EXHIBIT 6

Cyberguide: A Mobile Context-Aware Tour Guide

Gregory D. Abowd[1], Christopher G. Atkeson[1], Jason Hong[1], Sue Long[1,2], Rob Kooper[1] and Mike Pinkerton[1]

[1] *Graphics, Visualization and Usability Centre*
College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280
E-mail: {kooper,mpinkert,hong,abowd,cga}@cc.gatech.edu

[2] *Wink Communications, Alameda, CA*
E-mail: sue.long@wink.com

Future computing environments will free the user from the constraints of the desktop. Applications for a mobile environment should take advantage of contextual information, such as position, to offer greater services to the user. In this paper, we present the Cyberguide project, in which we are building prototypes of a mobile context-aware tour guide. Knowledge of the user's current location, as well as a history of past locations, are used to provide more of the kind of services that we come to expect from a real tour guide. We describe the architecture and features of a variety of Cyberguide prototypes developed for indoor and outdoor use on a number of different hand-held platforms. We also discuss the general research issues that have emerged in our context-aware applications development in a mobile environment.

Keywords: Mobile computing, context-awareness, location-dependent applications, hand-held devices

1 Introduction

Future computing environments promise to free the user from the constraints of stationary desktop computing, yet relatively few researchers are investigating what applications maximally benefit from mobility. Current use of mobile technology shows a slow evolution from our current desktop paradigm of computing, but the history of interaction shows that the adoption of new technology usually brings about a radical revolution in the way humans use and view technology [11]. Whereas the effective use of mobile technology will give rise to an interaction paradigm shift, it is difficult to predict what that shift will be. We follow the advice of Alan Kay, therefore, and choose to predict the future by inventing it. Our approach is to think first about what activities could be best supported by mobile technology and then determine how the technology would have to work. This applications focus is important to distinguishing our work in mobile computing.

In April 1995, we formed the Future Computing Environments (FCE) Group within the College of Computing and the Graphics, Visualization and Usability (GVU Center) at Georgia Tech to promote such an applications focus. Our group is committed to the rapid prototyping of applications that benefit from the use of emerging mobile and ubiquitous computing technologies. Quick development of these futuristic applications allows us to predict and shape what our everyday lives will be like when today's novel technology becomes commonplace.

Applications for a mobile environment should take advantage of contextual information, such as position, to offer greater services to the user. In this paper, we present the Cyberguide project, a series of prototypes of a mobile, hand-held context-aware tour guide. Initially, we are concerned with only a small part of the user's context, specifically location and orientation. Knowledge of the user's current location, as well as a history of past locations, are used to provide more of the kind of services that we come to expect from a real tour guide. We describe the architecture and features of a variety of Cyberguide prototypes developed for indoor and outdoor use on a number of different hand-held platforms. We also discuss the general research issues that have emerged in our experience of developing context-aware applications in a mobile environment. Some of these research issues overlap with those that we have considered in applying other applications of ubiquitous computing technology.

The general application domain which has driven the development of Cyberguide is tourism, but we have found it necessary to be even more focused in our research. The initial prototypes of Cyberguide, therefore, were designed to assist a very specific kind of tourist —a visitor in a tour of the GVU Center Lab during our monthly open houses. Visitors to a GVU open house are typically given a map of the various labs and an information packet describing all of the projects that are being demonstrated at various sites. Moving all of the paper-based information into a hand-held, position-aware unit provided a testbed for research questions on mobile, context-aware application development.

The long-term goal is an application that knows where the tourist is, what she is looking at, can predict and answer questions she might pose, and provide the ability to interact with other people and the environment. Our short-term goal was to prototype versions of Cyberguide on commercially available PDAs and pen-based PCs in which context-awareness simply meant the current physical position and orientation of the Cyberguide unit (and since it is hand-held, this locates the user as well). Position information improves the utility of a tour guide application. As the prototypes of Cyberguide evolve, we have been able to handle more of the user's context, such as where she and others have been, and we have increased the amount in which the tourist can interact and communicate with the place and people she is visiting.

1.1 Overview

This paper is an extended version of an earlier report on Cyberguide [7], we discuss the evolution of the Cyberguide design and prototype as well as what future research areas our experience has uncovered. We begin in Section 2 by describing scenarios for the use of context-aware mobile applications. In Section 3, we provide context for our research within the area of applications-centered mobile computing. The generic architecture of Cyberguide is explained in Section 4. We will describe in Section 5 the initial realization of the generic components of the Cyberguide architecture, a series of prototypes developed for the Apple MessagePad. We will then describe in Section 6 how the initial indoor prototypes were extended for use outdoors and for greater interaction with the environment. We conclude in Sections 7 and 8 with a discussion of significant issues for context-aware applications development and how our past experience will influence our future development plans.

