Research in Mobile Computing:
Problems and Opportunities

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ABSTRACT

The mobile phone has emerged as the most significant addition to IT infrastructure since the birth of the internet. It has also spawned a prodigious amount of research. However, in the IS field there is a paucity of technical research in mobile computing. The authors justify this position via a survey of the literature as well as a survey of leading conferences in IS. Predictably, the IS field is focused on impact and usage studies rather than design so this is a tremendous opportunity for the field. According to the authors' survey of IS conferences that includes over 8,500 articles, the number of publications dealing with technical research is only 0.53%. This is clearly cause for concern. The authors' position is that the IS field could have a major role in the design and development of the device and that the design science methodology with its focus on artifacts is an appropriate methodology for this exciting field.

Keywords: Design Science Research, IS Research, Mobile Applications, Mobile Computing, Software Engineering Research Methodology, Technical IS Research

INTRODUCTION

The mobile device has matured and in a very short time assumed its place alongside desktops as an extension of the organizational computing infrastructure. Approximately 40% of cellular customers have smart phones and as many as 90% of them have used it for accessing organizational resources (Emailmonday 2013). Adoption rates are exceeding 70% (DeGusta 2012). However, the device has many well-known resource limitations including limited battery, limited screen size and in some cases limited connectivity. Due to these limitations it is not yet a replacement for desktops (Han et al. 2007). Some tasks such as working with spreadsheets and large documents are better carried out on desktops at the present time. The device is unprecedented in its adoption, in its power and capability as well as in raising new and exciting opportunities for research. Current research problems run the gamut of infrastructure, protocols, application architectures, mobile interfaces, device interactions and dynamic adaptation to resource and usage contexts (Poslad 2009).

Topics such as infrastructure, protocols and application architectures are well researched in the Electrical and Computer Science disciplines (vide literature review presented in a later section). Higher level application issues have not received their due attention – a simple example

is what features should be provided for a phone intended for executives? Historically, these issues have been part of Office Information Systems and Human Computer Interaction (see for example Amaravadi 2014). Now they appear in a different guise in mobile computing. There is also considerable overlap with Ubiquitous Computing (or Pervasive Computing) research. In the information systems area, research on mobile computing is frequently limited to usage, adoption and impact studies (see for example Fisher et al. 2013). This has been a problem in the IS discipline since the early days. The IS field inspite of its technical foundations has a tendency towards behavioral research (Pfeffers et al. 2007). This problem apparently continues to the present day. We take the position that "Systems Analysis and Design" is a core competency of the discipline and that IS researchers are uniquely qualified to specify functional requirements of systems.

The theses of this paper are: a) There is a paucity of technical work in the IS area concerning mobile computing. Technical work here means work that contributes directly to design of mobile device. This type of research is sometimes referred to as "software engineering" research and more generally as "design science research" (DSR). b) IS researchers should design functionality for mobile devices including mobile interfaces/interaction methods, application features etc. c) The problem involves many reference fields including ubiquitous computing and OIS. Both of these are traditionally in the domain of Computer Science, but it will be argued that specification of application functionality is the stronghold of information systems discipline. This paper is organized in the following manner. First, we discuss ubiquitous computing, a key enabler of mobile computing. Next, we discuss existing research in the area, primarily focusing on that which addresses problems or contributes to functionality of device. Then we present results of a survey of research presented in leading IS conferences to support thesis "a". This is followed by a discussion of open research areas in mobile computing. Finally, we discuss the need for technical research/design science research in this area.

UBIQUITOUS COMPUTING

The term ubiquitous computing was coined by Weiser (1993) as a method of making numerous computers available throughout the physical environment without their being noticed except when needed. Weiser envisioned employees being surrounded by hundreds of computing devices which took the form of "tabs," "pads" and "boards" analogous to post-it notes, notepads and white boards, their physical counterparts. He identified a number of hardware, network, interface and application level issues as summarized in Table 1. In hardware the first order of business was to design or re-engineer off-the-shelf devices for use in ubiquitous computing. Digital pens were needed to enter information, especially in noisy environments. These had to be designed at the hardware/OS level since commercial offerings were not satisfactory at that time. Pens that were not tethered were needed for mobility. Power consumption was an added challenge and is a problem in mobile devices as well as in other forms of ubiquitous devices. It is a function of processor speed which in turn is dictated by the functionality provided by the device. Chip architectures for these devices have to be specially designed to minimize power consumption. In the area of networking the issues were bandwidth and protocol. For effective communications, devices need to have the necessary bandwidth and access protocols. In LANs, bandwidth tends to be a function of the medium and the number of users/devices. Weiser assumed that bandwidth needed to be in the gigabit range for dozens of devices to have satisfactory speed. A media access protocol is needed to allow devices to access media such as wireless and communicate without interference from other devices.

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