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Human Activity Based Friend Recommendation For Social Network

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Abstract - The current social networking applications such as Facebook, Twitter and so on provide friend recommendation services based on mutual friends, job, literacy information, contacts one has imported and other factors. The recommendations provided this way, sometimes, may not be the most pertinent to match user's predilection in real world. Hence, we propose a Friend recommender system, which suggests friends to users in social network, based on the activities that they carry out in their day to day lives. "Human Activity Based Friend recommendation System" is an application that presents a proposition to users by extracting their lifestyles from Smartphones. The recent Smartphones are outfitted with ample sensors such as accelerometer, gyroscope and so on. These sensors are used to capture the daily routines of users. The captured information is then processed and lifestyles of users are excerpted using a text data mining algorithm known as "Latent Dirichlet Allocation". Further, similarities between users are computed using the lifestyles extracted from LDA and the user with highest similarity is suggested as friend. To further, improve the efficiency of the application, a feedback system is incorporated. Using which the users can evaluate the suggestions presented by the system.

Key Words: *Social Network, Friend Recommendation, Activity Recognition, Sensors.*

1. INTRODUCTION:

Today Social networking services are a very popular means to communicate with people around the world [1]. These social sites behave like an online community of internet consumers. Plenty of these online community members share common tastes in hobbies, politics and other lifestyles. Some of the popular social networking services are Facebook, Twitter, Google+, Instagram, LinkedIn and so on. The current systems group together people based on Tastes and people they already know. The Proposed system, "Human Activity Based Friend Recommendation System For Social Network" is based on the system proposed by authors Qing Cao, Zhi Wang, Hairong Qi and Jilong Liao in [8], which provides friend suggestions based on users daily activities. Habits and Lifestyles are factors that are not widely used and are most intuitive and impractical to collect online in real life. The current smart phones are rigged with sensors such as accelerometer, gyroscope, barometers, photometers, magnetometers and so on. These sensors in smart phones can be used to collect the users activities. There are a number of data mining techniques available to extract useful patterns from a large set of data. And hence, text mining techniques can be applied on the collected raw data from sensors for human activity recognition, based on which friend recommendation can be provided.

2. RELATED WORK:

The social networking services such as Facebook, Twitter, Google+ and so on use recommendation systems to suggest friends. The Facebook application uses "People you may know" [2] which provides recommendations based on mutual friends. These recommendation systems are also used by Amazon, which recommends the items based on previously visited items and even the items other users are searching for [3]. The authors Bian and Holtzman have presented a system called Matchmaker, which recommends friends based on personality matching [4].The MatchMaker system extracts social and mutual understanding information from users in network connections and produces friend recommendation based on the rich contextual data collected from real world user's interactions. It produces recommendations based on the personalities that, mainly matches with that of TV serial characters. For eg, Let A and B are social network users. And let X be a TV serial character who is the most similar to A and Y be a TV serial character who is friends with X in serial and B is similar to Y. Hence, B can be recommended as friend to A.

Kwon and Kim have presented a recommendation method to suggest friends, which uses physical and social context [5]. The fried recommendation is made based on Physical and Social context. It is a three stage process where the friendship are computed for physical and social context and are combined to obtain a final friendship score, based on which the recommendation is made. However, the authors did not explain how to obtain the social and

physical context. CenceMe [6] is a system which uses sensors of smart phones to capture the users activities such as sitting, standing, running and so on, habits and so on. And enables the user's to share this information in social network. But this system was built and tested on Symbian phones and it senses diverse data such as web search history, call history, VOIP, messages, information from social networking applications, GPS data, sensor data, health monitoring and so on. Performing processing and analysis on the captured data may become tedious. Authors X.Yu, A.Pan, L. A. Tang, Z.Li, and J.Han. [7] proposed a recommendation scheme which recommended geographically linked friends in social networking services by incorporating the GPS data with social network system.

3. SYSTEM OVERVIEW:

The proposed scheme is a recommendation system, which recommends friends to social network users. The Figure 1 shows the system architecture of the friend recommender system. It consists of client side and server side. The client end is a smart phone embedded with sensors. The main function of client is to first register with the application and collect the raw sensor data and send it to server for pre-processing. The server side consists of functionalities such as authenticating the registered user, data collection and pre-processing, activity recognition, calculate similarity and user feedback and query control. The server uses MySQL database to store user information. The server performs median filtering on the raw data to remove outliers and K-Means algorithm for activity recognition. Activity recognition is the base for extracting users high level lifestyle information from low level sensor data. A text mining algorithm known as LDA is used for lifestyle modelling to extract lifestyles. Further, similarities are calculated using lifestyle information and are presented as a list of friends in social networking sites.

