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FriendProbe - A New Friend Recommender System for Social Networks

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Abstract: Social networks provide an important source of information regarding users and their interactions which is very valuable for the recommender systems. In web-based social networks social trust relationships between users indicate the similarity of their needs and opinions. In this paper, we presented a social network based recommender system named "Friendprobe" an app that utilizes the information of the user and makes recommendations by considering users major interest and calculating the similarities between each user, thus recommending friends. A probabilistic model is being developed to make this personalized recommendation from the basic information collected from the user. We also help the users in a way by searching and recommending friends who do not belong to the same category of the major interest as the user.

Keywords: Social networks, Recommender system, user interest.

I. INTRODUCTION

Social networking is expanding the number of social contacts by making connections through individuals. While social networking has gone on almost as long as societies themselves have existed, the unparalleled potential of the internet to promote such connections is only now being fully recognized and exploited, through Web-based groups established for that purpose. it establishes interconnected Internet communities that help people make contacts that would be good for them to know. Websites dedicated to social networking include Linkedin, Facebook etc.

Fig. 1. Social networking

Social networks are now visited more often than personal email is read. Some social networks have grown to such enormous proportions that they rival entire countries in terms of population- If Facebook, for example, was a country it would be the fifth-most populated in the world. Facebook is one among the most popular sites in this era of communication and sharing. according to the statistics, it has 1.4 billion active users!

Recommender systems (RS) are the ones used to recommend friends to the users based on some criteria. They are normally used to handle and solve the information overload. The existing social networking system includes Netflix for movie recommendation, Facebook for friend recommendation, Foursquare for recommending places etc.

The challenge for the existing social networking services is how to recommend a good friend to a user as most of them rely on the pre-existing user relationships to pick the friends.

There are typically two types of algorithms for recommender systems1) content-based methods- measure the similarity of the recommended item(target item) to the ones that a target user likes or dislikes based on the item attributes[10]. 2) collaborative filtering method- that finds users with tastes that are similar to the target users based on their past ratings. This can then make the recommendations to the target user based on the opinions of the similar users[11].

For more than a decade, RS's have been proposed to overcome the information overload and many algorithms and systems have been developed for the same. Still, they face the challenge of cold start users and data sparsity in case of Collaborative filtering technique.

The recent emergence of online social networks provides us with enormous amount of information related to user behaviour and friend interactions have demonstrated their importance to develop a efficient RS in this field.

Facebook's friend recommender system is based on the concept of social graphs. It features people as the people you may know through connections on the users profile i.e. mutual friends based on their work, education details, networks etc. For instance, if both two users A and B add the same college in their education, then both A and B will be shown with the people they may know on each other's profile or if both A and B have large number of mutual friends then Facebook guesses that A and B might know each other and so the recommendation follows. This system wasn't found to be much appropriate.

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In this paper, we have presented an app named "Friendprobe" that extracts the users basic information like name, id, interests, they have liked on from the Facebook database and stores these information into our backend database. Once the user logins through the app, automatically his basic details will be collected and stored and the major interest of each user will be calculated through probability and saved. Then the similarities between each users are also calculated and then recommend friends based on the highest similarities between the user. The user can also search friends other than his major interest from the set of people who are present in our database.

II. RELATED WORKS

The paper like [1] three social factors i.e personal interest, interpersonal interest similarity and interpersonal influence are fused into a new recommendation model based on probabilistic matrix factorization. They tried to solve the cold start problem of the user. But the experiments were performed by collecting the three to four months old historical data from three shopping sites Yelp, Douban and Epinions. The main contributions of the paper is to propose a personalized recommendation system combining the social factors which would the direct connections between the user and item vectors. They also proposed a personalized recommendation approach by enforcing user personal interest, modelled to get an accurate model for cold start and sparsity problem of the user. The CircleCon model [3] has outperformed the BaseMF and SocialMF in terms of accuracy of RS. The approach focuses on the trust factor and infers the trust circle, and recommend based on that.

Jiang *et al.*[9] demonstrated the significance of social contextual factors for an item adopting on real Facebook and Twitter style datasets. The task of ContextMF model here is to recommend the acceptable items from a sender to a receiver, its interpersonal factor being similar to that in [3].Many social network based model [2] have been proposed to improve the performance of RS. Yang *et al.* [3] propose to use the concept of "inferred trust circle" based on the domain-obvious circles of friends on social networks to recommend user favourite item. Their approach not only refines the interpersonal trust in the complex networks, but also reduces the load of big data. Phelan et al. [4] used the real-time Twitter data as the basis for ranking and recommending articles, and proposed a news recommendation technique. R.Sinha [5] examined the quality of recommendations of six online recommender systems and the results show that the users friends provided better recommendations, consistently. EasyTracker [6] used the GPS traces collected from smart phones that are installed on transit vehicles to determine routes served, locate stops, and infer schedules. MatchMaker[7], a collaborative filtering friend recommendation system by Bian and Holtzman was based on personality matching. Zhibo Wang *et al.* [8] discovers life-style of users and calculates the similarity between the them, and recommends friends to users if their life-styles have high similarities. They have implemented it on android based smart-phones.

