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Targeted Advertisement in Social Networks using Recommender Systems

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Abstract

Within the emergence of social web (web 2.0), new platform in technology named social networks, brought in to being. Social networks (SN) become more crowded and their rapidly growth caused scientists to search for methods analyzing the data which is implicated in social networks. Social network analysis with special attention to SN's graph is a method that helps data extraction. These data could be used in targeted advertisements (Ad) which could impress users more. In the field of e-advertisements, presenting ads and sales are combined together using hypertexts or hypermedia to the nearest retailer or e-shops. So, targeted advertisement could be mentioned as an effective solution in the field of marketing on the web. Scientists have been focused on various variables and features that could be considered to target users in an appropriate way. While mentioning them, some new features are added. In this article, a framework has been proposed which facilitate targeted advertisements in social networks' platform; using social networks information, previous advertisements and their status to have more precise information for recommender systems. Recommender system is used as a tool to target each user according to its preferences and interests. The main goal is to show the most effective advertisements in sidebar and attract users to share word of mouth (WOM) advertisements with each other. Considering user's type through their activity in a social network and omitting repetitive advertisements ease our aim.

Keywords: social networks; advertisement; word of mouth; recommender systems; multimedia mining

I. INTRODUCTION

Marketing is listed as a primary activity in Michel porter's value chain model and it has a critical role in each business. Lots of researches have been performed for finding suitable methods of targeted advertising and making the most impression possible on people.

This paper's main goal is not only to fascinate customers, but also to make an improvement in the field of advertising. Reaching this aim would result in paying attention to new media such as social networks. Analyzing social networks

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would help to have exact information from any user through its profile, users' interactions with others and generally their behavior. Social Networks (SN) users are considered as potential customers and having exact and precise information about each user, would guide us to recommend useful goods or services to them according to their own interests and tastes. This is a good solution to overcome data's redundancies, which is the problem of information century. Receiving information in a proper time could increase use's satisfaction and it is an important issue in customer relationship managements. Using a constant advertisement for many times could cause inattentiveness and ignorance to advertisements and sidebars in web pages and even the media. In this research, advertisements are not going to show repeatedly. In this way in additions to omitting repeatedly advertisements, showing new advertisements will be accessible.

The availability of internet and growth of intranets cause e-commerce be mature. Web 2.0's interactivity property and arising social networks, result in having social networks as an appropriate media for targeting advertisement. Targeted advertisements in social networks are based on recognizing users well. This means to use new and up to date methods to extract accurate information out of it. It is essential to use multimedia mining for covering more aspects of user's information. Considering user age, gender, country, nationality, religion, friend's number and the average age of each user's friends could add exact information for recognizing users well. More information about user's behavior would help finding the collaboration and cooperation level, and this will cause making groups out of use's similarities. Discovering similarities could help predicting other inserting issues to the users. Recommender systems which are based on collaborative filtering result in more accurate prediction. Building some categories among different goods is possible via hierarchical model. The group's name could illustrate the main idea or the main usage of goods and tracing from root to leaf will show brands name and the special properties each goods may have. These special properties interest users to select a product from which brand and also have dramatic effects on words of mouth advertising. Recent researchers on social networks as a media for targeted advertising was dispersed on different directions such as assuming instant massaging or emails as a social network while others consider multi-purpose social networks such as Facebook or Google Plus. In case of advertisement locations there were two aspects, the first one was the webpage or the software sidebar and the second one was using word of mouth (WOM) to spread advertisement. Each former research makes an improvement in targeted advertising based in social networks but scattering ideas was the problem. In this research, it is tried to use all improvements which prior researches made and also some new ideas to make the targeted advertising system more powerful. Having reviewed basic concepts and related works, the new framework will be illustrated.

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II. BASIC CONCEPTS

In this section concepts which have been used in related works and new framework are reviewed.

