comMotion: a context-aware communication system

Natalia Marmasse
MIT Media Laboratory
20 Ames Street
Cambridge, MA 02139, USA
nmarmas@media.mit.edu

ABSTRACT

How many times have you gone to the grocery store but left the grocery list on the refrigerator door? Wouldn't it be more efficient to have a reminder to buy groceries and the shopping list delivered to you when you were in the vicinity of the store?

We live in a world in which the information overload is part of our daily life. Many of us receive large quantities of email or voice mail messages. Yet many of these messages are relevant only in a particular context. We can use a system of reminders to keep up with all we have to do, but these reminders are often relevant only to a specific location. If reminders, to-do lists, messages and other information were delivered in the most timely and relevant context, part of the overload would be reduced. This paper describes *comMotion*, a context-aware communication system for a mobile or wearable computing platform.

Keywords

Mobile, ubiquitous and wearable computing; location-aware, context-aware applications.

INTRODUCTION

Knowledge workers are overwhelmed with the information overload they have to deal with. Filtering the information and delivering it only when in the relevant context can partially alleviate this problem. This paper describes *comMotion*, a context-aware communication system for a mobile or wearable computing platform. Emphasis is put on the mobility of the user, as opposed to that of the computer. Context-awareness is a term that describes the ability of the computer to sense and act upon information about its environment, such as location, time, temperature or user identity. *comMotion* focuses on outdoor user tracking, using the Global Positioning System (GPS); while seamless indoor-outdoor tracking would be ideal, no such affordable sensor is currently available. Context relevant reminders, to-do lists, information and messages are triggered by and sent to the user at his current geographic location.

RELATED WORK

For indoor location sensing, some type of active badge or beacon is usually employed. A number of systems based on this technology have been implemented, several of which offer context-aware messaging in the office environment. Two-way pagers with the Clues [2] message filtering system are used at the MIT Media Lab. This system infers geographic location based on entries in the user's calendar. However, it does not know the user's actual location. There are systems that use GPS or barcodes to track users outdoors and deliver information. Such systems are employed, for example, for guided tours of cities or a university campus [1, 4]. These systems are not user dependent. The information is triggered according to physical location regardless of user-identity. Stick-e Notes [3] is an electronic version of the *Post-It note* that enables users to wander around outdoors attaching stick-e notes to locations and later have the notes trigger when passing through the area again. It uses GPS for the positioning information and is a user-dependent system.

ARCHITECTURE OF *comMotion*

The system client-server architecture is depicted in Figure1. The client consists of three modules: a behaviour-learning agent, a message engine and a query engine. The client application runs on a mobile platform, which communicates wirelessly over the Internet to remote servers running on Sun SPARCstations. The client is being developed in Java on a Mitsubishi Amity Vp. The speech recognition and synthesis interface uses AT&T's Watson API. The server processes are written in Perl.

Behaviour-Learning Agent and Message Engine

User position information is obtained from the GPS system. The latitude and longitude coordinates are received by the behaviour-learning agent and translated to a virtual location, such as "home" or "work", if it has been defined. The GPS data is stored by the agent and analyzed to recognize frequented locations. This feature eliminates the need for users to fill out extensive forms and provide this data before using the system. Once a salient location has been identified, *comMotion* informs the user and prompts him to assign it a virtual location string tag (e.g. "home", "work", "grocery store"). The user is not required to tag a location immediately – this can be done at any future time by identifying a mark on a map. The new location can be

assigned a corresponding to-do list. To-do lists can be specific or shared. For example, two grocery stores would typically share the same list. The lists can contain text and audio data and can be edited in a number of ways: full text editing via the graphical user interface on the mobile client; audio entries via the client user interface; text entries through the regular email system.

Reminders are messages that have specifically been assigned to a virtual location. They can be speech or text and need not be from the user himself. They may originate from the client user interface or from email. Besides location, they may also be constrained to date and time ranges.

