Evaluating Location-Based Reminders

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ABSTRACT
Although location-based reminder applications have been widely prototyped, there are few results regarding their impact on people: how are they used, do they change peoples' behavior, and what features most influence usefulness. Cell phones provide a compelling platform for the delivery of location-based reminders within a user's everyday natural context. We present requirements for location-based reminders resulting from a qualitative study performed at a university campus, and how these results are influencing ongoing design of a more comprehensive location-based reminder system.

Author Keywords
Context-aware, User Interface Design, Reminder Systems, Location-Based Services

ACM Classification Keywords

H3.4 [User profiles and alert services]; H4.3 [Communications Applications]; H5.2 [Evaluation and Prototyping]

INTRODUCTION
Reminders are used everyday to help people remember to perform a task at an appropriate place or future time. Common methods for reminding are carefully placed post-it notes, email, to-do lists, and electronic calendars. Unfortunately, these existing methods often lack the ability to trigger reminders at an appropriate place. A grocery list reminder is more helpful while passing the supermarket en route home from work rather than after getting home. Using location to trigger reminders is a valuable piece of context that can improve the way people use reminders.

The comMotion and CybreMinder systems are examples of such an approach [2, 5]. Among the open issues for location-based reminder systems are how best to provide ubiquitous support for setting, detecting, and delivering location-based reminders to people.

Cell phones provide a compelling platform for delivering location-based reminders. The widespread adoption and use of cell phones allows easy deployment and evaluation of a reminder system. The ubiquity of cellular networks enables pervasive location sensing and reminder delivery, expanding the ability to use a reminder system outside of research labs. Previous reminder systems lack wide deployment and thus are limited in their ability to evaluate how people use reminders within their own natural context. In addition, delivering reminders on cell phones does not require any extra hardware, and gives users a familiar device for interaction. Yet, the suitability for cell phone-based location-based reminders is unclear. How can messages be delivered to ensure they are noticed, yet not obtrusive? How important is positional accuracy and timeliness to the usefulness of reminders? What application features might be required by users?

In this paper we describe several principles learned through a qualitative study of a location-based reminder system, deployed on a university campus. The campus setting is the hub for thousands of students' lives and offers many situations when reminders may be useful. Our results are being used in the ongoing design of a wider scale reminder system.

SYSTEM ARCHITECTURE
To gain quick insight on these issues, we piggybacked our system on the ActiveCampus system [3]. The ActiveCampus Explorer (ACE) client incorporates a variety of location-based services centered around the university life such as display of nearby buddies, activities, and sites, as well as digital graffiti. ActiveCampus also provides an interface for setting location-based reminders throughout the university.

ActiveCampus relies on known 802.11 access points pervasive throughout the campus to provide room scale location sensing [3]. The system is able to give a location estimate to the user as a place name (*e.g.* Lecture Hall 105) and position the user on a map for intuitiveness. Evaluating reminder usage with a relatively high-accuracy system (accuracy under 20m) permits us to understand how accurate a system needs to be for location-based reminders

to be useful without discouraging users from using the system

Setting and Receiving Reminders

Using ACE, users are able to set reminders in a variety of ways. They can view the map of their current location and then click on a nearby position, or they can browse through a dropdown menu of known maps and then click on a position on that map (Figure. 1). Both maps are zoomable and scrollable. Alternatively, they can view a list of buddies or nearby sites, or perform a substring search for the name of a building or other entity (Figure 2), directly setting a reminder on any of the displayed search results. Regardless of how they select the location of the reminder, a textbox is presented for a reminder message, and an expiration date is chosen (Figure 3). When the system detects the user is within 20m of the chosen location, the reminder is triggered and sent to the user.

