Social Net: Using Patterns of Physical Proximity Over Time to Infer Shared Interests

Michael Terry, Elizabeth D. Mynatt
Everyday Computing Lab, GVU Center
College of Computing, Georgia Tech
Atlanta, GA 30332
{mterry, mynatt}@cc.gatech.edu

Kathy Ryall, Darren Leigh
Mitsubishi Electric Research Labs
201 Broadway
Cambridge, MA 02139
{ryall, leigh}@merl.com

ABSTRACT
We describe Social Net, a novel interest-matching application that uses patterns of collocation, over time, to infer shared interests between users. Social Net demonstrates new possibilities and methods for using the capabilities of mobile devices equipped with RF-communications.

Keywords
Mobile device, wearable computing, matchmaking

INTRODUCTION
Wireless, peer-to-peer RF-communication (e.g., Bluetooth [3]) is an increasingly accessible option when designing mobile devices and applications. A recent trend in both the commercial and research worlds has been to outfit pocket-sized devices with RF-based communications so that applications can continually broadcast the user's presence, while simultaneously detecting others nearby. For example, the Hummingbird is a handheld Inter-Personal Awareness Device (IPAD) [4] that signals the arrival of a friend in the area and maintains a user-viewable list of which friends are close by. The Lovegety [1] is a commercially-available device that acts as a romantic matchmaker by sounding an alarm when someone with similar interests of the opposite sex is detected.

Other applications transform the portable devices into mobile personal agents. Work in Wearable Communities has created agents that automatically optimize to-do lists by swapping and consolidating errands between people encountered [5]. For example, if two people both need items from the grocery store, the agents exchange errands when they meet so that only one person goes to the store, but obtains the items on both users' lists.

Social Net is a novel interest-matching application that demonstrates new possibilities and strategies for using mobile devices outfitted with RF-communication. Like other applications in this domain, Social Net broadcasts a user's presence and detects others nearby. However, Social Net also records the time and duration of encounters, and searches for patterns of physical proximity between people, *over time*, to infer shared interests between users. For example, if two people regularly exercise in the same fitness center at the same times of the day, Social Net detects this pattern and assumes they share common interests. When two strangers are assumed to share interests, Social Net consults the strangers' lists of friends to seek a mutual friend between the pair. If one is found, the mutual friend receives a suggestion to introduce the two (see Figure 1). In this way, Social Net strikes a balance between the affordances and capabilities of the technology (i.e., the ability to detect long-term trends of collocation between people) and the natural ability for people to mediate interpersonal interactions (e.g., deciding if, when, and how two people should be introduced).

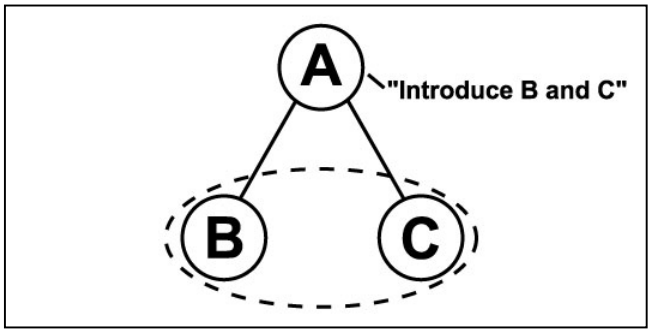

Figure 1 - "A" knows "B" and "C", but B and C don't know each other. Social Net notices B and C frequently near each other and suggests A introduce B and C

In this paper we introduce Social Net, compare it to existing matchmaking devices and schemes, and discuss the benefits of using patterns of physical proximity to infer interests between people. We also show the advantage of incorporating a person to interpret and mediate suggested introductions. We conclude with a look at the results of a 3-day field test and opportunities for future work.

SOCIAL NET

Design
Social Net is an application that runs on a portable device carried with the person throughout the day. The first time a user starts Social Net, the application prompts him to enter his name, which is stored and associated with a unique, but

CHI 2002, April 20-25, 2002, Minneapolis, Minnesota, USA.
ACM 1-58113-454-1/02/0004.

arbitrary, ID representing the physical device. The device's ID, rather than the user's name, is continually broadcast to signal the user's presence. The use of the ID enables applications to detect and distinguish devices without revealing personal information about the owner.