Recommendation systems that try to suggest items to users have become more popular these days. For example, Amazon recommends items to the user based on the items the user previously visited, and items that other users are looking for. Netflix recommend movies to a user based on the users previous ratings and watching habits. The user-user relationship of social networks contains factors like interpersonal interest and influence on which[1] applies the CirlceCon[3] model to enforce the factor of interpersonal influence.

III. PROPOSED SYSTEM

In this paper, we have presented a new app named "Friendprobe". This is a web-based app that is directly being integrated with the Facebook(Fb) database. The user who logs through the app, with valid Fb credentials will be directed to the home page of the app. The pictorial representation is as shown below in Fig.2. In our project, we have considered only five categories for the calculation of the major interest i.e. Music, Movies, Sports, Games, and Books.

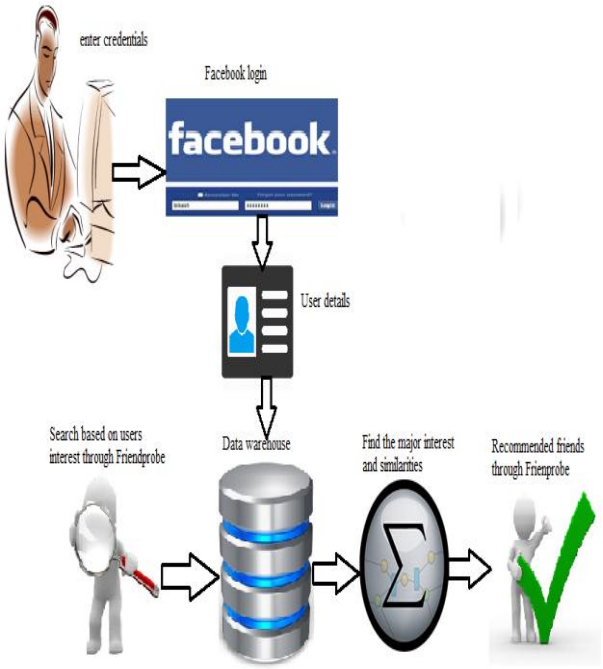

Fig. 2. The process of recommendation.

The framework of our system consists of two main parts:

1)Web application - "Friendprobe" is the web app that we have developed here for the working in the client side with HTML and PHP platforms. Once the app was developed, we provided a link to the users through which they could login to the app through valid Fb credentials. A session will begin and a request will be sent to the server to access the information of the user. When the user allows the access permission, a access token will be generated for each user for authentication, and thus the user data will be retrieved. This is the major activity of the web app.

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2)Calculations and recommendations - Once the user is logged in through our app, the user will be directed to the welcome page of the app. There, "Find friends" option will trigger our algorithms of finding the probabilities of each users major interest. Then, we find the similarities between all the users who are logged into the database. After getting the similarity, based on the values obtained for the similarity, the user whose logged in will be recommended with friends.

When the user clicks on the "Search" option, the user data is extracted from the database and each of their likes in every category is being compared to find their major interest. These values are stored separately and then the user will be recommended based on the category of interest the user clicks on. If the major interest of a person is more than in one category, then that person also will be recommended to the user.

Since our app is directly integrated with the Fb database, once the user logs in, his/her basic information like name, profile pict, likes, mail id, location etc. will be collected and stored into our external database. This information will be present in the Facebook SDK's Graph API tool and can be extracted if the user gives the access permissions.

TABLE I: SYMBOLS USED IN THE PAPER

Symbols	Description
W	The user activity
D	Set of documents
S_d	Distance similarity
S_c	Cosine Similarity
p_1, p_2	Any users who have logged into the app

In the first step, when the user clicks on the "Find friends" option in the app, based on the principle of LDA algorithm[12] i.e. it finds the topic of interest from a large collection of topics in a document by calculating the probability of each word in the document. In the same way, by using the basic information that we have already stored in our database, we calculate the probability of occurrence of each like in the five categories under consideration. This probability is calculated as:

$$P(W|d_i)=\Sigma\, p(w|z)\; p(z|d_i).$$

This gives the probability of the interest of each user. In the same way, in an iteration, probabilities are calculated for each user for the five categories we have considered. Now, to find the major interest of the user, we set a threshold value say α(alpha) = 0.2.
This helps us to categorize the users whose count value greater than 0.2 as their major interest among the five considered categories. Once we have calculated and stored the major interest of each person, we now go on to find the similarities between the users in our database.