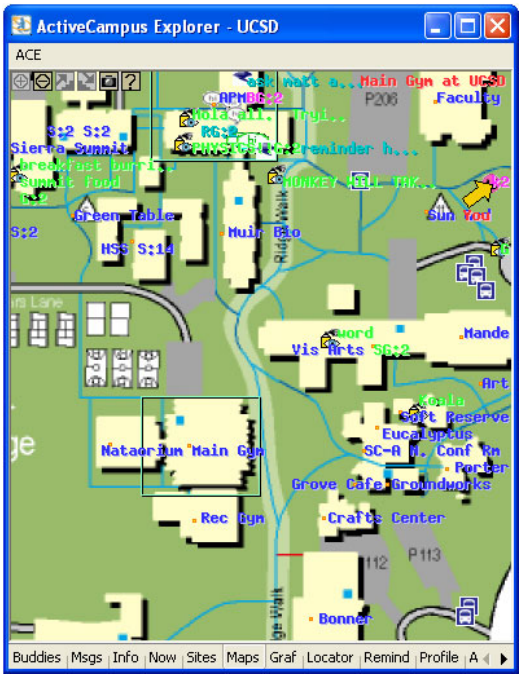

Figure 1. ActiveCampus Map. Clicking the map lists a set of actions that may be performed at the indicated location.

METHODOLOGY

In this informal study, four users from our research group were asked to set reminders for tasks they felt were relevant within the university campus, over the course of a week. No specific requirements were imposed on the users regarding the quantity or the nature of their reminders. Since ActiveCampus requires an 802.11 interface for location sensing, users were asked to carry around a laptop with an 802.11 radio as they performed their daily activities. The ActiveCampus sensing support enables accurate positioning for timely delivery of reminders. For this study, reminders were delivered redundantly both through ACE and as an SMS message sent to the user's cell phone. At the end of the study, users were interviewed regarding their usage of the system.

Figure 2. Search list of entities. Clicking the blue icon next to an entity initiates the reminder process.

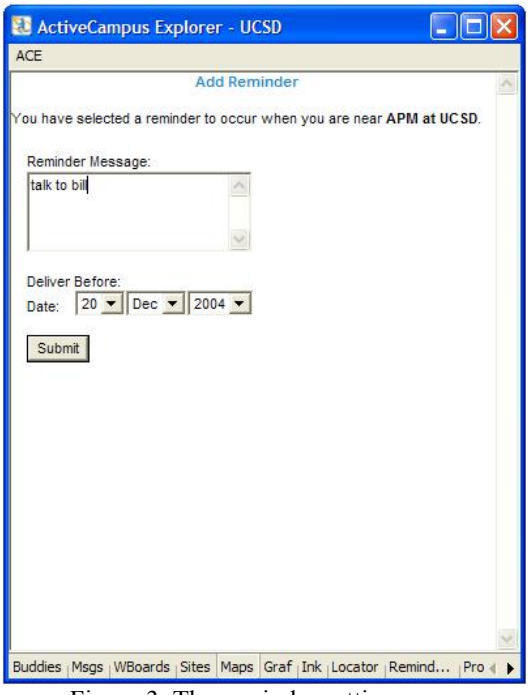

Figure 3. The reminder setting page.

RESULTS AND DISCUSSION

The results of this informal study are qualitative and meant to be used to explore user needs for a reminder system. This preliminary examination of a location-based reminders system yields three principles suggesting the cell-phone to be a promising platform:

Reminders are a metaphor for situated notes

A common non-technical technique used for setting reminders is to write notes to oneself, either via email, a post-it note or even a small piece of paper. Carefully placed physical objects can provide the obstruction necessary to trigger a mental reminder as well. For example, an electricity bill might be intentionally placed on a computer so that the next time the user turns the computer on, they will remember to pay the bill. Reminders are really a metaphor for notes and such physical artifacts, providing a way of "leaving a note on your office desk" remotely from the comfort of your home [1]. Location aware notes have already been shown to take advantage of important context [5]. This observation reveals the power of reminders, allowing users to effectively write a note to themselves and placing it at a remote location. To take advantage of this capability, users need the ability to set reminders *whenever* they think of them, *wherever* they are. Cell phones provide a ready, convenient solution, as people tend to carry their phones with them wherever they go. As such, the ideal application for setting reminders should reside on the phone itself and not on a computer as many existing solutions do.

The user needs to trust the system

Users commented on the need for reliable, in particular, timely, delivery of reminders. In a couple of instances, the reminder was noticed first on the user's laptop, delivered via ACE. It appears the cause was that the phone had been reset, reverting to audible notification, rather than vibration. Other possible causes include delayed message delivery (SMS does not provide timeliness guarantees), the phone being out of range of a cell tower, or the phone depleting the battery. Receiving redundant reminders through multiple avenues was not irritating to the users. Rather they were comforted to see that the backup solution was working satisfactorily. (A slightly more advanced system could retract redundant messages once the first has been acknowledged.) In all, the desirability of guaranteed delivery suggests a different approach than that taken by many existing reminder systems, which try to infer the context of the user and route the reminder to the most appropriate device [2]. Otherwise, the value of such a system drops drastically.

