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Myfriend: A User Preference Based Friend Recommendation System for Social Networks

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Abstract: ***Existing social networking services recommend friends to users based on their social graphs, which may not be the most appropriate to reflect a user's preferences on friend selection in real life. Myfriend is a novel friend recommendation system for social networks, which recommends friends to users based on their life styles and preferences instead of social graphs. By taking advantage of sensor rich smart phones, Myfriend discovers life styles of users from user-centric sensor data, measures the similarity of life styles between users, and recommends friends to users if their life styles have high similarity. Upon receiving a request, Myfriend returns a list of people with highest recommendation scores to the query user. User can be able to given the user preferences and location preferences to improve the friend recommendation. Finally, Myfriend integrates a feedback mechanism to further improve the recommendation accuracy.***

Keywords: Friend Recommendation, Mobile Sensing, Social Networks, Life style, Social networking services

1. Introduction

Twenty years ago, people typically made friends with others who live or work close to themselves, such as neighbors or colleagues. We call friends made through this traditional fashion as G-friends, which stands for geographical location based friends because they are influenced by the geographical distances between each other. With the rapid advances in social networks, services such as Facebook, Twitter and Google+ have provided us revolutionary ways of making friends. According to Facebook statistics, a user has an average of 130 friends, perhaps larger than any other time in history.

One challenge with existing social networking services is how to recommend a good friend to a user. Most of them rely on pre-existing user relationships to pick friend candidates. To the best of our knowledge, Myfriend is the first friend recommendation system that clubbing user's life style information discovered from smartphone sensors together with user preferences given to produce the best friend recommendation results. Myfriend can help mobile phone users find friends either among strangers or within a certain group as long as they share similar behaviors. This recommendation mechanism can be deployed as a standalone app on smartphones or as an add-on to existing social network frameworks.

In our everyday lives, we may have hundreds of activities, which form meaningful sequences that shape our lives. In this paper, we use the word activity to specifically refer to the actions taken in the order of seconds, such as "sitting", "walking", or "typing", while we use the phrase life style to refer to higher-level abstractions of daily lives, such as

"Office work" or "shopping". For instance, the "shopping" life style mostly consists of the "walking" activity, but may also contain the "standing" or the "sitting" activities.

The rest of the paper is organized as follows. Section 2 presents the literature survey. Section 3 provides the high level overview of Myfriend. System architecture described in section 31. Section 3.2 and section 3.3 presents activity recognition and life style modeling. Properties of dominant lifestyle explained in section 3.4. Section 3.5 describes about similarity and following section explains about preferences given by the user. Section 3.7 includes the feedback control mechanisms. Query recommendation algorithms included in section 3.8 and followed by the conclusion and the future work.

2. Literature Survey

Literature survey deals with the related techniques which contribute to the development of the friend recommendation system Myfriend. There are a number of works related on different types of friend recommendation mechanisms. Some of them recommends items to a user based on items the user previously visited, and items that other users are looking at.

Bian and Holtzman [1] presented MatchMaker, a collaborative filtering friend recommendation system based on personality matching. The goal of MatchMaker is to leverage the social information and mutual understanding among people in existing social network connections, and produce friend recommendations based on rich contextual data from peoples physical world interactions. MatchMaker allows users network to match them with similar TV characters, and uses relationships in the TV programs as parallel comparison matrix to suggest to the users friends that have been voted to suit their personality the best.

Kwon and Kim [2] proposed a friend recommendation method using physical and social context. However, the authors did not explain what the physical and social context is and how to obtain the information.

Xiao Yu and Ang Pan [3] recommended geographically related friends in social network by combining GPS

information and social network structure. Hsu [4] studied the problem of link recommendation in weblogs and similar social networks, and proposed an approach based on collaborative recommendation using the link structure of a social network and content based recommendation using mutual declared interests. Here address the problem of link recommendation in weblogs and similar social networks. Liang Gou [5] proposed a visual system, SFViz, to support users to explore and find friends interactively under the context of interest, and reported a case study using the system to explore the recommendation of friends based on peoples tagging behavior in a music community.

