
Movement: A Secure Community Awareness Application and Display

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Abstract

The proliferation of mobile devices and popularity of applications like Facebook and Twitter has allowed people to stay connected to their far-spread networks. However, little attention has been spent on connections in the local, physical community. These colocated connections are important for building social capital, sharing resources, and providing physical support. Movement is a visualization that uses location data generated automatically by mobile devices to increase community awareness following a new standard of privacy preservation. Movement also consists of an app that allows for direct connection to people with shared location histories, again in a secure and private manner. An integrated demo at CSCW will display the popular venues visited by conference attendees and allow users to connect with others who visited the same locations.

Author Keywords

Movement, public display, location tracking, community awareness, local networks

ACM Classification Keywords

H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

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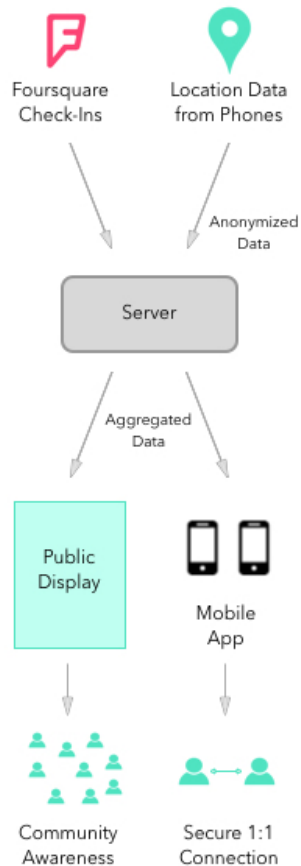


Figure 1: Movement. Location data is drawn from Foursquare check-ins or collected passively from mobile devices. It is displayed as a visualization to promote community awareness and in a mobile app that allows attendees to connect over shared locations.

Introduction

The proliferation of mobile technology allows people to stay connected to their far-spread networks regardless of their physical location. Networks like Facebook, Twitter, and Instagram help users maintain communication with their ties and encourage broadcasting to an online audience. However, with a couple notable exceptions like Meetup and Nextdoor [7], few successful applications are aimed at creating and building local interactions. The disconnect between collocated individuals pervades in different relationships, from neighbors to co-workers [4], and can be aggravated in urban areas.

Importance of Local Networks

Local communities are able to provide different support than that from distributed networks. Collocation allows for sharing of resources, enabling physical support and building social capital. Social capital serves as a private and public good, leading to better living conditions within a community. It also establishes a norm of generalized reciprocity such that individual members are more willing to help each other without expectation of return [8].

Community Applications

A number existing neighborhood platforms show that there is a desire for these services. Such services include systems for sharing resources (e.g. Neighborgoods, Peerby) and broadcast local neighborhood announcements (e.g. Nextdoor, Neighborhoods.nyc). However, these services can suffer from a lack of refreshed content and cannot always maintain themselves.¹ Hence, we looked for a data source that is passively generated instead of requiring constant user-input.

¹www.i-neighbors.org

Small Data / Opportunity

Movement proposes populating a local network-building application by utilizing automatically-generated data from mobile devices. Phones collect a vast amount of personal data that is constantly updated [2], ranging from a person's physical movement during a day to calendar availability to web browsing activity. Instead of involuntary surveillance from big companies, this data could be used for voluntary sharing [1]. We propose new standards for practical, secure sharing of small data within a community. Movement uses location data from mobile phones, but we envision future systems could expand to utilize data streams collected on other personal digital devices like wearables or smart home systems.

Movement

Our system, Movement, securely uses small-data location traces to increase community awareness and provide a platform to interact with others based on shared locations and without any loss of privacy (Fig. 1). At a high level, Movement:

- tracks participants' locations on their own mobile devices
- collects anonymous data for a large-screen community-level awareness display
- uses secure computation for matching between individuals who are willing to expose their overlaps (and only those) to each other

Our security system is stricter than current anonymous social applications (e.g. Yik Yak, Whisper) as identification information in those apps is only anonymous to other users; a user's IP address can still be used to trace back a user to the information submitted. In comparison, Movement uses

privacy-preserving techniques such that *even the Movement server* 1) can never connect an individual to a submitted location, and 2) can never recreate a log of locations for a specific individual.

This app and visualization will be presented as an Integrated Demo at CSCW 2016.

