
Participatory Sensing for Community Building

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Abstract

In this research, we explore the viability of using participatory sensing as a means to enhance a sense of community. To accomplish this, we are developing and deploying a suite of participatory sensing applications, where users explicitly report on the state of their environment, such as the location of the bus. In doing so, community members become reliant on each other for valuable information about the community. By better understanding the relationship between participatory sensing and community, we inform the design and research of similar participatory sensing, or crowd-sourced sensing applications.

Keywords

Participatory Sensing, Crowd-Sourced Sensing, Citizen Science, sense of community

ACM Classification Keywords

H.5.3. [Group and Organization Interfaces]: Collaborative computing, web-based interaction.

General Terms

Human Factors

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Introduction

We define ourselves based on the communities we affiliate with [7].

Online community research has long examined how to foster the formation and maintenance of relationships through technology for information sharing, socializing and support. Mobile technologies might also support connecting and sharing information with people physically near each other. We are investigating the viability of a particular type of crowd-sourcing mobile application, participatory sensing, to engage and enhance communities of users.

An important aspect of any community is the community members' sense of community – individuals' perceptions of belonging to a group that meets their needs. This sense of community is quite dynamic because it relies on multiple elements, such as membership, influence, integration and fulfillment of needs, and shared emotional connections [5]. Due to this dynamic nature, it is possible to disrupt the sense of community through the introduction or removal of various community elements. With this in mind, our work aims to examine the effect that sharing of community-based participatory sensing data (i.e., bus location, parking availability) has on the sense of community of an existing physical community.

Research Goals

We are investigating whether or not a participatory sensing environment can be used to enhance the sense of community among a physically defined community. To do this, we are developing a suite of participatory sensing applications to be deployed at the University of North Carolina Charlotte (UNCC). We are currently

testing a parking availability application, and developing a bus location / arrival expectation application. We will deploy these applications to our

campus community and evaluate the impact on sense of community through a variety of qualitative and quantitative methods. We are also examining issues of identity management and reputation within and across the applications. Our work contributes to research in Human Computer Interaction through a novel examination of the impact of participatory sensing applications on community.

Background

Drawing from a long history of citizen science, participatory sensing is communities of users either explicitly or implicitly collecting data about their environment using a mobile device [2]. A variety of systems have been developed to utilize sensors on a user's phone to measure air quality [1], noise level [4] or personal environmental impact [6]. Other systems rely on explicit human input, such as to provide garbage data [9], commuting routes [3] and even fauna growth [10]. While the participatory sensing and citizen science research is gaining momentum in the HCI community, researchers have yet to deeply investigate the effect that such systems have on the communities that use them.

Research into other crowd-sourcing applications has investigated community more closely, in particular Wiki communities. Wikis are similar to participatory sensing applications in that groups of community members are contributing to a collective knowledge base. Community research in these areas can be directly related to McMillian and Chavis's [5] sense of community theory

in so much that members can (and do) influence the group, share some form of connection, and are rewarded for participation.

Participatory Sensing Suite

The overall intent of our participatory sensing suite is to deploy multiple applications that support community engagement at UNCC. So as to foster engagement, participants develop a reputation around their chosen identity that will be used across all of the suite's applications. The first two applications in the suite will address two common university questions: Where can I find a parking space and is it faster to walk than wait for the bus? While not novel in their concept [8] these participatory sensing applications will allow us to investigate whether or not a participatory sensing environment can be used to enhance a sense of community, as well as examine identity management and reputation building within the community across a suite of related applications.

Because this research is based on community development (in our case UNCC students, faculty, and staff), we want as many interactions within an application as possible. Therefore, it is our intent not to utilize automated sensors. Rather, users will provide relevant data based on their experiences and knowledge. While the data will be subjective in nature, it will also reflect a better representation of a user's identity and allow them to build a reputation for providing useful community information. The applications in the suite are being developed using jsp, rather than on a specific hand-held platform such as Android or iPhone. In addition to being available to a wider range of handheld users, individuals will also be able to interact with their laptops and desktops. We

now briefly describe the two applications currently under development and evaluation.

Parking Application

The basic concept of the parking application is that members must support the community through personal submissions in order for the application to be useful.

