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You Are Your Cell Phone

Roy Want

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Editor in Chief: Roy Want ■ Intel Research ■ roy.want@intel.com

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One characteristic that sets mobile computers apart from desktop computers is that they're intimately associated with their user's daily life and experiences. This unique connection lets mobile computers serve as a proxy for their owners, mediating a variety of tasks for their host. Instead of interacting with the person, digital services interact with the person's computer—and, in a similar way, people interact with network services through their computers.

Now that cell phones have become mobile and ubiquitous computers in their own right, we can take the proxy concept to a new level.

A PERSONAL PROXY

By design, cell phones are already communication proxies for their owners, and, unlike a landline phone, a cell phone directly mediates personal communication wherever it happens to be.

Furthermore, a cell phone can identify a caller not only through caller ID but also with a uniquely designated ringtone, letting the owner quickly decide whether to answer the call without even looking at the display. Characteristic ringtones can also serve as a proxy for the owner by projecting some aspect of his or her personality—perhaps to create a talking point or make a favorable impression. Ringtone sales have turned out to be surprisingly lucrative for service providers, demonstrating the popularity of this use.

MOBILE CONTEXT AWARENESS

The personal-proxy analogy becomes even stronger when you consider adding sensors to a phone to support mobile context-aware operation. A person's cell phone experiences almost all the physical parameters that the person experiences—it feels the same forces, travels at the same velocity, is about the same temperature, is exposed to the same sounds and pollution levels, and is near the same people and equipment. By recording the state of sensors attached to a mobile phone, you're effectively recording its owner's experiences across a rich set of dimensions.

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This use of sensing is entirely different from those I discussed in an earlier column ("Sensor-Driven Computing Comes of Age," April–June 2007). There, I focused on using sensors to improve user interaction with small devices—for example, adding 2D accelerometers to let users scroll graphical lists and make selections by simply tilting the device back and forth. Yet another, more traditional use of sensors embedded in computers is to determine the static state of the computer itself. For example, a thermal sensor might tell a computer that it's getting too hot and should turn on a fan.

Sensing used for mobile context-aware operation, in which the computer becomes a proxy for the user, is yet another use of sensing. This lets the device—or servers wirelessly linked to it—analyze the sensor data and infer user activity.

ACTIVITY INFERENCE

Digital pedometers were one of the first tiny computers developed as proxy monitors for activity. They let the user enter stride length, height, and weight. Then, by simply sensing the rhythmic motion of walking and by counting footsteps, they could estimate not only distance and speed but also total calories burned. By early 2000, commercial products started using proxy sensors in a more sophisticated way to better determine what the user was doing on a daily basis and to provide a personalized (and private) analysis of this information through the user's PC.

One of the first products I tried out in

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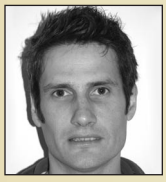
EDITORIAL BOARD CHANGES

Armando Fox, a founding editorial board member, is stepping down after over six years of service to *IEEE Pervasive Computing*. I thank him for his help in shaping the magazine and maintaining the quality of the publication.

At the same time, I'm pleased to announce that Kenton O'Hara is joining the board. He brings broad HCI expertise to our publication, and I look forward to his contributions to the magazine. *—Roy Want*



Kenton O'Hara is currently employed at CSIRO (Commonwealth Scientific and Industrial Research Organization), in Sydney, and is the newly appointed Research Director for the HxI initiative. His research explores social and behavioral factors that shape design and use of emerging technologies. He has studied a wide variety of topics including social and collaborative aspects of mobile video, public and situated displays, collaborative music consumption, location-based computing, local and remote collaboration, context-aware computing, smart environments, and mobile communication. He previously worked for Hewlett-Packard Laboratories and Rank Xerox EuroPARC. He received his PhD in HCI and cognitive psychology from the University of Wales, Cardiff. Contact him at kenton.ohara@csiro.au.

this category was Body Media's SenseWear mobile computer. You could strap it to your arm, and through its onboard sensors and processing capability, it would record physical characteristics of your body (such as acceleration, temperature, and galvanic skin resistance) throughout the day. It then stored this data in memory for later analysis on a PC. The PC dock also served as a charger, so you didn't have to worry about replacing batteries.

After wearing the SenseWear device for a few days, I was fascinated to see the graphical presentation of the data from the 2D accelerometer. Even with the untrained eye, I could clearly see the patterns of my schedule, from the sedentary state of office work, to the characteristic patterns of walking, to the striking acceleration markers indicating a car journey. It was clear to me that digital-signal-processing techniques could do better than my eye and thus had the potential to extract much more detailed information and identify a wider range of activities. For this reason, connecting the device to a powerful desktop computer, or to a server, enabled it to be much more than a sophisticated pedometer. Furthermore, I have described only one of several embedded sensors in the device. By correlating the output of one sensor with several other independent parameters, the device could determine activities that might have been ambiguous when using only one data source.

Mobile monitoring is without doubt a powerful tool for tracking personal fitness. It's far more effective than relying on self reporting or periodic, and likely infrequent, measurements taken at a doctor's office. People who are genuinely interested in their fitness will wear the device on a daily basis, will be motivated to keep it charged, and will regularly download data to measure how their lifestyle affects their health. With the recent concern that more young people are becoming obese than ever before, this technology is also timely, letting us study underlying trends in our society. Furthermore, in a world with an increasing elderly demographic, we need to ensure that elders can live healthy, independent lives as long as possible. Allowing relatives to have remote access to data summarizing the inferred activity of an elderly relative should help families support each other, even when distributed across the country.

Whereas the first mobile-monitoring devices were highly specialized, cell phone companies are now incorporating them into mainstream products. My latest cell phone from Sony Ericsson has a built-in accelerometer and can automatically collect my activity data and

IEEE Computer Society Publications Office
10662 Los Vaqueros Circle, PO Box 3014
Los Alamitos, CA 90720-1314

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FROM THE EDITOR IN CHIEF

show months of results graphed by an application that runs on the device. It will only be a matter of time before cell phones provide comprehensive activity inferencing as a standard feature.

PAYMENT PROXY

I can extend the notion of a mobile computer serving as a proxy for you to yet another application. Consider the use of the mobile phone as an electronic wallet that makes payments on your behalf. Near-Field Communication (NFC) lets two devices that are in close proximity (up to 5 cm) exchange data. In Japan, companies have embedded the equivalent system, Mifare (also encompassed by the NFC standard) in smart cards and cell phones. So, for example, in the Tokyo subway, a ticketing fee can be automatically charged to your device as you pass through the subway barrier.

Similarly, California's FastTrak system lets automobiles make proxy payments for their drivers. A driver equips his or her car with an RFID transponder that the system can read when the car passes through a toll booth. This obviates the need to stop and deposit physical cash and increases the flow of traffic. One day, a similar capability embedded in your cell phone might replace FastTrak.

In both of these examples, using a mobile payment proxy is faster and more efficient than the traditional approach and another reason why proxies, for the right set of applications, are highly desirable.

In many ways, your mobile device is becoming a proxy for you and your activities, improving your effectiveness while on the go. Furthermore, it's intimately connected with your life and can continuously log and track activities that would be difficult using any other approach.

Proxy devices are an excellent example of practical pervasive computing providing us with tangible benefits through a mobile use model—something that's being explored and expanded by research contributions in this special issue. The notion of your cell phone acting as an agent on your behalf is likely to be an ongoing theme in the years ahead.