Anonymous Mobile Data Collection

Prior to the conference, attendees would be encouraged to download the Movement app. The app records locations and allows users to connect to one another. Movement collects the location traces of participants, computes the venues from the locations locally, and submits the venues anonymously to the server. As the information being collected is sensitive, one can use tools to ensure people's security e.g. by cryptographically anonymizing the location data using Anonize [5]. In any case, no identification will be stored with the location information on the server. To maximize participation though, users may also log in with their Foursquare account information to contribute to the display. Because this data is public to Foursquare, it will not be anonymized in our server. Gathering data from two data sources increases the likelihood of the display changing dynamically over time as it mimics the ebbs and flows of a day's movement.

Awareness Display

To display the locations visited, we created a visualization that allows participants to interact with the collected data (Fig. 2). We only present aggregated data of location traces, and the anonymized location information is not displayed below a certain threshold of visitors. Using a public display serves as a way to provide community awareness for non-users; attract attention from conference attendees; and hopefully draw in further participation. The public wall provides a physical hub and persistent display without re-

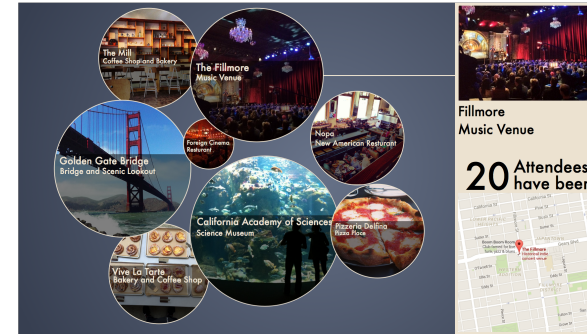


Figure 2: Movement visualization that would be displayed in the conference venue

lying on users to constantly open the applications themselves to see updates. In addition, we hope that the display can become a hub for attendees to be able to congregate around and start conversations.

When designing the interface, we wanted to follow principles of ambiguity [3] and anticipation [6]. Instead of using an overlay on top of a map, a common way of displaying location information, we created a design which emphasizes the important features of the locations: their popularity in the network. Map locations of individual venues can still be viewed by interacting with the display, but is not the first information gathered at a glance. Instead, the display provides a persistent window into attendees' behavior outside of the conference venue. Similar to the statistics that are often presented at the opening keynotes of conferences on the demographic information of attendees, seeing overall location traces could provide attendees with a better idea of the CSCW community as a whole. They could also utilize the visualization as a resource to learn about venues that

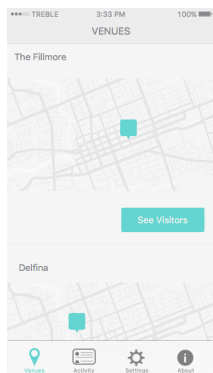


Figure 3: Mobile app that lists venues the user has visited

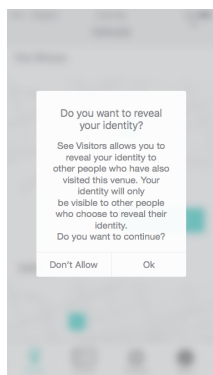


Figure 4: Mobile app where users can choose to reveal their identity to other visitors.

they may not be familiar with.

Mobile App Connections and Information

While the display provides aggregate information about location traces to address awareness of the group, the application allows attendees to directly connect to one another. We are interested in understanding the meaning that people extract from overlaps in common venues and whether this leads to greater willingness to connect. Movement allows users to see a list of the venues that they have been to (Fig. 3). They can choose to reveal that they visited a particular venue to the other people who have been there (Fig. 4). Only those who agree to share a venue will be able to see the list of other attendees. While conferences can sometimes result in siloed interactions, the application brings attention to other attendees people may not meet otherwise. Seeing overlaps in location surfaces common ground for attendees that they may not be aware exists. Attendees could use this tool to exchange information with someone from the conference they met at a particular venue, or to find people who have the same interests as them.

Conclusion

We propose presenting Movement as an integrated demo that uses location data in a secure way to 1) increase awareness of the CSCW community through a public display visualization, and 2) allow attendees to connect to one another through shared venues. This demo serves as one of the first community-oriented systems to utilize automatically generated data from mobile devices that we intend on expanding on and applying to different groups in the future.

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