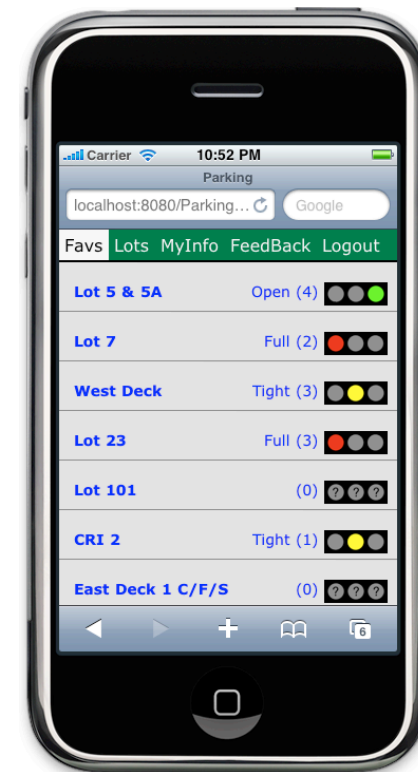


Figure 1: UNCC Participatory Sensing Suite: Parking Application Favorites screen.

Logistically, the parking application provides multiple community interaction points. Individuals are provided

with the opportunity to view and share data about the state of parking of a particular lot (full, tight, open), leave comments about the state of a parking lot, and maintain a list of Favorite Lots (figure 1). They can also develop an identity through a reputation-based rating system, and rate others in regards to the correctness of information submitted. In addition, we provide an incentive of achievement titles based on continued interactions within the application, similar to Four Square, such as “Lord of the Lot”.

Bus Application

Similar to the parking application, the bus application community members must rely on each other to submit bus location information in order to know when the next bus will arrive. As noted earlier, UNCC members are often faced with the decision to walk or wait for the bus. To remedy this situation, we are in the process of deploying a bus schedule application (Figure 2). When users submit location information, the application uses this data to infer stop times for the rest of the route. In addition, and similar to Parking, achievement titles are provided to users for various accomplishments such as being the “Bus Route Owner” for submitting the most correct data of a given bus route.

Instead of implementing a peer rating system, the bus application provides reputation points by association. Because it would be impossible for a user at Stop 6 to know whether or not the user at Stop 2 is telling the truth, the program calculates whether or not the times between submissions of various Stops are congruent

with each other and assigns reputation points accordingly.



Figure 2: UNCC Participatory Sensing Suite: Bus Application

Implementation / Initial Feedback

Thus far, the parking application has been released for beta testing for several weeks to a handful of users. We

are currently doing additional small-scale evaluations to gather preliminary feedback before full deployment in spring of 2011. Feedback thus far has mainly dealt with interface and feature requests, such as adding a lot

history feature. We have received a few comments regarding community. Participants felt that they might experience a form of ownership of a particular lot and a feeling of alliance with others that provide data the same lots.

The bus application is currently under development, with preliminary evaluation and deployment also expected in spring of 2011. Initial feedback on the application concept has been positive. Individuals felt that there really was no connection with fellow bus riders and an application that helped share bus information might also provide a sense of connection with other application users.

Discussion

There are a number of issues we are facing, similar to many participatory sensing systems. First, is how to provide community-based incentives to motivate people to continue interacting with the applications. We have added an incentive system of “badges” or “titles,” allowing users to build an identity within an application. However, because there are different titles for each application in the suite, it is unclear how these can be shared across applications to support identity development throughout the suite.

Similarly, we are interested in the role that reputation will have in this environment, and its importance in helping community members trust each other and the data within the system. Will increasing reputation

provide incentive for users to provide data for the community? Will users trust others who have built reputation in completely different applications? For example, how will a reputable parking identity be received in the bus application? And how can identity be aggregated and represented across an entire suite of applications? We continue to investigate these issues as we design and deploy our applications.

Finally, our goal is use participatory sensing applications to improve the sense of community of an existing community. Is community impacted merely by accessing information provided by others? Or do users have to more explicitly interact and provide information, building an identity and reputation within the system? In addition, do these applications help foster a feeling of community on campus in general, or instead foster connections only among people who interact the most with the applications? We aim to answer these questions as we deploy our applications, and evaluate their impact.

Conclusion and Future Work

Currently, there exists minimal work that examines the effect that participatory sensing applications have on the development of communities. While our work is being deployed in a university setting, we believe our results and the applications themselves may be applicable to many types of physical locations, such as buildings, towns, and cities. We are just beginning our evaluation of our existing two applications, and will be adding additional applications to the suite for further investigation. We hope our results will provide valuable insight into the impact that participatory sensing applications might have on a community, and the

potential for their use in enhancing existing communities of mobile users.

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