this method is that when a large number of features, extracted from user preferences it is difficult to understand the main feature [25, 26].

B. Collaborative Filtering

In collaborative filtering method or briefly (CF), first described by Goldberg [23] and is the most famous and most successful technique in e-commerce applications that the items are recommended based on other people who have similar interests

with the interests of this user which called neighbors, they are using a series of standard formulas and statistical dependence (for example items which are rated) can be found. At first users must find their own similar neighbors, but nowadays CF techniques try to recommend items that they are not rated according to nearest neighbor rating [20, 23 and 24].

The advantage of CF algorithms is that they require no information about the product or item that will be recommend, because they recommend items based on neighbors rating; It is suitable for recommend complex products such as movie and music, Especially they can consider products quality at the recommend time. For example, it is possible two movies have the same genre but have different qualities, with considering explicit ratings which are given to the movies CF algorithms can recommend movies with a better quality to the user [21, 22].

Disadvantages of CF algorithms are that they don't have any reasoning for given recommend, and they are unable to give description for the given recommend. Another problem of these algorithms is their cold start problem. When a new item is stored in the database, until the users do not rate them or do not specifies that this item similar to the other items, this item is not recommended to any user [25, 26].The next problem is when a user has a different taste from the other neighbors (gray sheep); these algorithms can recommend him hardly. Another disadvantage of this algorithm is that many people should participate until everyone is able to find user with the same interest as him that in this situation we are face with SPARSITY problem, because the number of participants make experiments be costly [27, 28].

C. *Hybrid Filtering*

These recommender systems combine some of recommend techniques to increase efficiency and to overcome the problems of other methods [29].many commercial systems use hybrid techniques such as Amazon [38].among the applications of this method can be noted the LIU paper that is based on parameters such as choice of user preferences [30], or SCHEIN [26] consider a method for recommends items which combine collaborative filtering information and content based. Also they gave a new metric performance.

III. STUDY OF RECOMMENDER SYSTEMS

In this section we have discussed about some of the last successful papers that are presented in the field of recommender systems .since the recommender systems can be in the form of individual or group, both of them have been studied.

A. *A Mobile Recommender System*

In the paper presented by FANG et.al [31], he implemented a mobile recommender system for recommend for indoor environments. Also have been expressed, because the global positioning system (GPS) is not suitable for the indoor environments and devices equipped with GPS do not work in indoor environments, also RFID is very expensive and still should pay high costs to buy RFID readers. Another method is mobile positioning system (MPS) that also gives poor results. Because of discussed reasons a method have been expressed that only by the user's mobile can find his position in the building. According this method that forms by user's mobile we can find the user position in the building, known his interests, and based on user interests give him recommend. Presented method is without cost because client's mobile is the only device that user position identifies by it and advertisement will be displayed on it. Presented method by FANG et.al is based on received signal strength (RSS). In this systems, information such as user location, time left in the store are including factors that are used to identify the user's preference and it is not necessary that users' information enter separately. Proposed system consists of three modules:

1) Location server: identifying the position of the person while entering the store.

- RSS pattern: for storing RSS patterns and their comparison position
- RSS information of user are storing in the form of real time. Both of them enter the algorithm and the algorithm identifies the user's position.

2) Recommendation server: it is for making recommends and includes the following:

- User activity logging DB: records of the user previous activities for example time spent in the store for shopping and times of entering the store.
- User profile DB: weights that users give to their preferences for example for someone price is important and for others discount is important.
- User preference learning algorithm: weight of user preferences.
- Recommendation algorithm: information of users' position with weight of preferences and information of stores, are inputs of recommendation algorithm and finally, the results sent to mobile.

3) Mobile terminal

The mobile terminal has two functions:

- Storing the mobile RSS data in form of real time and transferring to location server.
- Showing recommendation.

The other recommender system that data must be entered manually has been used to show that the new method has led to more satisfied for users. Accuracy of this method has been compared with GPS and lower costs with RFID [31].Advantages and disadvantages of the proposed method:

Among the advantages of the proposed method is that positioning method does not include the additional cost of hardware and only used customers' mobile, and another advantage is that users does not require entering their preferences because many users are reluctant to entering data. As also mentioned in the article limitations, one of the problems of RSS is storing the RSS information of all stores.