The similarity S is calculated as:

$$S(p_1, p_2) = S_c(p_1, p_2) \,.\, S_d(p_1, p_2)$$

$S_c(p_1, p_2)$ is the Cosine similarity and is given as:

$$S_c(p_1, p_2) = \cos(p_1, p_2) = \frac{p_1 \,.\, p_2}{|p_1| \,.\, |p_2|}$$

$S_d(p_1, p_2)$ is the Distance similarity and is given by:

$$S_d(p_1, p_2) = 2 \,.\, \frac{|D_1 \cap D_2|}{|D_1| + |D_2|}$$

The similarity array of values that we get from $S_c(p_1, p_2)$ and $S_d(p_1, p_2)$ are then multiplied to get a final array with the similarity values in it. In this final or the resultant array, the number of rows and columns are the number of users that are stored in the database. Every user in a row will be compared against every other user across the column. For this comparison, we again set a threshold value say β(beta) = 0.5. While comparing if any value or the count value is greater than this β value, then that particular user will be recommended to the user in the row. This is how the algorithm works when the user clicks on the "Find friends" option i.e. based on the users major interest, he will be recommended with the friends who have similar interest as his and hence he can make friends.

Consider that, the user not only wants to have friends of his interest, but he also wants to have friends who have different interest, then our app will help him by suggesting him with the friend who has different major interest than the user. When the user clicks on the "Search" button in our app, he can select any category from Music, Movies, Sports, Games and Books. Based on the category he selects, he will be recommended friends. When the algorithm of search triggers, the major interest values of each user that we have calculated and stored will be extracted and then each of those count values will be compared to every users to find the major interest as above. Then the searching operation is performed among the set of users present in the database, depending on the category the user has clicked upon, and thus the friends will be recommended to the user.

The user can also get a small description about the admin of the app when he clicks on the "about me" option in the app, so that the new user can get a brief description about the admin so that he can login to the app without any fear of security breach or leaking of his basic information. The "Logout" button will exit the user from both the app and his Fb account that he had logged in.

IV. EXPERIMENTAL RESULTS

The result of the project is being shown as screen capture of our app "Friendprobe". The below figure shows the calculated probability count for every user in each category based on which the recommendation based on both users personal interest and search by the user based on his own interest than his own interest. pmo, pbo, pso, pmu, pga are the probability values that we have calculated for each user for the considered five categories

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i.e. Movies, Books, Sports, Music, and Games respectively.

Fig.3. Table containing the probability of each user in every category

The above screenshot shows how the probability values for each user are being calculated and stored into our database. Using these count values we will be calculating and recommending potential friends to the user.

The next screenshot demonstrates the friend recommended to me based on my major interest i.e. Music from the set of users in my database.

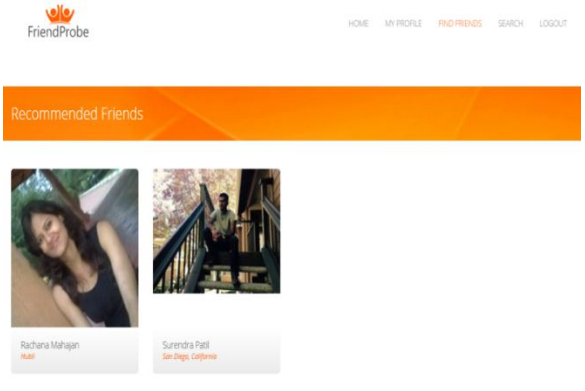

Fig .4. Recommended friends basic on our interest.

The next screenshot demonstrates the working of search option by the app. As my major interest is Music, I can search friends whose interest is other than Music.

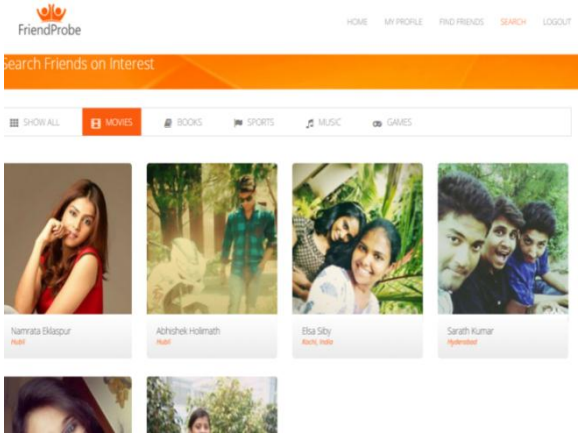

Fig .5. Friends with their interest in Music.

The above screenshots gives us a the demonstration of how our app "Friendprobe" works as and when the user clicks onto the various options in it. Friends are recommended based on both the user's personal interest and find friends other than his own interest.

V. Conclusion and Future Work

In this approach, we have developed a web based social network recommender system as an app named "Frienprobe". Our app is directly integrated with the Fb database and when any user logs into it, all his basic information stored in the Fb database will be extracted and saved into our database at the backend. The similarity between every user in the database is being calculated using the similarity metrics, and friends are recommended in the cases of both users personal interest and also based on his non-interest categories. As a future work, we can extend the project to some other social networking sites and add more new feature to the existing recommender systems. Friendprobe can consider more number of categories as Fb provides large number of topics for the user to Like on.

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