Demo: Friendbook - Privacy Preserving Friend Matching based on Shared Interests

Zhibo Wang
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
zwang32@utk.edu

Clayton Edward Taylor
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
ctaylo56@utk.edu

Qing Cao
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
cao@utk.edu

Hairong Qi
Electrical Engineering and Computer Science
University of Tennessee
Knoxville, TN 37996, USA
hqi@utk.edu

Zhi Wang
Control Science and Engineering
Zhejiang University
Hangzhou, Zhejiang 310027, CHINA
wangzhi@iipc.zju.edu.cn

Abstract

With the development of social networks, it has been increasingly easier to make friends on the Internet. However, it may not be as easy to automatically find a friend with "similar interests". In this paper, we develop a novel system that allows users with similar interests to be quickly introduced based on the similarity of pictures they took. A real online system, named Friendbook, is implemented on a smartphone network. Due to the limited resources on a smartphone as well as privacy issues, instead of directly comparing the original pictures for similarity measure, Friendbook uses "feature-based" picture comparison. By comparing features extracted from pictures taken by people who want to make friends, their similarity in interests can be automatically inferred based on the content of these pictures. We refer to friends made through Friendbook as "S-friend" for "Semantic-friend". The system also demonstrates the difference between S-friend matching with geographic-based G-friend matching.

Categories and Subject Descriptors

C.3 [**Special-Purpose and Application-Based Systems**]: Real-time and Embedded Systems

General Terms

Algorithms, Design, Experimentation

Keywords

Mobile Phone, Semantic Friend, Picture Comparison

SenSys'11, November 1–4, 2011, Seattle, WA, USA.
ACM 978-1-4503-0718-5/11/11

1 Introduction

Twenty years ago, one person typically makes friends with people who lives or works close with him, such as neighbors or colleagues. We call this traditional way of making friends as G-friend which stands for geographic-friend because friends are made based on the geographical distance between each other. With the rapid development of computers and networking, a lot of social networks, like Facebook, Twitter and even google+ which was just released in July 2011, provide us a revolutionary way of making friends. One can make friends much more easily than any other time in history through these social networks. However, this does not mean one would like to make friend with anyone. The fact that people usually intend to make friends with people having similar interests brings new challenges to social networks. First, how to help people automatically find potential friends with similar interests? Second, how to help people find potential friends at any time and any place? Third, how to protect the privacy of users when helping them find friends?

With the development of mobile phones with cameras, it has been more and more common for people to take pictures and upload them onto the Internet. There is an old saying that "A picture is worth a thousand words." Different pictures usually imply different interests of people. For instance, if two people taking pictures of the same scene frequently, this usually indicates that they like the same subject, hence, having similar interests. Motivated by the image comparison based semantic neighbor selection algorithm developed in [1], we propose to find the similarity of interests of different people by comparing the content of pictures taken by these people.

The main contributions of this paper are summarized as follows: (1) We adopt a picture-based friend searching algorithm for social networks where picture comparison is feature-based instead of raw data-based. (2) We implement a comprehensive centralized system that exploits this algo-

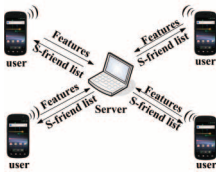

Figure 1. System architecture of Friendbook.

rithm for matching potential friends. (3) We demonstrate the difference between S-friend and the baseline approach, G-friend.

2 Semantic-based Friend Matching

Instead of direct pixel-by-pixel comparison of the original pictures, which would consume large network bandwidth as well as suffer from privacy problems, the proposed similarity measure is derived from the "feature-based" picture comparison. We first extract distinct and accurate features from pictures, e.g., corners, by applying the Speeded-Up Robust Features (SURF) [2] algorithm, then make comparisons based on the Euclidean distance of these features. If the similarity level of pictures from two persons exceeds some predefined threshold, they may be potential friends. Therefore, if one wants to make friends with others, he/she just needs to upload features of representative pictures to a central repository, e.g., a website, then the server will automatically find potential friends for him/her and return the result as suggestions.We refer to the friends found by this system as S-friend for Semantic-friend.

3 System Design and Implementation

Based on the S-friend searching algorithm, we have developed and implemented a real-time online friend matching system, called Friendbook, which we shall demonstrate in this demo. We adopt a client-server mode for Friendbook. Figure 1 shows the setup of this demo. The demo consists of three components: clients (e.g., mobile phones), wireless network (e.g., Wifi) and a server (e.g., a laptop).

3.1 Client

In Friendbook, we adopt Nexus S phones as clients. Nexus S is a smartphone co-developed by Google and Samsung and uses the Android 2.3 "Gingerbread" operating system. It is equipped with Wifi, bluetooth and several sensors such as camera, accelerometer and magnetic.

If one user wants to make friends with others, he/she just need to follow three steps:

- Select one or more representative pictures;
- Calculate features by applying the SURF algorithm;
- Send these features to the server via wireless network.

The Processing library [4] and P-surf library [3] are used on the smartphones for calculating the features of pictures. After sending features to the server, the client is supposed to receive a list of potential friends with similar interests ranked with similarity measures, based on which the client can choose to make friends with some or all of them.

3.2 Wireless Network

Friendbook will work on both Wifi and 3G networks. However, due to the limitations of the demo environment, we shall only demonstrate the Wifi version of the system.

(a) Alice (b) Bob (c) David (d) John

Figure 2. Pictures from four users.

3.3 Server

When the server receives a connection from a client, it needs to follow four steps:

- Read features from the client via TCP;
- Perform feature matching with all features in database;
- Return the list of ranked potential friends to the client;
- Add the received features to the database.

4 Demonstration

Several Nexus S smartphones and a laptop will be placed on a table. Any Sensys attendee will be able to use our system. Attendees can take pictures whatever they like, extract features on the phone, and then upload the extracted features to the laptop. Once receiving features from users, the server will automatically match these features and infer their similarity, and then respond to users who would be their potential friends and show on the GUI the ranking information.

Table 1. Friendship between four users.

User	Alice	Bob	David	John
Alice	–	G	G	S
Bob	2m/#12	–	G/S	N
David	3m/#13	1m/#56	–	N
John	15m/#52	17m/#5	18m/#5	–

For instance, given pictures taken from four users, shown in Figure 2, the lower-left corner of Table 1 shows their geographical distance in miles and the number of matched features in the format of, e.g., "2m/#3". The upper-right corner of Table 1 shows the type of friendship where *G* stands for G-friend, *S* stands for S-friend and *N* stands for no relationship. Suppose the threshold for G-friend is 10 miles and that for S-friend is 15 matching features. We observe that even Alice and John are not G-friend, they can become S-friend since they are interested in the same scene.

5 Acknowledgements

This work was supported in part by National Science Foundation under Grant NSF CNS-1017156.

6 References

[1] Y. Bai and H. R. Qi. Feature-based image comparison for semantic neighbor selection in resource-constrained visual sensor networks. *EURASIP Journal on Image and Video Processing (IVP)*, pages 1–12, 2010.

[2] H. Bay, T. Tuytelaars, and L. V. Gool. Surf: Speeded-up robust features. In *Proc. of the 9th European Conference on Computer Vision, Springer LNCS*, volume 3951, pages 404–417, 2006.

[3] C. Fantacci, A. Martini, and W. Nunziati. P-surf: A surf library for processing. *http://processingsurf.altervista.org/*, 2009.

[4] B. Fry and C. Reas. Processing. *http://processing.org/*.