B. *Entertainment Recommender System*

In the paper presented by Ingrid A. Christensen, S. Schiaffino [32] the main problem is recommendation to group and expressed that

for recommending to group we face some difficulties, also trying to recommend movie and music to the group of users. The presented system works based on a framework which called group recommendation. The presented recommender systems are jmusic recommender and jmovie recommender. For creating group recommends have been used various methods, including six techniques, aggregation method, one merge method, modeling group preferences. In the aggregation method ratings of individual users aggregate and also it is mentioning that integration method is appropriate when the proper techniques are used for it. And proper techniques turn out to be just the goal. Used aggregation methods are:

- Multiplicative
- Maximizing average satisfaction
- Minimizing misery
- Ensuring some degree of fairness

For example goal of the last method is to have an appropriate degree of satisfaction for group members. Finally the construction of a preference group model is in order to build a group profile that this work is done by techniques such as collaborative filtering or demographic. In the proposed paper, a hybrid technique is provided by Christensen, S. Schiaffino that in this method at first individual recommends merge, and then multiplicative recommends aggregate that individual recommends merge are intended to filter items. To identify user preferences, proposed system uses two methods:

- Explicit specification
- Implicit detection

For the explicit method, after listening to the song user selects an icon for that song and for the implicit method, if the song is played more than threshold, it is a favorite song. As the frequency with which a song is played and listened to songs that are more frequently have higher rate, as implicit detection can understand the user interests. By default, the songs that have not been rated are considered as a dislike in the system. In the proposed system there are also capabilities such as restricting the list results of songs that have not been played so far by any of the members. In the section of movie recommendation for group users, they are able to control the movie with features such as title, director, actors, release date, genre and more; feedback will be used to acquire user preferences. Movies communications are measured by their different features. The most important feature of the system is presented in terms of movie genre. To verify the claims accuracy, the ratio of personal satisfaction to the all techniques is used [32]. Advantages and disadvantages of the proposed method:

One of the problems of proposed method in this paper is in section of movies that not used from implicit feedback, and system only respect to users evaluation and trust to them do their job, this is not the appropriate method for identifying user preferences.

C. Movie Recommender System

In the paper presented by Maria S. Pera et.al [33] a group recommender called GROUPREM is proposed that use three techniques for giving recommends:

- Identify personal interests of group members and then merge them and creates group profile that reflects the group preferences.
- To find similar content movies use word correlation.
- Considering the popularity of movies on a website.

In studies that have been done on this paper, concluded that all of group recommenders proposed for movie have used collaborative filtering, but in this paper have been used from content based filtering method. The procedure in this paper proposed that GROUPREM is recommends based on given tags to the movie and movie popularity in the website. This system acquires the interest of each member based on the tags assigned to the movies that bookmarked in the user profile, and then these tags are combined to create a group profile. To create a group profile GROUPREM use aggregated model techniques that this technique merges the individual users' models. And finally forms group profile that includes all personal users' tags and their combined frequencies. The occurrence of a tag in a group profile indicates the user greater interests to the movie. After certain of group profiles, GROUPREM using word correlation to identifies movies that are similar to the bookmarked movies of group members, and there is not in the profile of the group members and group most likely interest them. In this paper, the similarity degree between two words forms based on the relative distances in each Wikipedia folder. These folders are used to build the associated words matrix, because these folders include a wide range of varied topics and diverse concepts, and also their authors' styles are different.

Because the number of movies in a website is much, for recommending this number of films in the website need to spend a lot of time. In this paper to solve this problem, blocking techniques are used to select movies, this technique reduces the number of comparisons between the records and therefore reduces the processing time, this blocking technique acts that the tags given by each member for movie is considered book mark And then if any of tags given by its member exactly similar to at least on tag in that movie tag cloud, that movie is considered part of the selected films.