Jeff Naruchitparames and Sushil J. Louis[6] proposed Friend Recommendations in Social Networks using Genetic Algorithms and Network Topology. Social networking sites employ recommendation systems in contribution to providing better user experiences. Zhibo Wang[7] proposed a novel semantic-based friend recommendation system for social networks, which recommends friends to users based on their life styles instead of social graphs called as FriendBook.

3. System Overview

Our proposed solution is motivated by the recent advances in smartphones, which have become more and more popular in people's lives. These smartphones (e.g., iPhone or Android-based smartphones) are equipped with a rich set of embedded sensors, such as GPS, accelerometer, microphone, gyroscope, and camera. Thus, a smartphone is no longer simply a communication device, but also a powerful and environmental reality sensing platform from which we can extract rich context and content-aware information. From this perspective, smartphones serve as the ideal platform for sensing daily routines from which people's behavior could be discovered.

The contributions of this work are summarized as follows:

- To the best of our knowledge, Myfriend is the first friend recommendation system that utilizing both user's life style information discovered from smartphone sensors together with user preferences for an efficient friend recommendation.
- Inspired by achievements in the field of text mining, Myfriend model the daily lives of users as life documents and use the probabilistic topic model to extract lifestyle information of users.
- Proposes a unique similarity metric to characterize the similarity of users in terms of life styles and then construct a friend-matching graph to recommend friends to users based on their life styles.
- Accessing the user preferences and location preferences through Smartphone's to directly analysing the behaviour of the user.
- Integrate a linear feedback mechanism that exploits the user's feedback to improve recommendation accuracy.

3.1 System Architecture

The system architecture of Myfriend which adopts a client server mode where each client is a smartphone carried by a user and the servers are data centers or clouds.

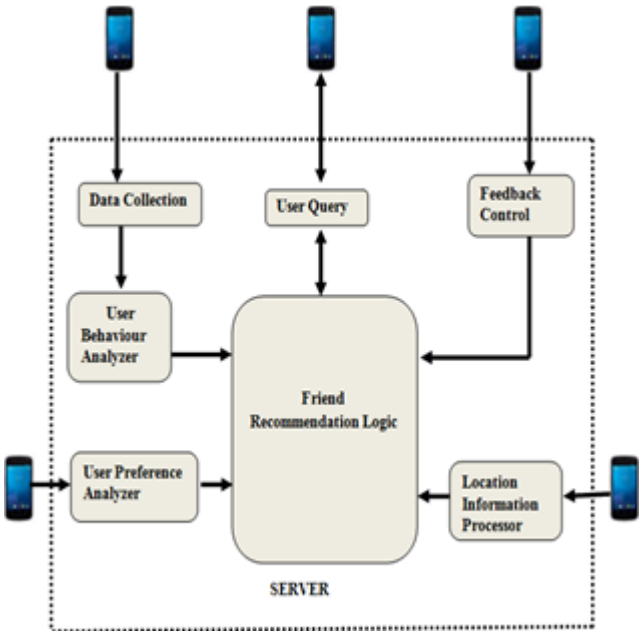

Figure 1: System Architecture of Myfriend

On the client side, each smartphone can record data of its user, perform real-time activity recognition and report the generated life documents to the servers. We spent three months on collecting raw data of eight volunteers for building a large training data set.

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On the server side, seven modules are designed to fulfill the task of friend recommendation. The data collection module collects life documents from user's smartphones. The life styles of users are extracted by the user behavior analyzer module with the probabilistic topic model. The user query module takes a user's query and sends a ranked list of potential friends to the user as response. The friend recommendation logic found out the proper matching friend by using both behavior information's and user preferences. The system also allows users to give feedback of the recommendation results which can be processed by the feedback control module. With this module, the accuracy of friend recommendation can be improved. As each user typically generates around50 MB of raw data each day, we choose MySQL as our low level data storage platform and Hadoop MapReduce as our computation infrastructure.