2 Scenarios for a mobile context-aware application

This section outlines some possible uses for future mobile context-aware applications. Some of these uses are currently being implemented and some are futuristic. We begin with our initial assumptions about what technology we expect Cyberguide to use. Tourists are usually quite happy to carry around a book that describes the location they are visiting, so a reasonable packaging would be in the form of a hand-held device. The ideal hand-held device will have a screen and pen/finger interface, access to substantial storage resources —possibly through an internal device such as a CD drive, or through substantial communication and networking resources (cell phone, pager, data radio interface) providing access to other storage servers (such as the Web)— an audio input and output interface with speech generation and potentially sophisticated voice recognition, and a video input and output interface. The video input (a video camera) could be pointed at the user to interpret user gestures, or pointed at the environment to interpret objects or symbols in the environment. The video output could be integrated into the main screen or be a separate video display device, such as an attached screen or heads up display on glasses worn by the user.

One major application of mobile context-aware devices are personal guides. Museums could provide these devices and allow users to take personalized tours seeing any exhibits desired in any order, in contrast to today's taped tours. In fact, many museums now provide portable devices for just such a purpose, but what we are envisioning is a device that would allow the tourist to go anywhere she pleases and be able to receive information about anywhere she is. Walking tours of cities or historical sites could be assisted by these electronic guidebooks. The hand-held devices could use position measurement systems such as indoor beacons or the Global Positioning System (GPS) to locate the user, and an electronic compass or inertial navigation system to find user orientation. Objects of interest could be marked with visual markers or active beacons or recognized using computer vision. Some objects, such as animals at a zoo or aquarium, might be difficult to mark but could be recognized with simple computer vision and some assistance from the environment (indications that this is the elephant cage, for example). The personal guide could also assist in route planning and providing directions. Some of these functions are currently being provided by automobile on-board navigation systems.

There are other ways to assist users. Consider a traveler in Japan that does not speak or read Japanese. The hand-held device could act as a pocket multilingual dictionary, actually speaking the appropriate phrase with the appropriate pronunciation to a taxi driver, for example (or even showing the appropriate Kanji and an associated map on the screen). A device that included video input or a scanner could assist in reading signs or menus. A device that could show stored images might be able to show a shopkeeper the desired object or favorite meal. Another more futuristic use is to assist the user by

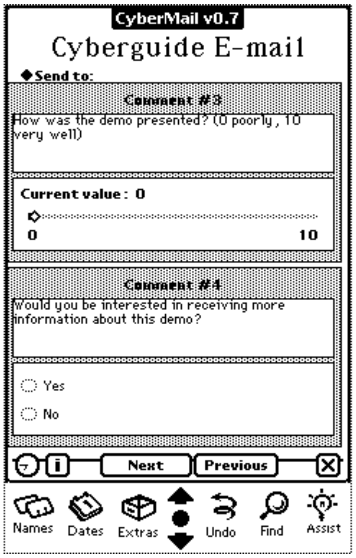

Figure 2: Questionnaire using communications module for delivery.

erably, allowing for an automated information update process without requiring data be hard-coded directly into the application. Throughout all three versions of our information module, we were able to modify the information module independent of the development efforts of the other modules, validating the modularity of part of our design.

5.3 Communication Component

Our initial implementation of a communication module consisted of a wired Internet Appletalk connection from a Apple MessagePad through a Unix Appletalk Gateway. We designed an application level protocol on top of a public domain implementation of the Appletalk protocol for Solaris[4]. This allows us to open a connection-based Appletalk stream from the Apple MessagePad to a UNIX platform. We then invoked our gateway application to repacketize Appletalk packets into TCP/IP packets for transmission over the Internet. This allowed for TCP/IP connectivity from a Apple MessagePad via an Appletalk connection. We could then fetch HTML documents as well as send and receive e-mail. We utilized this functionality within Cyberguide by providing a questionnaire for users to complete, which was sent to the developers as an e-mail message. (see Figure 2)

5.4 Position Component

Position is the obvious starting point for a context-aware mobile device. We considered several methods for sensing the user location. Outdoors, continuous services, such as GPS, can be used. Indoors, however, GPS signals are weak or not available. We considered RF

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | **sales@docketalarm.com** | **1-866-77-FASTCASE**

Smarter legal research.