Social Net maintains a *friend list* for each user. Each entry includes the friend's name and her device's unique ID. Users add people to this list through a mutual action that exchanges the unique IDs and users' names. Currently this friend list is manually maintained by users, but it is conceivable to leverage existing contact lists in PIMs, cell phones, or "buddy lists" in instant messaging applications.

After entering their name and adding their friends, users simply carry the Social Net device with them throughout the day. When another ID is detected, Social Net checks the friend list to see if the ID is that of a friend. If the ID is not a friend's, Social Net assumes it is a stranger and records the unknown ID, and the time and duration of the encounter in an *encounter record*. To protect people's privacy and prevent "tracking," none of these data are directly accessible to users.

Periodically, Social Net examines the encounter records for unknown IDs, and applies a function to determine whether there are any patterns of physical proximity over time. The function considers the frequency and duration of the encounters over a two week period: To pass the test, infrequent encounters must be of a relatively long duration, while more frequent encounters can be of shorter duration. If an unknown ID passes this test, Social Net copies the ID into an *unknown list*.

When two friends encounter each other, the applications exchange unknown lists, and each device checks if any of the unknown IDs received are on the user's friend list. If any are, then the user's device generates a message suggesting he introduce the friend just encountered, and the friend represented by the unknown ID.

Comparing Social Net

Existing matchmaking applications (e.g. [1, 2]) require users to describe themselves using predefined categories that enable easy comparisons. When someone with matching interests is found, the system immediately alerts the users. What follows is a potentially awkward social interaction in which users must first locate each other, then introduce themselves with little context to facilitate the introduction.

Social Net improves upon this scheme in several important ways. First, Social Net's method of inferring shared interests does not require users to explicitly define their interests, nor does it "pigeon-hole" users into pre-defined categories that may only partially described themselves. This mechanism provides a secondary benefit: because users do not reveal personal interests, less personal information is broadcast into the environment, helping to allay privacy concerns. Second, when an introduction is suggested, Social Net delegates the task to a mutual friend. The mutual friend adds a human element who can interpret the suggestion and act accordingly, mediating the introduction rather than the technology. The requirement for a mutual friend also adds an additional filter to the number of potential introductions suggested, and further increases the chance the strangers truly share something in common.

Field Test

To test Social Net, we implemented the application on Cybiko devices [2] and deployed it at a major conference for three days. Nine users participated; one of the authors also participated as the 10th user and initially served as the common link between all participants.

Social Net successfully generated introduction suggestions, and post-test interviews revealed that users appreciated features of the design that worked to guard their privacy. For example, one user commented that the decentralized design of the application allayed his fears of being tracked. However, the process of introducing people was not perfect. Some users cited the inability to know exactly why Social Net suggested an introduction – that is, they were unsure of what the pair held in common. It is unclear whether this problem would lessen in day-to-day use, where people vary their location and activities more frequently than at a conference. A second problem uncovered was that people would not immediately add each other as friends after being introduced, so other mutual friends would receive suggested introductions for the pair.

Future Work

Social Net's foundation is the use of patterns of collocation over time to infer shared interests between people. However, interest-matching is only one use of these data. Opportunities exist to analyze these data to infer other types of relationships between people. For example, people regularly observed together on nights and weekends implies close, personal relationships, while daytime patterns of collocation infer work colleagues. Once known, these data could feed into a wide range of applications, such as context-aware applications.

ACKNOWLEDGEMENTS

We thank Cybiko for donating several units for this work.

REFERENCES

1. *Bleep at First Sight*. Wired News. http://www.wired.com/news/culture/0,1284,12342,00.html
2. *Cybiko, Inc.* http://www.cybiko.com
3. *The Official Bluetooth Wireless Info Site*. http://www.bluetooth.com
4. Holmquist, L.E., Falk, J., and Wigström, J., *Supporting Group Collaboration with Inter-Personal Awareness Devices*. Journal of Personal Technologies 3(1-2) 1999.
5. Kortuem, G., Schneider, J., Suruda, J., Fickas, S., and Segall, Z. *When Cyborgs Meet: Building Communities of Cooperating Wearable Agents*. In *Third International Symposium on Wearable Computers (ISWC'99)*, San Francisco, California, 1999.