

Challenges and Opportunities for the Design and Evaluation of Mobile Applications

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ABSTRACT

Thanks to the convergence of telecommunications and data communication, future computer applications will rely on seamless wireless networking, and will thus be inherently mobile. But the requirements for mobile applications will be very different from the stationary (primarily desktop-based) setting that has until recently been the dominating one in Human Computer Interaction. We identify a number of unique properties of the mobile setting and put them forth as *challenges* and *opportunities* for the design and evaluation of mobile applications.

Keywords

Mobile applications, mobile setting, design, evaluation

INTRODUCTION

Future computer applications will be inherently mobile and rely on seamless wireless networking. Although the desktop computer will still exist and be used for many tasks, the majority of tomorrow's computer applications will be accessed on other devices. We are already familiar with mobile phones and PDAs; soon, there will also be cars, toys and even clothing equipped with both powerful computation capability and wireless networking. The integration between telecommunication (e.g. GPRS, UMTS) and data communication (e.g. IEEE 802.11b) will contribute to the creation of a global networking infrastructure that is seamlessly available any time, anywhere, and through a multitude of different devices.

Given the assumption that this global network will soon be available, applications designers will find that a number of properties of mobile computer use are unique for this setting, and constitute very different requirements on design and evaluation than those that have been established for stationary applications. We believe that these unique properties constitute not only *challenges* but also *opportunities* for the research community.

PROPERTIES OF MOBILE APPLICATIONS

Usage extended over time and space. For mobile services, small bursts of usage are often extended throughout the entire day, and in many different places. This makes the evaluation of mobile services hard, since it is often not pos-

sible to create a realistic usage situation when confined to a controlled lab environment. Instead, other methods of studying and evaluating mobile services must be used.

Ergonomics. Stationary usage involves sitting down in front of a large screen with a keyboard and a mouse. The radically different mobile settings and mobile devices will involve new ergonomics (standing, walking, split attention), new input modalities (baby keyboards, pen-based, button-based, voice, tactile) as well as mini-screens. In addition, this new ergonomic setting will take place in noisy, crowded and on-the-fly settings. This places new design demands on information presentation, interaction modes and hardware.

Same application, many devices. In a mobile service environment, there will be a plethora of terminals (small and medium-sized mobile devices in addition to public screens such as cash machines and information kiosks). Services must be able to present themselves on many of these, with consistent functionalities and understandable interfaces. If users are to understand and feel familiar in this complex world, service interface consistency becomes vital.

Same applications, many places. In the mobile, "always-on" world, people will be able to access services and information independent of location. Thus, activities that previously were restricted or associated to certain places, now drift into new settings, giving rise to new usage practices. Phone conversations become possible in public spaces, we can work from home, we can send e-mail from the car, or even collaboratively prepare the workplace budget while waiting for the kids at the Kindergarten. This affects the ways in which users will perceive activities and places, including social conventions normally associated to that place or activity.

Access variability. Universal access will, however, always be relative. Roaming between various wireless technologies and operators will cause bandwidth fluctuations. Some services allow position-based functionality, and some can identify users, while others do not have these features. Ser-

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vices must be able to adapt to these changing conditions in terms of functionality and interface.

Ad-hoc meetings. Ad-hoc connections between devices in local settings enable people to show, access and distribute files, services and personal information. We can expect such meetings to take place in a variety of environments such as workplace corridors, public spaces, or on the road. Establishing and managing such meetings will involve a number of issues – who is allowed into the meeting and why, what information am I willing to share and to whom, are outsiders allowed to interrupt the meeting, etc.

Windows of opportunity. Some services will be useful only during a specific time span, such as when people move close to each other, or when a user passes an object. For example, in car-based applications the speed of the users as well as the timing and the duration of the service will be essential. The “windows of opportunity” that open up when users move between different locations and networks can be exploited to design time-based mobile services that offer very different functionality from stationary technology.

Shifting social roles. In everyday life, we constantly shift social roles. At breakfast, we adopt family roles and responsibilities. At work we adopt professional roles such as waiter, farmer, office worker or boss. At breaks, we may adopt more relaxed and private social roles. Shopping makes us aware of our consumer rights and obligations. With friends we become entertainers, gossipers, and therapists. Traveling may turn us into tourists, sports into players and teammates, and so on. Every role means shifting responsibilities and allegiances vis-à-vis other people, and thus fundamentally affects how people behave and set priorities. Explorations of these shifting social roles may ensure better-designed mobile services, and it might also serve as inspiration for completely new services.

Context sensitivity. Digital systems provide the ability to automatically log and aggregate usage, which can be used to design collaborative filtering systems, predictive user interfaces, etc. With mobility, the context parameters increase in number, involving not only actions in the digital domain, but also real-world data such as geographical position, temperature, somatic status of user, other devices or users nearby, and so on. This information may be used to recommend information or services to the user or provide services in situation in which they are most needed. Additionally, context information can be used to generate presence and social awareness between users.

Merging digital and physical realms. In stationary settings, the digital and physical worlds are more or less separated (users ‘look into’ and manipulate the digital world on the computer screen). In contrast, in mobile systems these realms may be combined. Sensors, smart rooms and ambient environments capture real world information of users and devices and represent it in a format that is usable in the digital realm. Geographical information systems (GIS) and

positioning technology enable content providers and users to ‘overlay’ geographical space with digital information that can be accessed via mobile terminals. In addition, by attaching digital information to users we can merge digital and embodied presence. These technologies have the potential to transform how users navigate and experience places and will have a profound impact on concepts of places and presence.

EXAMPLES OF MOBILE APPLICATIONS

We will briefly describe three mobile applications that we have developed that can serve to illustrate some of the properties listed above. *GeoNotes* [2] allows users to place virtual “Post-It notes” that are anchored to locations in the real world. These can be accessed through various devices such as mobile phones and PDAs. Users can choose to receive an alert when they are in a physical location where a note has been placed. *GeoNotes* thus shows how the merging of physical and digital realms can be explored in mobile applications. *Pirates!* [1] is a mobile game played on hand-held PCs equipped with wireless LAN cards and short-range RF-transceivers for position sensing. The game uses a graphical interface, but events in the game also rely on the players’ physical position – for instance, treasures can only be found by walking to certain areas, and players can only enter into fights with each other when they are physically close. *Pirates!* takes advantage of ad-hoc meetings and context sensitivity to enhance game-play, and thus merges the physical and digital realm. Most recently, based on a field study of motorcyclists, we have developed *Hocman*. It is an HTTP-based peer-to-peer application over wireless ad hoc networks, which runs on a variety of hand-held computers. It allows mobile users to share and design rich content when being in the vicinity of each other. This is useful for highly mobile groups with strong social commitment such as motorcyclists. *Hocman* exemplifies how windows of opportunity and ad-hoc meetings can be used in the design of mobile applications. All three applications also raise the question of evaluation methods when usage is extended over time and space.

CONCLUSION AND FUTURE WORK

There is a need for a general and coherent design approach that addresses properties that are unique for mobile applications. We have tried to summarize our current understanding of these issues with the intention that they should be used as a starting point for further exploration of the design and evaluation of mobile applications. The applications we mention above explored only a subset of the unique properties of mobility, and thus there is great opportunity to continue building on these and other properties to create many other new and innovative applications.

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