After identifying the selected movie, GROUPREM rates the movies based on two different rating including group appealing and group popularity. Group appealing determines interests' rate of the group members to the selected movie. By use of word correlation, compares tags which are stored in the group profile with available tags in that film tag cloud and then gives more points to those which are more similar. Group popularity considers worldwide acceptability of selected movie that is rating in a website [33]. Advantage and disadvantages of the proposed method:

The advantage of this method is that, movies that have great popularity and received high rate on a website, most likely group members also are interested in them. But GROUPREM does not use this technique only and its scoring based on group appealing, and also it does not use of word net to find similar words, because the same words are not found in it as well.

D. The Tourist Recommender System

In the paper presented by Inma Garsia et.al [34] a framework for the recommender system has been provided and this framework is

based on the tourist issue. A recommender system based on web has been proposed for tourist that provides a trip plan for Valencia City in Spain; this system is able to recommend either user or a group of users. This recommender system provide a list of tourist activities that can do on the trip and most likely interest them, and then presented a travel planning that consider constraints such as distance location, and hours of each location. The architecture of this plan consists of for subsystems.

- Control subsystem: In this section user's information is taken and after operating, it presents a list of recommended activities that comes from GRSK subsystem and also a plan for the trip that returned from planning subsystem. Generally this subsystem exchange information as a interface and also is a starter of other subsystems.
- GRSK subsystem: it Takes and analysis user's profile that includes personal details such as age, sex, family, country, etc, and user preferences and general interests and also previous user interactions with system i.e. set of items that are recommended to the user and the user has expressed his satisfaction and rate that items, and finally returns a list of recommended activities to the control subsystem for a group of user, GRSK takes each of user profile and make a group profile and recommends based on group interests.
- Planning subsystem: it takes recommended activities that returned from GRSK subsystem and then it will return to a planned trip.
- Data base interface subsystem: Process the requests that returned from modules planning subsystem and GRSK subsystem.

GRSK architecture consists of six modules:

- Engine: it takes recommends and ratings, and updates user profile, and gives to single user/group manager, and finally after operations return final recommend.
- Single user/group manager: takes user profile and after operations returns final recommend to engine.
- Basic recommendation technique: takes the user's profile and based on three parameter, general likes based and content based and demographic, returns three list of user preferences to the single user/group manager.
- group preference manager: If the suggestion is given to a group of users this module can be used, hence the three lists that obtained from the previous module is given to this module, and this module returns three lists from group preferences by two intersection and aggregation techniques.
- Item selector: it receives three lists of preferences and for each list, returns set of items which have the most correspondence.
- Hybrid techniques: Collects three lists of items that returns by item selector and returns a list that consist of individual and group recommended items.

Advantage and disadvantages of the proposed method: in the aggregation method if at least one person interested in an item it recommends, and in intersection method all individuals should interest in an item to be recommended [34]. Disadvantage of this method is that if a person of group members is not interested in an item intersection method returns the empty list.

E. Software Recommender System

In the paper presented by Enrique Costa-Montenegro et.al [35] is mentioned that users due to increasing of uncontrolled software and lake of proper classification for software, also because the software are very different, the good classification of them is not provided, and users always have difficulty in choosing the appropriate software. To solve this problem which APP is a comprehensive solution that presents new software to the users based on previous download software. Based on tag based recommender systems that are two categories, the emphasis is on a method that uses the tag data to improve traditional algorithms. This system is used of hybrid technique that consist of content base and collaborative and context based techniques and expressed that is more complete than systems such as APPOKE and App-brain.
This system has five main components

- Which app service: it is running on the user smart phone, and sends data about sofwares that user works with them to the recommendation server periodically.
- Recommendation server: it processes information that obtained from different users with different techniques until recommend to users which this work is based on users' history, user similarity with other users, previous tags of used programs and user context.
- Web server: it uses recommends that obtained from recommendation server, services to the web pages
- Web client: causes that user by use of web 2.0 rating tags and understand the benefits of social performance.
- Which app? Application: when the user runs the software, it starts to work, and send users contexts to the recommendation server.