A. *Advertisement*

The word advertisement means transmitting thoughts or ideas and shares them with people to overcome other ideas. Business advertisements are usually broadcasted in various media. They must be catchy and interesting which companies invest in advertisement industry for producing and broadcasting it. The main idea of all modern advertisements has been driven out from traditional advertisement such as e-banners, pop-up, pop-under, e-catalog, e-WOM and location base advertisement. These advertisements could be shown according to the cookies or the subject each user has searched for in a search engine. Internet base advertisements are more attractive and inexpensive in compare with traditional advertising. They seem to be catchier because they are enriched with multimedia techniques, pictures, videos and animations when necessary. Just like an old saying "a pictures is worth thousands of words."[1] Advertisements which contain audio and video are called multimedia advertisement. [2] In japan there are web pages such as "youfu" and "hexuan" that they have developed a method which though an advertisement the spectator could try the clothe on with different sizes and colors that are available for the clothe ad the shipping will occur right away after ordering the clothe. [3] Also "silhouette" which is a famous brand in producing frameless glasses have three options for trying on a frame. Each user could take a photo right away through the webcam, choose a picture which had taken before and upload it to try on different frames and styles on its face. Also it is possible to choose a model photo to have a virtual fit. Choosing a frame, web pages would guide user to the nearest retailer through user's IP Address.

Types of perfuming advertisement from pure traditional to electronically are divided into three areas. 1) There are not any shops available and the shopping is completely virtual on a web page it is called "Click-and-Mortar". 2) Customers must go to shop and do shopping. This is named "Bricks-and-Mortar". 3) In this method both above mentioned ways are available. It results in more selling rates and then it is known as the most beneficial model.[4][5]

B. *Mining social networks :*

In today's life with huge amount of information the first step for targeted advertising is using web mining and multimedia techniques, which are updated methods based on data mining. Data mining is the process of analyzing data from different perspectives and summarizing it into useful information and multimedia mining does the same to multimedia data. Data mining, web mining

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and multimedia mining are the main bases for recommender systems.

After reviewing mining method, some depiction about recommender system will be presented.

1) ***Data mining***

The simplest methods to process data and analyze them are data mining. Data mining techniques are not as useful as they were before, because data which is on the web is different from textual data and lots of new data types are available that data mining cannot analyze them as well.

2) ***Web mining***

Web mining is very similar to data mining but it discovers pattern from the web or in other words it is a mining method that is dedicated to web. It is the base of targeted advertisement. According to analysis targets, web mining can be divided into three different types, which are Web usage mining, web content mining and web structure mining. [3][6] Social networks data which the huge amount of it is multimedia need to be searched and discovered with more precise approach like multimedia mining.

3) ***Multimedia mining***

With the existence and grows of social networks, web contain more multimedia than any other data type. Web mining was not enough to extract data from social networks as it was just proper for web1.0 environment. But web2.0 with user generated content and rowing multimedia content needs new methods for discovering data. Social multimedia mining is the solution to find more precise data. There can be two different aspects in study of social multimedia mining; there categories are found according to multiple sources of the multimedia target data: data related to the multimedia content and data related to social activity around the multimedia data. But this article is to describe social concepts because the media o advertisements are social networks. Social multimedia mining is grouped by three other issues.[3]

- Social multimedia content mining: the focus is on mining content which has been captured from social networks. Such data may be images, videos, sounds, tags and etc.
- Social multimedia activity mining: the emphasis is on people's activity on a multimedia data from social networks. These data could be collected from visitors' behavior and their responses around multimedia content such as sharing, writing comments, tagging and etc.
- Social multimedia relations mining: its aim is mining relations among people. In this case multimedia is considered as the medium that show how people are connected and transferring information. Profiles, links and all users' preferences are contents which are usable in these fields.