Coverage is more important than accuracy

Users were not extremely concerned with location accuracy. We initially expected that users would have stringent location-precision requirements for many of their reminders. Instead, they required coverage in all areas where they might want to set reminders. The desire for accuracy did vary depending on the intended task. A reminder set on a person. e.g., "Alert me when Bill is nearby," had higher accuracy requirements than a reminder set around a location with the intent to perform activity at that location. e.g., "Buy an ink cartridge when near the student store." The reason appears to be that the absolute location of a known fixed entity like a store permits the user to reliably walk to the location, whereas tracking down a person is a bit trickier. A further requirement, not supported by the current reminder application, is to detect when one is leaving a location, e.g., "Remind me to talk to Frank when I leave the Computer Science building," signifying that an activity is ending, creating the opportunity to quickly attend to another.

Given that this study was performed within the confines of a university campus, the positioning sensitivity suggested by the results may differ from those of a wide-area deployment. However, in interviews, all users said they would tolerate a lower level of positioning accuracy for off-campus use, suggesting that the geo-location requirements for a wide-area deployment may be even more lenient.

The low-accuracy requirement of location-based reminders is promising for wide-area deployment. In order for reminders to be useful at a larger scale, users cannot be required to carry any extra hardware for location-sensing. Our future design involves using only a phone for both GSM-based location sensing and reminder delivery. A recent study showed that GPS, the most widely used location technology, only had coverage 5% of a person's day in the studied environment [4]. However, GSM had virtually 100% coverage in that same environment, with an accuracy of 100m in urban areas and 180m in suburban areas.

THREATS TO VALIDITY

This qualitative, exploratory study was undertaken to discover the issues for ubiquitous location-based reminders based on cell phones. The number of users, four, is acceptable for such purposes. Past work has validated the need for reminders in general, though not necessarily location-based ones. To accurately evaluate the efficacy of location-based reminders, a more comprehensive study needs to be conducted, one in which additional equipment beyond a cell phone is not required, to eliminate second order effects. Had we tried to evaluate the usefulness of location-based reminders in this study, the results would have been skewed by the cognitive load of ensuring that geo-location services were active. This paper represents a first step towards that goal.

The participants of this study are for the most part, a technically oriented. It is possible that less technical users—not suitable for an early-stage study like this one—might encounter additional issues in a later study.

FUTURE WORK

Our results present cell phones as a compelling platform for a location-based reminder system. Phones exhibit already ubiquitous deployment, appropriate sensing capabilities, and a familiar interface. The always-on connectivity provides for the ubiquitous level of access required by users for guaranteed reminder delivery and for setting reminders wherever they are, whenever they want to

Phone Support

Our future work involves using Place Lab's phone offering [4] for location-sensing. Place Lab provides accessible location support with appropriate coverage and accuracy for location-based reminders. In addition, Place Lab's low-barrier of entry makes it easy for reminders to be used everywhere by anyone.

We are currently developing a Java based phone application for setting and receiving reminders. In addition to text-based reminders, the multimedia capabilities (*i.e.* picture, audio, video) of cellular phones presents opportunity to augment reminders with more meaningful content.

Interface Features

Feedback from participants of the study suggests useful features to be integrated into a cell phone based reminders system currently in development. Almost all users involved disliked the map based interface for setting reminders and would much rather prefer a purely textual one for its simplicity. Also, users found themselves setting reminders at the same places and would have liked to have been able to select the location for a reminder from a list of locations they had frequently selected in the past. Finally, a delay reminder feature would be useful for when the user cannot attend to the reminder.

CONCLUSION

Much work has been done by the research community in developing context-based reminders. However, these solutions often require specific additional hardware or access to a computer terminal to set reminders. As a result these options lack the ubiquity desired of a reminder system. While cell phones have become pervasive for other reasons, the technology exists now to build location-based reminders on these devices. The qualitative results of an informal study reinforce the idea that cell phones would be a suitable platform. Further usability studies are required to examine the value of such a reminder system.

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