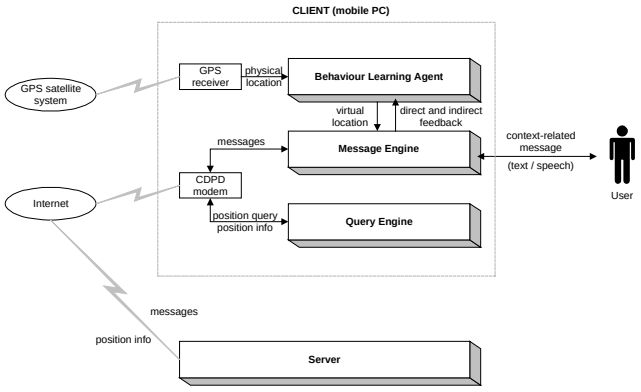

Figure 1: Architecture of the *comMotion* system

The message engine can also deliver content such as news, weather and traffic reports from information sources on the Web. The requested information may vary depending on geographic context. Therefore, the user can subscribe to different information services based on location, and different schedules can be made for different days. For example, the user might request to receive a list of the movies showing at the local cinema when leaving work on Fridays.

When the mobile user enters a defined virtual location, he will receive, from the message engine, an auditory cue indicating whether he has relevant reminders, items on the corresponding to-do list or other information he has subscribed to. The auditory cues for each class of information are chosen by the user from a limited set. These cues can be disabled, if preferred. All text data can be received as text and/or synthesized speech. Interaction with the system is done through the graphical user interface or with speech commands. The user can define whether to receive the data when arriving or leaving the specific location and how many minutes before or after.

Additionally, at any given time a user can view a map of his current location together with neighbourhood locales, such as banks, movie theaters, grocery stores, etc.

Privacy Issues

A system that monitors the mobility of a user raises many privacy issues. A common reaction is "Big Brother is watching". Therefore, the user's privacy was taken into account. The GPS tracking and behaviour-learning agent's monitoring is done on the client side and is solely accessible to the client. When the mobile user moves from one virtual location to another, the server is updated with the current position in order to retrieve relevant messages. However, no history is stored on the server.

Query Engine

This module permits others to query the location of a *comMotion* mobile user. In order to prevent the feeling of "many little brothers" monitoring, authorization can be assigned per virtual location. A user can be queried via a *comMotion* client or via the regular email system. The query request goes through the server to the specific client. If the request was sent by an authorized person, she will receive the location information, for example, "user-X is on his way home". If queried by someone unauthorized, the response will be "user-X is incognito". In either case, the queried user can log by whom and when location information was requested.

FUTURE WORK

comMotion is a work in progress. Future work will include looking at ways to filter email, according to body content, and forward the appropriate timely messages to the relevant context. Reminders will also include relevant information from the user's calendar, located on a remote workstation. The behaviour-learning agent will profile the user and learn his preferences, such as text or audio message delivery for the different classes of information. Ways for the agent to proactively get relevant content from the Web, will also be researched.

ACKNOWLEDGEMENTS

Many thanks to my advisor Chris Schmandt, head of the Speech Interface Group at the MIT Media Lab.

REFERENCES

1. Long, Sue, Dietmar Aust, Gregory Abowd, Chris Atkeson. "Cyberguide: Prototyping Context-Aware Mobile Applications". *Proceedings of the conference on Human Factors in Computing Systems, CHI'96.*
2. Marx, Matthew and Chris Schmandt. "CLUES: Dynamic Personalized Message Filtering". *Proceedings of CSCW '96*, pp. 113-121, November 1996.
3. Pascoe, Jason and Nick Ryan. Stick-e Notes. http://www.cs.ukc.ac.uk/research/infosys/mobicomp/Fieldwork/Sticke/
4. Smailagic, Asim and Richard Martin. "Metronaut: A Wearable Computer with Sensing and Global Communication Capabilities". *Proceedings of the International Symposium on Wearable Computing*, IEEE, October 1997.