C. ***Recommender systems***

Recommender systems usage in targets advertisement is based on a basic idea,

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which is to advertise products according to users' preferences. Users; interests and preferences could be specified in three ways. First the rates that user had made on different products explicitly and second could be implicitly discovered by previous transactions records. [7] Recommender systems are the only best solution which could overcome information overload. The most important reason that makes recommender systems so popular is the way they help giving the right information to the right user at a right time. [8][9] Recommender systems can be classified into four classes which are illustrated below.

- Content base filtering: items will be recommended to each user which are similar to what the same user had preferred in former transactions. This means records of previous transactions are the basis of recommending new items to each user. Content base filtering needs a profile which belongs to a user and it has to indicate user's interests, then features of the other products should be compared with user profile and then if there is enough similarity the recommendation will be presented. [10][11]
- Collaborative filtering: this method provides recommendation based on other users which have similar preferences to a user. Finding the nearest neighbor makes the recommends more effective and shows the most relevance between two users. This approach sometimes called social based.[10],[12][13]
- Hybrid: combining collaborative filtering and content base systems result in hybrid systems which could overcome the limitation of previous mentioned systems.it has four different implementations, which the strengths of each one or the way of implementing and predicting data are differed among them.[11]
- Knowledge base: it tries to use data fully, effectively and also deeply in the form of mapping between abstract user's preferences and required product features. It is assumed that user does not need two products which have many similarities and somehow the same usage. These systems focus on items' descriptions and learn individual preferences model. These systems focus on items' descriptions and learn individual preferences model.[14]

Recently a new type of recommender systems have been introduced, which is relying on user's interests. In this new method, intelligent agents play a critical role and they could exploits beliefs, aims and interests. Intelligent agents are software agents that could learn things from use's behavior.[15] they are in search of above mentioned in each user's profile. They could find out the reasons which are behind any decision that users make and also they are able to resolve conflicts by

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cross checking their data. [9] To be more obvious, intelligent agents are solving the data overload problem according to each user's needs.[16]

With considering the diversity of recommender systems, there is not a proper system available to choose which of them are more useful. Because no one could admit which model is appropriate for all users in all systems with different usage. Even it is clear that collaborative filtering and hybrid systems are more successful but it is not fair to eliminate system in a proper way would result in the best. In [8] there us a framework available that all recommender systems could make recommendation and collaborate to each other for choosing best recommends from all available. The main goal of [8] is to use the sidebar in an effective way.

D. *Social networks*

Social networks have been part of peoples' life. People usually spend hours on digital social networks such as emails, weblogs, instant messaging and also social activity networks. In general, social networks are interactive networks on the purpose of communication, which use Internet use as connectivity media.[17] the term "Social activity networks" is used to make difference between two general groups of social networks. Some of the most attractive social activity networks are Facebook, twitter, Google Plus and MySpace. The core of social networks consists of user's profile. Through profiles people make friendships and as social networks are constructed on the base of web2.0 and users prepare the contents themselves, each user who can prepare and post more attractive topics and practical information would make more friends. These kinds of users are considered as effective users because others could share their information and they would be referenced by others.[18]Those users also have a critical role in WOM and they could spread advertisements easily and quickly. Social networks are set of users and links when a connection is available between two nodes. The thickness of the link shows the level of similarities between two users.[7]

III. RELATED WORKS

So far many different researches have been performed on targeted advertising using each type of social networks. Any of them tried to makes an improvement in this field. In this part and through a table the main part of each idea has been shown. Papers and ideas have been chosen according to the relevancies of the subject and also the date of publishing.

Pervious researches were totally different in two aspects; one of them was the way they implement their work and the other is the place of advertisements. According to

Table 1, targeted advertising through social networks can be categorizes in three

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groups, that each research had chosen a type of advertise and a type of implementation for that. A research on 2011 has used both types of advertisements in social activity networks. About advertisements in emails scientists just worked on word of mouth advertising.

