

Human-Centered Design in Mobile Application Development: Emerging Methods

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ABSTRACT

Mobile platforms (e.g., Google Android, Apple iOS) and their closely integrated app stores transformed the mobile industry and opened the market for mobile application developers. Consequently, applications for smartphones quickly soared to phenomena levels. As mobile technology continues to evolve and shape human interaction with technology, human-centered design (HCD) methods adapt to the capabilities of technology and to the needs of mobile application development. This study presents a preliminary review of 79 research papers on the practice of HCD in mobile application development for the smartphone touch era. The aim of the study is to highlight emerging methods and their implications for mobile application development. The methods discovered by this study assist mobile application developers to better understand their target users. Further research is needed, particularly in exploring what user research and evaluation methods are the most effective in the context of mobile application development.

Keywords: Design and Evaluation Methods, Human-Centered Design, Literature Review, Mobile Application Development, Mobile Platforms, Smartphone, User Research Methods

INTRODUCTION

Research in Human-Computer Interaction (HCI) for mobile computing devices has yielded valuable techniques to understand mobile users and improve interaction with mobile devices. Most of the techniques emerged from traditional Human-Centered Design (HCD) methods, adapted to specific characteristics of mobile technology and its usage behavior; for instance, using the device while walking on a treadmill to augment a usability lab with a mobile-like situation (Kjeldskov & Stage, 2004), or self-

reporting methods utilizing the mobile device, as in mobile probes (Hulkko et al., 2004) and mobile diaries (Brandt et al., 2007). However, the smartphone touch era that commenced with the introduction of the iPhone in 2007 (Fling, 2009) constitutes a major shift in mobile usage behavior (context of use and user experience) and mobile technology (mobile platforms and app stores). These aspects have an impact on HCD methods and on developers of mobile applications (hereafter, developers) for the smartphone touch era (hereafter, smartphone).

Context of use is commonly described with five aspects: the user, its task space, technol-

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ogy, physical environment, and social aspects (Hiltunen et al., 2002). The diversity of mobile users and the physical context of mobile usage are almost boundless, while the technology in a smartphone greatly expands the task space and social settings. Consequently, developers need cost-effective techniques to understand usage behavior of smartphone users and to evaluate the product in real context.

Smartphones are also increasingly integrated in our lifestyle. The close relationship with the device implies a need to complement the largely task-oriented HCD with user experience (UX) facets such as hedonistic, aesthetic, emotion, mood and expectations (Hassenzahl & Tractinsky, 2006). For developers, it is essential to understand what UX aspects are relevant, their connection to application design, and how they can be evaluated.

The most significant impact on developers of mobile applications is derived from the transformation of the mobile ecosystem (Basole & Karla, 2011). In particular, mobile platforms have taken a dominant position in the ecosystem with new entrants (Apple iOS and Google Android) swiftly taking over the lead positions. Mobile platforms could not achieve their phenomena level without their closely integrated app stores, which opened the market for masses of developers. Though, platform providers solely govern the content and operation of their app stores, leaving developers with a lack of control of their products' distribution (Fling, 2009).

This study extends the contributions of previous studies (Coursaris & Kim, 2006; Coursaris & Kim, 2011; Hagen et al., 2005; Kjeldskov & Graham, 2003). It presents a review of 79 papers on the practice of HCD methods in the context of mobile application development for smartphones. The study aims to discover emerging HCD methods and their implications for mobile application development. Consequently, the main unit of analysis is a framework of HCD methods based on the HCD process as described by ISO (2010). The study would help to direct future needs for

development and research questions, while developers can benefit by utilizing and improving the methods.

The study discovered four emerging HCD methods – *living lab*, *digital ethnography*, *in the wild* evaluation, and *data logging*. These methods demonstrate the dynamic nature of HCD methods in adapting to the capabilities of new technology and in attending to the increased role of technology in our life. New methods provide contextual data that can help developers better understand the lifestyle of their target or current users. Future research can focus on what are the most effective methods for mobile user research and for evaluation, what data to collect, how to conduct evaluations of social-oriented application, and how sensors embedded in smartphones impact HCD methods.

The next section discusses previous studies in the field of mobile HCI and application development for smartphones. Then we describe the procedure of conducting the study, followed by the conceptual framework for the review. Thereafter, the paper continues with presentation and explanation of the results, followed by a discussion of the results. Limitations of the study are made clear before concluding with opportunities for future research.

RELATED WORK

Various studies focused on reviewing HCI aspects in the development of mobile software prior to the smartphone touch era. Kjeldskov and Graham (2003) contributed an early overview of applied research methods for Mobile HCI. They classified papers based on methodology (e.g., case study, field study, action research, survey) and research purpose (e.g., understand, engineer, evaluate). Their review highlights a clear tendency for building and testing mobile systems in laboratory settings. Consequently, they argue for more natural setting research in the form of basic and action research that consider the actual needs and use of mobile systems.

Hagen et al. (2005) reviewed new methodological approaches that address mobile chal-

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