Low-Fidelity Location Based Information Systems

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ABSTRACT
In this article, we describe the intrinsic constraints of mobility and discuss how we can work around and often exploit these constraints using information implied by the context of the mobile user. In particular, we outline some of the work we have been doing in providing information to users on the basis of "Low-Fi" location information retrieved from user's cellular phone. A user's location and other contextual information is used to retrieve task relevant information and avoid many of the problems posed by limits of mobile devices and their use. This is part of an ongoing effort to build "smart" navigational interfaces based on information about a user's location.

Keywords
Context, Mobile, Location, Information Retrieval

INTRODUCTION
The incredible expansion of functionality on Internet enabled mobile devices has increased their adoption with the assumption that there soon will be applications that make use of this new connectivity. Unfortunately, there have been few applications that make full use of the power of the devices, to a great extent, because of the constraints they impose on systems. Input modalities, screen size, and speed of connectivity all participate to limit the effectiveness of many applications. The opportunity exists, however, for a "frictionless" approach that makes use of any and all context information linked to these devices to more precisely address user needs.

WHAT'S LOW-FI LOCATION?
While there have been many applications aimed at incorporating hi-fidelity location information of the type provided by GPS (Global Positioning Systems) into applications, there still remain very few computational devices in use that are GPS enabled. Because of this, we have decided to focus low-fidelity location information that can be obtained using MPS (Mobile Positioning Systems) technology available to all cell phone users. Instead of using satellite communication to determine location, a low-fidelity model uses signal strength information to calculate location coordinates for a mobile user. The accuracy of the system in determining location relies on environmental factors, buildings, available towers, etc. The accuracy can range from a few meters to several kilometers. With inconsistent location information, it is difficult to determine the type of location a user is in. You can easily determine a rough estimate of latitude and longitude, but figuring out exactly where someone is located is somewhat unrealistic.

In many cases, we are able to use cell information to obtain longitude and latitude information down to a one block radius. Our efforts in the area of low fidelity (Low-Fi) location information is aimed at using this less than perfect data to still provide users with services that are more powerful, effective, and easy to use than those that lack any location information at all.

STICKY NOTES
Information is often tied to location. Reviews, recommendations, comments, even warnings about general locations and specific services found at those locations (e.g., restaurants, stores, etc.) make the most sense when they are linked to the locations themselves.

Unfortunately, even systems that form these links and expose the information in, for example, the form of annotated maps, are useless to most mobile users. This is simply because the user is placed in the position of having to tell these services exactly where he is when he is out and about in the world. Even when a user has this information (which is often not the case) he still has to deal with having to input it using a device that is at best awkward with regard to text input. This friction renders such systems useless.

The StickyNotes project is aimed at addressing this problem of location centric information access. It does so by using Low-Fi location data to provide a context for information access and presentation that gets users to location specific information without any need for direct input. Because the system itself knows where a phone is, users not only do not have to input their location, they do not even have to know it themselves.

Once invoked, the StickyNotes system presents a mobile user with a map of his general location based upon MPS information. While the system does not know the exact location of the user, it does have enough information to guarantee that the users location is well within the confines of the map itself. The map, which can be navigated using both standard NSEW, focus, and expand controls, is annotated with "notes" from other users and sources trusted by the end user. These notes can then be examined on the phone, giving the mobile user with highly relevant information that can be accessed without ever using a keypad or even knowing where he or she is at any given time.

Figure 1. A set of notes in downtown Evanston IL.

The StickyNotes system allows users to effectively review and post notes while exploring the real world. With Low-Fi location information in hand, the new generated notes can be linked to the user's current physical location as the note is generated. The notes are displayed to the user as pushpins on a user's navigational map. The pushpins categorize the content of the notes by indicating the type of information they provide (reviews, warnings, etc). As a user moves through the world, the system displays a map of his or her current location in addition to the notes that exist in the area.

Integrated with existing "buddies" lists, StickyNotes also allows users to expose their notes to communities of friends and colleagues. Users can create virtual graffiti that is visible only to other people using the system. By sharing notes with other people, StickyNotes helps build community around the commentary and information generated by the system's users.

The StickyNotes system creates powerful new platform for information distribution. It allows users to read and create notes that are tied to the physical locations. In addition, it allows users to communicate information to a community of users that wander the same space.

YOU ARE HERE

Generating driving directions has become easier with the advent of computer technology that can calculate precise driving directions. These systems, while better than using road atlases, still require a significant amount of user input. Knowing the address of where you are and where you want to go is necessary to make these systems work. Finding directions between two well defined, predetermined locations usually consists of printing out travel itinerary before a trip. In a mobile deployment, however, inputting in a starting and ending location becomes incredibly tedious. Not only do users need to be constantly aware of their location (in a format the software can understand), but they have to deal with the input limitations of most mobile devices.