Table 1: Type of advertisements in social networks

Type of Advertise / Type of Implementation	Word Of Mouth(WOM)	Sidebar
Social Networks	First Zone e.g [18,22]	Second zone e.g [20,21,22,23]
IM & Mail	Third zone e.g [17,19]	Not Available

In the [17] WOM advertisements take place because they believed that the amount of users who use emails and instant messaging services are much more than social activity networks. Using classic methods like unigram and weighted is the other feature. Not paying attention to hierarchical ways, ontology and multimedia mining are some of its weaknesses. According to [19] which had chosen the social activity networks, sidebars are the place where advertisements have been shown. They had noticed IP-Address, favorite brands and telling the way of implementations explicitly are reasons which make this research different from others. They did not concentrate on different types of users. Another research that is first mentioned in [12] is completed in [7] focused on sidebar advertising in social activity networks. The main idea is to build some cohesive subgroups of the users while classifying products as well. In [7] it is considered to update cohesive subgroups when new users are added to a social network, which is a unique idea among other articles. None of both paid attention to users' IP-Address or users' location. In [20] both kinds of advertisements are implemented in social activity networks. It is completely based on Facebook's advertisements and it mentioned a good model of paying for advertisements. It is made by paying per users clicks on links. All users in Facebook have a chance to make pages about different subjects, so others who are interested in that subject will become a fan of that. Each user has many friends and they are the fans of different pages. So Facebook itself would randomly show the pages name and also friends name who are subscribed of that page. It is a kind of WOM advertising in Facebook.

Some users in social networks have a supportive role in advertisements, which is mentioned in [20], [21]. We are about to bring up a new model which has included all other beneficial methods and also

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paying attention to some hidden aspects that others have not mention it yet.

The details of other researches in compare with this resent paper are illustrated in the comparison table below.

Table 2:Comparison table

Different Points	P.M.Zade [17]	M.Irusov [18]	J.Surma [19]	W.S.Yang [20]	N.Beloff [21]	C.Chan [22]	Y.F.Chou [23]	This Article
WOM,Viral	✓	✓	✓			✓	✓	✓
Sidebar				✓	✓	✓		✓
Email, chat	✓		✓					
Social Activity network		✓		✓	✓	✓	✓	✓
Cohesive Subgroups				✓				✓
Classic model(Unigram)	✓				✓			
Multimedia						✓	✓	✓
Location / IP address					✓			✓
Brand loyalty					✓			✓
Graph Analysis	✓			✓				✓
Supportive users						✓	✓	✓
Ads classification			✓					✓
User Tracking				✓				✓
Sidebar To WOM		✓				✓		✓
Intelligent Agent						✓		✓
Weight Assigning								✓
New Advertisements								✓

IV. SOLUTION

According to Table 2 it has been attempted to have other method's advantages as well as new more improvements and also three new features. The new features can be grouped in:

1- Determining user's type, based on how often a user checks its account on a social network and computing the average of session's length.
2- Considering each user's friend number to target users in both WOM method and sidebar. For WOM, it is essential to find users which have more friends than a threshold subscriber. This would result in having a shared link on other's walls. In case of allocating sidebar to different advertisements, it is crucial to check the categories if advertisement of then adapting with groups of friends that each user had made in his or her account, such as common city, college or workplace.

