Design and Evaluation for the Future of m-Interaction

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INTRODUCTION

Mobile technology has been one of the major growth areas in computing over recent years (Urbaczewski, Valacich, & Jessup, 2003). Mobile devices are becoming increasingly diverse and are continuing to shrink in size and weight. Although this increases the portability of such devices, their usability tends to suffer. Fuelled almost entirely by lack of usability, users report high levels of frustration regarding interaction with mobile technologies (Venkatesh, Ramesh, & Massey, 2003). This will only worsen if interaction design for mobile technologies does not continue to receive increasing research attention. For the commercial benefit of mobility and mobile commerce (m-commerce) to be fully realized, users' interaction experiences with mobile technology cannot be negative. To ensure this, it is imperative that we design the *right* types of mobile interaction (m-interaction); an important prerequisite for this is ensuring that users' experience meets both their sensory and functional needs (Venkatesh, Ramesh, & Massey, 2003).

Given the resource disparity between mobile and desktop technologies, successful electronic commerce (e-commerce) interface design and evaluation does not necessarily equate to successful m-commerce design and evaluation. It is, therefore, imperative that the specific needs of m-commerce are addressed–both in terms of design *and* evaluation. This chapter begins by exploring the complexities of designing interaction for mobile technology, highlighting the effect of context on the use of such technology. It then goes on to discuss how interaction design for mobile devices might evolve, introducing *alternative* interaction modalities that are likely to affect that future evolution. It is impossible, within a single chapter, to consider each and every potential mechanism for interacting with mobile technologies; to provide a forward-looking flavor of what might be possible, this chapter focuses on some more novel methods of interaction and does not, therefore, look at the typical keyboard and visual display-based interaction which, in essence, stem from the desktop interaction design paradigm. Finally, this chapter touches on issues associated with effective *evaluation* of m-interaction and mobile application designs. By highlighting some of the issues and possibilities for novel m-interaction design and evaluation, we hope that future designers will be encouraged to "think out of the box" in terms of their designs and evaluation strategies.

THE COMPLEXITY OF DESIGNING INTERACTION FOR MOBILITY

Despite the obvious disparity between desktop systems and mobile devices in terms of "traditional" input and output capabilities, the user interface designs of most mobile devices are based heavily on the tried-and-tested desktop design paradigm. Desktop user interface design originates from the fact that users are stationary—that is, seated at a desk—and can devote all or most of their attentional resources to the application with which they are interacting. Hence, the interfaces to desktop-based applications are typically very graphical (often very detailed) and use the standard keyboard and mouse to facilitate interaction. This has proven to be a very successful paradigm, which has been enhanced by the availability of ever more sophisticated and increasingly larger displays.

Contrast this with mobile devices—for example, cell phones, personal digital assistants (PDAs), and wearable computers. Users of these devices are typically in motion when using their device. This means that they cannot devote all of their attentional resources—especially visual resources—to the application with which they are interacting; such resources must remain with their primary task, often for safety reasons (Brewster, 2002). Additionally, mobile devices have limited screen real estate and standard input and output capabilities are generally restricted. This makes designing m-interaction difficult and ineffective if we insist on adhering to the tried-and-tested desktop paradigm. Poor m-interaction design has thus far led to disenchantment with m-commerce applications: m-interaction that is found to be difficult results in wasted time, errors, and frustration that ultimately end in abandonment.

Unlike the design of interaction techniques for desktop applications, the design of m-interaction techniques has to address complex contextual concerns. Sarker and Wells (2003) identify three different modes of mobility—traveling, wandering, and visiting—which they suggest each motivate use patterns differently. Changing modality of mobility is actually more complex than simply the reason for being mobile: with mobility come changes in several different contexts of use.

Most obviously, the physical context in which the user and technology are operating constantly changes as the user moves. This includes, for example, changes in ambient temperatures, lighting levels, noise levels, and privacy implications. Connected to changing physical context is the need to ensure that a user is able to safely navigate through his/her physical environment while interacting with the mobile technology. This may necessitate m-interaction techniques that are eyes-free and even hands-free. This is not a simple undertaking given that such techniques must be sufficiently robust to accommodate the imprecision inherent in performing a task while walking, for example.

Users' m-interaction requirements also differ based on task context. Mobile users inherently exhibit multitasking behavior which places two fundamental demands on m-interaction design: first, interaction techniques employed for one task must be sympathetic to the requirements of other tasks with which the user is actively involved—for instance, if an application is designed to be used in a motor vehicle, for obvious safety reasons, the m-interaction techniques used cannot divert attention from the user's primary task of driving; second, the m-interaction technique that is appropriate for one task may be inappropriate for another task—unlike the desktop paradigm, we cannot adopt a one-technique-fits-all approach to m-interaction.

Finally, we must take the social context of use into account when designing m-interaction techniques; if we are to expect users to wear interaction components or use physical body motion to interact with mobile devices, at the very least, we have to account for social acceptance of behavior. In actual fact, the social considerations relating to use of mobile technology extend beyond behavioral issues; however, given the complexity of this aspect of technology adoption (it is a research area in its own right), it is beyond the immediate scope of this discussion. That said, it is important to note that technology that is not at its inception considered socially acceptable, can gain acceptability with usage thresholds and technological evolution—consider, for example, acceptance of cell phones.

EVOLVING INTERACTION DESIGN FOR MOBILITY

When designing m-interaction, given that the ubiquity of mobile devices is such that we cannot assume users are skilled, our goal should be to design m-interaction that seems natural and intuitive, and which fits so well with mobile contexts of use that users feel no skill is required to use the associated mobile device. Part of achieving this is acquiring a better understanding of the way in which mobility affects the use of mobile devices, and thereafter designing m-interaction to accommodate these influences. Additionally, we need to better understand user behavior and social conventions in order to align m-interaction with these key influences over mobile device use. Foremost, we need to design m-interaction such that a mix of different interaction styles are used to overcome device limitations (for example, screen size restrictions). Ultimately, the key to success in a mobile context will be the ability to present, and allow users to interact with, content in a customized and customizable fashion.

It is hard to design purely visual interfaces that accommodate users' limited attention; that said, much of the interface research on mobile devices tends to focus on visual displays, often presented through head-mounted graphical displays (Barfield & Caudell, 2001) which can be obtrusive, are hard to use in bright daylight, and occupy the user's visual resource (Geelhoed, Falahee, & Latham, 2000). By converting some or all of the content and interaction requirements from the typical visual to audio, the output space for mobile devices can be dramatically enhanced and enlarged. We have the option of both speech and non-speech audio to help us achieve this.

Speech-Based Interaction

Speech-based input has been nominated as a key potential m-interaction technique for supporting today's