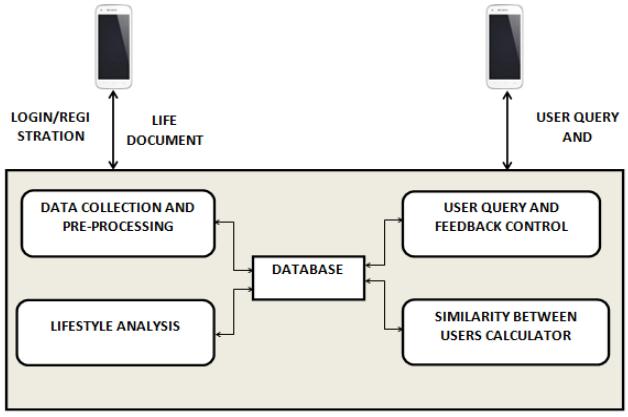

Figure 1: System Architecture

2.1 WORKING:

This section gives a high level view of working of the proposed system. The aim of the scheme is to build a friend recommender system, which would produce accurate recommendations for the social network users. This system can also be a standalone application. The client side is a mobile application, installed in the user's smart phone. The functions of the mobile application is to continually sense the sensor data and send it to the server and query the server for friend list. The server side performs pre-processing, clustering for activity recognition, lifestyle extraction using LDA algorithm and calculates similarities using the lifestyle information.

Once the user has registered with the application, the process is carried out as follows:

- First, the data is collected from smart phones in the format (acc_x, acc_y, acc_z, gyr_x, gyr_y, gyr_z) and are pre-processed. The filtered values are clustered using K-means clustering algorithm. Thus, partitioning into k clusters where each cluster represents an activity. The resulting centroid values obtained after K means are sent to the client application. Therefore, instead of sending raw sensor data to the server, an activity sequence is sent to the server. The activity sequence will consist of the cluster numbers, the sensor values are closest to.
- Second, the mobile application can directly send the cluster number a particular activity belongs to, instead of sending the raw sensor data. Thus reducing the computation overhead of pre-processing and clustering at server side for every arrival of raw sensor values. Further, the lifestyles are extracted from the activity sequence sent from user using which the similarities are computed.

4. RESULT AND ANALYSIS:

This section gives a description of the results associated with "Human Activity Based Friend recommendation System". The statistics of results computed, are represented graphically. The outcome of this scheme is a list of friends that are recommended for the respective user. The results are computed for a reference dataset and the dynamic data sent from smart phones. The process of result computation is performed in the same manner as described in the previous section. The life document consists of all the activities carried out by a user. For a given dataset, Figure 1.2 shows the frequency of occurrence of an activity given the life document. Figure 1.3 demonstrates the probability of activities carried out by respective users. It shows the probability of occurrence of an activity per user. The similarities are computed from the lifestyles extracted using LDA algorithm.

Figure 1.4a shows the similarities between users with Similarity_Score above a threshold value 0.03. As the threshold value is increased the number of users that could be recommended as friends reduces. Figure 1.4b shows the similarity score calculated without using LDA for those with threshold value above 0.1. The similarity without using LDA is calculated by comparing the probability of occurrence of a given activity among users. The users with high probability of occurrence of an activity are said to have a common lifestyle. The users with most common lifestyles are recommended as friends to each other. From Figure 1.4a and 1.4b, it can be deduced that the similarity score values obtained with using LDA are more precise than that obtained without using LDA. The user interface of the mobile application is as shown in figure 1.5a, 1.5b, 1.5c and 1.5d. Figure 1.5a is the UI for user registration or login, where the user has to register to the application. Figure 1.5b and Figure 1.5c are the UI for the user to start data collection i.e. the collection of raw sensor values in the format (acc_x, acc_y, acc_z, gyr_x, gyr_y, gyr_z) and also stop the data collection service according to user requirement. The user can also query for list of potent friend candidates which are calculated based on the similarity score. Figure 1.5d, shows the UI which gives list of recommended friends.