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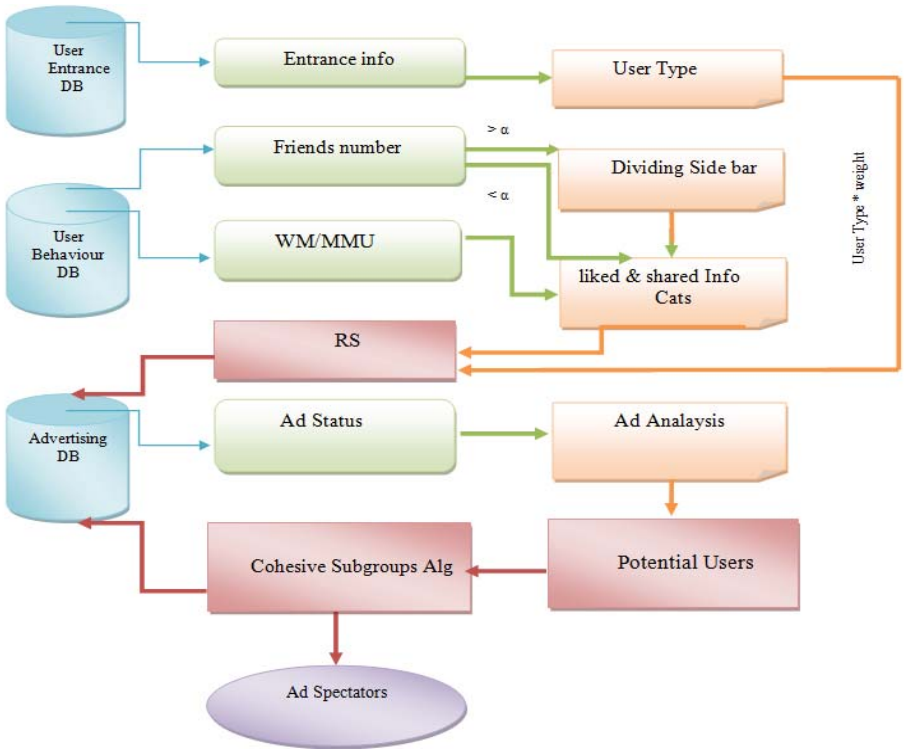
3- Preventing to show repetitive advertisements to users; by saving the goods categories which an advertisement had showed to the user.

Figure 1: Targeted advertising framework



Other important properties are paying attention to user's location which could be found from user's IP-Address or from a GPS enabled device.

It has been admitted by many scientists who worked in targeted advertisements that traditional methods of data mining such as clustering are not enough in today's crowded social networks, and to achieve a better result in recommending advertisements, it is important to use multimedia mining instead.

Based on the proposed solution and the first pseudo code, with extracting entrance counter and session length, it is possible to classify users according to their level of activity, i.e. the average time they are active in social networks would cause them to be classified in to active or inactive users. Assigning a weight to each class would help more, especially in WOM advertising. From the user's behavior database, the number of each user's friends, friends' categories and also users' interest field could guide system to divide sidebar to more efficient way. In this case intelligent agents and multimedia mining could be helpful.