Information such as which programs are used, how many times are used, how long are used, how many are updated etc, are collected to construct the profile. For description the recommender system in the content based recommendation section three sections are explained, as follows:

- Explanations for all softwares
- A list of the preferred programs of that individual person
- A method for measuring software similarity and users' preferences

And the vector space model is utilized for creating the content based recommends [35]. Advantage and disadvantages of the proposed method: Because softwares are very different, the good classification of them is not provided, and users always have

difficulty in choosing the appropriate software and the proposed system solved this problem, moreover it uses different filtering techniques to make the best recommend for users.

F. Nurse Supporter Recommender System

In the paper presented by Mei-hue Hsu [36], a mapping diagram recommender system is proposed for second language nurses which testes on Taiwanese nursing students. In this paper, data mining association rules are used in the system provided by optimum words or required terms for nursing automatically. This is because documentations are in English at Taiwan hospital and they are not in Chinese. Most of nurses are faced with problems for English charting in computer, so the aim of this paper is presentation of a recommender system that helps the second language nurses in the mapping diagram and taking care of patients. They also use nursing dictionaries and books in the field of nursing documentation. In this paper, it has been claimed that there is not writing common errors in their recommender system because there are many devices that detect and correct errors.

The presented recommender system works, as follows:

- At first, collected textual information is entered to the system.
- System divides textual information by checking the spot mark to sentence, and then it divides sentences to words by analyses vocabulary, so these words are identified and saved in DB and in the part of recommender corpus is used from nursing books and dictionaries.
- By use of associated rules scores to the words and the first recommender score for each word is considered zero.
- Then recommends based on given scores to nurses.

This system is implemented by visual C++.

Advantage and disadvantages of the proposed method: Advantage of this method is that also nursing specialist vocabularies are limited, nevertheless the major this advantage of these systems are abortion of translation of system that reduces the system efficiency significantly.

G. Product Recommender System

In the presented paper by Konstantinos Christidis et.al [3] is explained that buyers at electronic markets are encountered with problems such as multiple products and products long description that this causes buyers cannot find his favorite product. On the other hand sellers are faced with problems in electronic market such as Selection of an appropriate sales strategy and Proper description of the product, to solve these problems; recommender systems are used which they use content based and collaborative filtering approaches. Between all modes of auctions, English auction method has been studied that in this method the products have an initial price and buyers present suggested prices to sellers.
In this paper a web auction is considered, goal of the system from one side is recommend of related items to buyers and on the other side recommend related items and terms of the items that the seller is trying to sell it because sellers often do not know what price to sell their own product, View items related to the item the seller is trying to sell it causes that the seller somewhat become aware from the price of his product. And With this initial vision considers the Best price for the items that intended to sell. the next Problem is that sellers do not know how to describe their products Moreover, even if the desired information about the item that buyers are going to buy it are limited they don't choose that product and choose another one. By use of the system that presented by christidis, G.Mentza When the seller writes the item descriptions to create a topic his text is analyzing and this topic is using to find items with highest similarity, The seller can see better terminology to describe his own product [3].

Advantage and disadvantages of the proposed method: The advantage of the proposed method is that it is a general method and it can be useful for other auction methods such as Haggle and Biddings, moreover it uses content based and collaborative filtering to make the best recommend for users.

IV. CONCLUSION

In the present age, we face with mass of data and information. The information can be derived from different sources and it will be added each day. This phenomenon is known as information overload. Recommender systems emerged to help users to find items that fit their interests and preferences. Due to the lake of an appropriate survey for showing the applications of recommender systems, this paper tried to express some essential applications and advantages and disadvantages of the last presented systems. This analysis can be helpful to propose a solution for providing high performance recommendation systems.

According to prior studies, it is concluded that the major weakness of existing recommendation systems is the lake of attention to the commercial implementation. This is the major weakness due to the commercial nature of recommendation systems. Recommender systems move to the point that is able to discover user preferences without receiving the explicit information. Because of social nature of human, most of individual recommender systems need to work in a group form. In this paper, it is tried to investigate the latest papers concerning with applications of the successful recommender systems. It is expected that the current evaluation of strength and weaknesses of recommendation systems can provide a road map for future work.

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