3.2 Life Style Extraction

Life styles and activities are reflections of daily lives at two different levels where daily lives can be treated as a mixture of life styles and life styles as a mixture of activities. Let w = [w_1, w_2, …. ,w_w] denote a set of activities, where W is the total number of activities. Let z = [z_1, z_2, ….., z_Z] denote a set of life styles, where Z is the total number of life styles. Let d = [d_1,d_2, . . . , dn] denote a set of life documents, where n is the total number of users. According to the probabilistic topic model, we have

$$P(w_i|d_k) = \sum_{j=0}^{Z} p(w_i|z_j)\, p(z_j|d_k)$$

Here represent the life styles of a user using the life style vector, denoted by L_k =[$p(z_1 | d_k)$, $p(z_2 | d_k)$,…., $p(z_z | d_k)$]. In this paper, our objective is to discover the life style vector for each user given the life documents of all users.

3.3 Activity Recognition

Life styles are usually reflected as a mixture of motion activities with different occurrence probability. Therefore, two motion sensors, accelerometer and gyroscope, are used to infer users motion activities. Generally speaking, there are two mainstream approaches: supervised learning and unsupervised learning. For both approaches, mature techniques have been developed and tested. In practice, the number of activities involved in the analysis is unpredictable and it is difficult to collect a large set of ground truth data for each activity, which makes supervised learning algorithms unsuitable for our system. Therefore, we use unsupervised learning approaches to recognize activities.

3.4 Dominant Life Styles

The set of dominant life styles of a user i, D_i, is a subset of all the life styles satisfying the following requirements:

- The total probability distribution of the set is larger than or equal to λ which is a predefined threshold.
- The probability distribution of any life style in the set is larger than or equal to that of any life style not in the set.
- The set should have the minimum number of life styles.

3.5 Similarity Metric: The similarity is not only affected by their life style vectors as a whole, but also by the most important life styles, i.e., the elements within the vector with larger probability values, also known as the dominant life styles. Here also argue that two users do not share much similarity if majority of their life styles are totally different. Therefore, the similarity of life styles between user i and user j, denoted by S (i , j), is defined as follows:

$$S(i,j) = S_c(i,j) \cdot S_d(i,j)$$

3.6 User Preferences and Location Preferences

In addition to life style information's this paper describes the way to improve the friend recommendation by using user preferences and location preferences. Here we can provide facility for given the user preferences like users interests, age groups, sex etc and other user preferences to improve result obtained. It is done by user preference analyzer.

3.7 Feedback Control

To support performance optimization at runtime, we also integrate a feedback control mechanism into Myfriend. After server generates a reply in response to a query. The feedback mechanism allows to measure the satisfaction of users, by providing a user interface that allows the user to rate the friend list.

3.8 Query and Friend Recommendation

Before a user initiates a request, he/she should have accumulated enough activities in his/her life documents for efficient life styles analysis. The period for collecting data usually takes at least one day. Longer time would be expected if the user wants to get more satisfied friend recommendation results. After receiving a users request (e.g., life documents), the server would extract the users life style vector, and based on which recommend friends to the user.

The recommendation results are highly dependent on users preference. Some users may prefer the system to recommend based on preferences, while some users may want to know users with the most similar life styles. Location information processor found out the location information's and provides results based on location information's.

Friend Recommendation Algorithm:

Input : The query of user i required no of recommended friends from the system
Output : The Friend List L_i
1. Finding what are the activities performed by the user and finding frequency of performing the activity
2. Calculating the probability of occurrence of each activity
3. for each user i

1. Collecting the calculated probability value to form the life document Li
2. Finding the user preferences and location preferences
4. endfor
5. For each user i finding the similarity value with others using life document and preferences
6. Sort all the user n the decreasing order
7. Put the top p users to the friend list Li

4. Conclusion

This paper presents the design and implementation of Myfriend, a user preference based friend recommendation system for social networks. Different from the friend recommendation mechanisms relying on social graphs in existing social networking services, Myfriend extracted life styles from user-centric data collected from sensors on the smartphone and recommended potential friends to users if they share similar life styles. And it also collecting user preferences and location preferences through smart phones for a perfect friend recommendation.

5. Future Scope

Myfriend, is a perfect way of friend recommendation that utilizing the recent advances in smartphones. By implementing learning in the system, it is possible to establish a future extension to the current work. In current system there is only small no of sensors are using friend recommendation. In future if incorporate more sensors on the mobile phones into the system and also utilize the information from wearable equipments (e.g., Fitbit, iwatch, Google glass, Nike+, and Galaxy Gear) the recommendation becomes more accurate.

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