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```
For (each user in SN)
  {
      If (Useri . LoginNumPerDay >= 1|| Useri . LoginNumPerWeek > 5
       && AVG(Useri.SessionLength) >= 15)
     {
            Useri .UserType = Active;
     }
     Else If(Useri . LoginNumPerWeek >= 3 && Useri . LoginNumPerWeek <= 5
      && AVG(Useri.SessionLength) >= 20)
      {
         Useri .UserType = Middle;
      }
      Else If (Useri . LoginNumPerWeek < 3 || AVG(Useri.SessionLength)<=
5)
      {
          Useri .UserType = Inactive;
      }
    If (Useri . SubscribedFriendNum >= 50)
      {
        Useri. UserValue*=1.5; // Analyzing Users with deep impression
        ValuableUsersID += Useri.UserID   //Set of valuable users for WOM
      }
    }
```

Recommendations could be made over the users' age, gender, location and user's field of work or study. Users who have large number of subscribers could be awarded by free samples or special others but would not include commission costs to share a link with others. It could be better to give the chance to supportive users to choose and write attractive titles and sentences to their friends since they know their friends and their common culture well. Making users eager to share something could motivate their friends better than just showing an advertisement in sidebar. WOM basis in on trust so not including a commission cost would help majority of users to trust supportive users to share things which they believe are useful.

Having more detail about information such as when the users put "Like" on a link or "Share" it with others could help multimedia tools to create knowledge about a user and that knowledge could be the input of recommender system.

Advertising database contains all advertisements which belong to different categories. Consider that each product has an advertisement called Adv_P and each Adv_P belongs to a class with almost the same usage which has named Cat_{Adv_P}. Also Adv_P could have a property as an object to show its manufacturer. With categorizing advertisement we could aim omitting repetitive advertisement more easily. Manufacturer's name could have a supportive role on deciding a brand x among all possible brands for that special product. Assume that a product such as a TV set, comes up in different brands with various features, if a user has one of the popular brands on its account, then system should care about customer's loyalty and show the Adv_P which is a product in Cat_{Adv_P} which have been produced by x. The above mentioned feature could be

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used whenever at least one brand has been mentioned on the user's account. In case of multi brands from the same Cat_{Adv_P}, it is recommended to show a comparison table to the user instead of showing all brands available on Cat_{Adv_P}.

To achieve omitting repeated advertisements, it is necessary to track users to find out if they have ordered or bought goods electronically, after they clicked on its link. According to the second pseudo code, if a purchase request has been sent to the merchant's web page, the web page must return "1" in a flag or "True" in a Boolean variable. This variable will be used to update the advertisement database not for paying a commission cost to the social network. Such functionality could also be available if the merchant's web page redirect users to the social network after ordering processes, and the social networks has the Boolean variable in itself, but as far as the customer might close the browsers after ordering goods, it is recommended to have the variable on merchant's web page and then the web page would be responsible to return the value to the social network After the data base being updated, the system would not show any advertisement from the Cat_{Adv_P} , unless the product belongs to Cat_{Adv_P} which is books, articles or music tracks. Obviously it is possible to understand that whether $Advertisement_j$ is successful for the $User_i$ or not. This could help recommender system to suggest better advertisements in feature. For making more impression on users, it is crucial to consider user's location in case of none digital products.

For more effectiveness in WOM when a user click on a sidebar advertisement if it seems interesting the user, there is a share field available to share the advertisement individually for other friends. It is clear that system does not update its database for this kind of advertising. It could just help multimedia mining system to find out more about a user behavior and interests. WOM in this case could be useful for announcing new technologies, new attractive hair models or dresses for teenagers. These codes are supplementary for choosing cohesive subgroups that is mentioned in [7].

```
For (All Adv; Advi)
 {    Advi.NotSeenUserID =AllUsers - Advi.ShownUserID
     For (All ShownUserID ;UserIDj)
      {
         If (Advi.UserClick = false)
             Advi.SeenUsersID = Advi.ShownUserID - UserIDj;
           // A Set of attention & successful adv.

         If (Advi.UserClick = True && Advi.Buy =True )
          {
            AdvBoughtUserID = UserIDj; // Users who had bought the product.
            Advi.PontetialUserID =
             Advi.SeenUserID - UserIDj +  Advi.NotSeenUserID ;
            //Set of users had just clicked on the link +
            //Set of Users that didn't saw the adv yet
          }
      }
```

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```
      If (Advi.Type == Digital || Userj.Location == Advi.Location)
      // No change for digital products & same locations
          Advi.PontetialUserID = Advi.PontetialUserID;
    Else
    {
       For (each User in Advi.PontetialUserID)
          If (Userj.Location != Advi.Location
       //Omit the Users from different locations
                Advi.PontetialUserID =  Advi.PontetialUserID -
                Userj.UserID;
    }
}
```

V. CONCLUSION

In this paper, we have proposed a framework which aim is making better influence in targeted advertising of products considering different features. In this approach after defining the user types which has been mentioned in this article and using the algorithms of discovering cohesive subgroups in a social network according to previous researches, and also categorizing products we have omitted presenting repetitive advertisements to users by using logging each advertisement and all its viewers. Proposed algorithms could be used as a complementary to discovering cohesive subgroups. Considering user's sociability in social networks is another important factor which is covered in this framework.

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