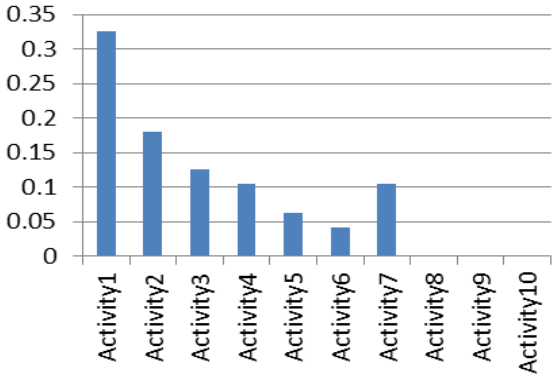

Figure 1.2: Probabilities Of Activities

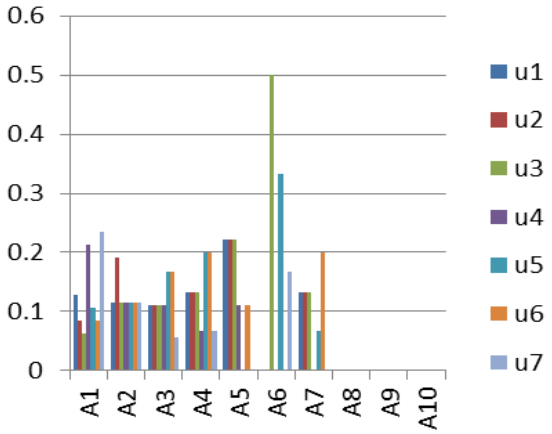

Figure 1.3: Probability Of Activities Per User

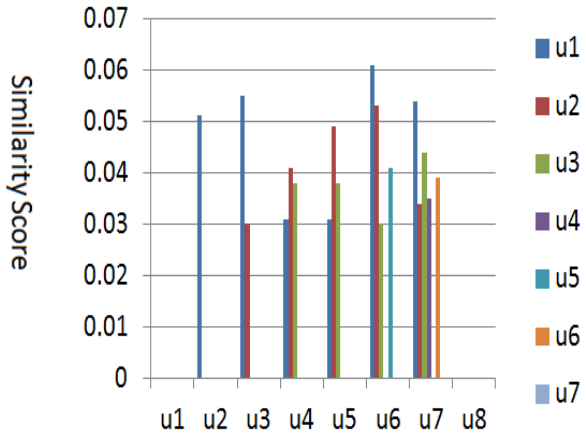

Figure 1.4a: Similarity Score Between Users Using LDA

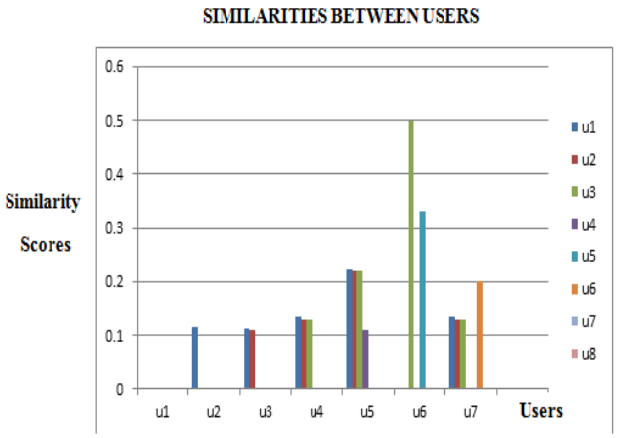

Figure 1.4b: Similarity Score Between Users Without Using LDA

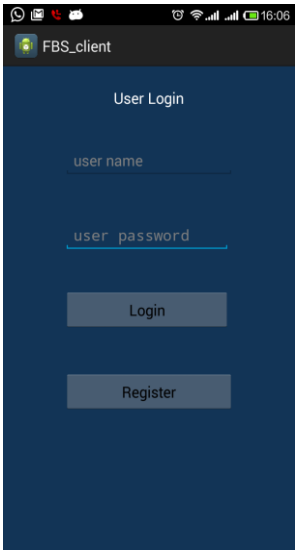

Figure 1.5a

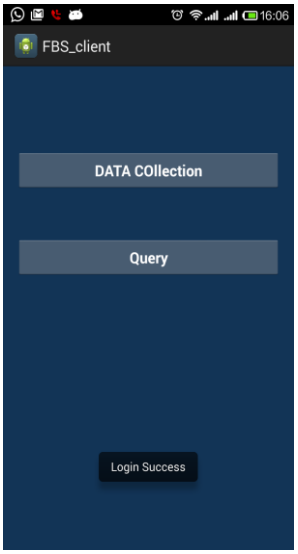

Figure 1.5b

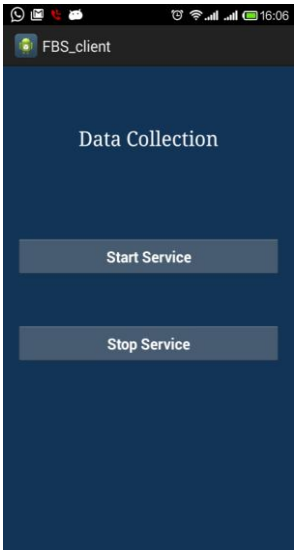

Figure 1.5c

Figure 1.5d

Figure 1.5a, 1.5b, 1.5c, 1.5d : User Interface for data collection, query service and feedback.

5. CONCLUSION:

Unlike the current friend recommendation schemes, which depend on the preexisting social relationships and geographical information, "Human Activity Based Friend Recommendation System" is a scheme where the friend suggestions are provided based on user's daily activities. The friend book mobile application captures the users daily activities from their smart phones and suggests friends to users if they share identical lifestyles. The proposed scheme is implemented as a mobile App on android devices. And small scale experiments are performed to evaluate the system performance. This paper gives a description of the design, implementation and analysis of the results obtained by the experiments conducted on the system.

Beyond the present model, the future work can be a three-fold. First, the friend book application can be integrated into current social networking services. Second, conduct large-scale experiments and evaluate the system to be scalable to large systems. The similarity threshold used in the experiment is fixed. Experiments could be conducted with varying threshold could be computed. Third, more sensors could be incorporated on mobile phones, into the systems and also make use of wearable sensors, so that the system could use more information for lifestyle extraction.

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