You Are Here is a system that alleviates the friction of computational tasks that require location as an input. The system takes into consideration the limitations of location awareness that users have when they are on the move in unfamiliar places. The system has knowledge of location, doing away with the user's need to know the physical address required to use map generation systems.

You Are Here also eliminates the often difficult process of typing in an address into a mobile device. Since the system retains a constant notion of the user's location, generating travel itinerary is reduced to pressing a single button. Friction is removed by eliminating the need to type in an address to a mobile device that probably has limited input capabilities. Removing the input step reduces the time and effort required to use the system, allowing users to focus on other things.

The You Are Here system leverages users' cellular phones to create travel itineraries that can be distributed to other users. The system allows a user to generate directions from their location to other locations without explicitly knowing where they or the other users are. A user can select a friend (or set of friends) from existing communication tools (i.e., Outlook Contacts, MSN Messenger) and send them directions to his or her location. The directions are different for each user, since each user may have a different starting point.

From a security point of view, the system is flawless. The target user (who is advertising his or her location) only has to know whom he or she is sending a message to. The user receiving the information accesses directions by sharing his or her Low-Fi location information with the system but not with the other user. As a result, the person who is distributing the invitation never has access to the locations of the people who are accepting it.

The starting point for any set of directions is automatically determined and users can distribute the directions to large sets of people without modification. The system generates

an identifying link for each user using their moving location via MPS. When a client accesses this URL the appropriate map and text directions to the tracked device are generated. Since the location identifying URL is sent

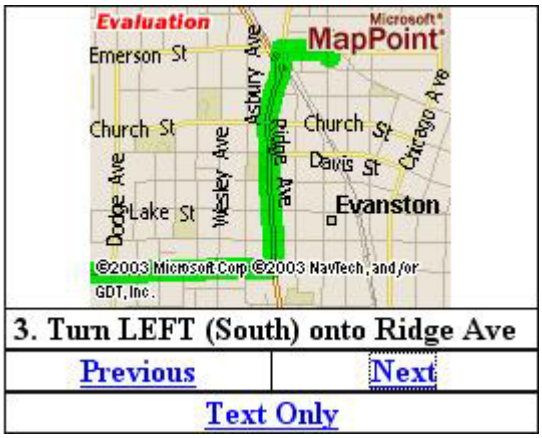

Figure 2. A set of direction generated by the You Are Here system.

by using a SMS (Simple Message System) and no map or directions are statically stored, the URL can be freely forwarded to more people. This allows automatic creation of travel itineraries from different starting points to the same, possibly moving, destination. Each device dynamically renders the map when a user accesses the URL, the direction set is guaranteed to be up-to-date, even if both parties have changed location. The system allows mass communication of directions with little or no user input.

The You Are Here system uses information about a user location to eliminate some of the friction related to the retrieval of driving directions. It allows users to easily track and meet friends, while promoting mass communication of directions to social hotspots.

Similar systems (AT&T – Find Friends) have not integrated with users' existing address books or buddy lists. The lack of integration fails to reduce friction since it requires users' to input phone numbers to the system. This becomes a huge use issue, since address book technology has all but eliminated the need to remember 10-digit numbers. In addition, these systems require users to constantly monitor and change their "visibility" to other users. Failing to change their status of the system would result in anyone they have previously interacted with (via the system) to track their location.

Assisting Large Scale Social Interaction

Cell phones have emerged as one of the leading tools for social interaction. Often groups of friends use voice and text messages to coordinate social gatherings. This becomes more and more difficult as larger and larger groups of people need to be notified of plans. This difficulty is compounded even more when participants in the interaction need driving direction because they are in disparate locations. Because of this needs, You Are Here has incorporated functionality to forward directions to large groups of people. This functionality is exposed only when the person being located has given express permission to have travel itinerary generated for people outside his initial list of recipients. Once again, the dynamic notion of the system allows additional user to be notified through the system. Once they receive the message, they have the option to forward the message to even more people. One can imagine how an incredibly large numbers of people can get direction to one location in a very short period of time. For better or worse, we see these as enabling a dynamic version of the "swarming" behavior that is now associated with IM systems.

CONCLUSION

In both these systems, we have used low-fidelity location information to help support users as they move about in the world. Furthermore, both systems' knowledge of location allow for "smart" navigational interfaces that alleviate the burden of users on the go. The limited input capabilities of current cellular devices make it difficult to leverage complex systems that require significant input from users. Moreover, systems that require location as an input necessitate that users are constantly aware of their location. By using low-fi location information to establish context for mobile information systems, we can help alleviate the burden on the mobile user.

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