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Mobile and Context: Divide or Conquer?

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Abstract: The interdisciplinary field of Human Computer Interaction (HCI), having barely matured past its adolescent shoes, now faces the challenge of meaningfully integrating Mobile Human Computer Interaction (MHCI). MHCI however, when viewed as an emerging independent discipline, does not have the luxury to leisurely plod along. Amid the great diversity of initiatives and interactions, the challenge is to compare or group similar interactions in order to identify synergies and commonalities from practice to feed back into theory. The authors argue for and present a matrix based on context and mobility. This matrix presents the stance of the user and how the users engage with the mobile technology in different contexts versus different mobility possibilities.

Keywords: HCI; MHCI, matrix, context, mobility.

1. Introduction

The interdisciplinary nature of HCI allows for MHCI to also feature as a sub-field of HCI. Despite the almost natural grouping together of these two disciplines, a consensus seems to exist amongst researchers that along with some of the commonalities shared, there is a fast difference between HCI and MHCI.

MHCI as an emerging independent discipline, however, does not have the luxury to leisurely plod along. The breakneck speed at which the technology has permeated society, has presented the research community with many challenges in the face of so many new interactions, technology and complexities that have been added to the PC platform. The potential sophistication of interactions, technology affordances and spread of these devices far outstrip the academic body of well-established research. The rate at which research is reflected on in journal articles cannot keep pace with such a rapid emergence and conference proceedings form the bulk of published research. These publications however often reflect research in progress and tend to be technologically orientated system architecture descriptions rather than deeper reflections on issues pertaining to the field.

MHCI as an emerging discipline which has deep roots and applications in computer science (CS) and HCI has, as is often the case in similar young research fields, had a tendency to be highly opportunity and technically driven with a “focus primarily on producing solutions” [1]. The definitions for MHCI reflect this origin and technology driven emphasis. It is debatable whether one definition of MHCI would eventually suffice as various application domain experts would integrate and apply innovations and learning

to their own areas of expertise. It is suggested that the definition of MHCI should also be tailored to the emphasis of the field and the appropriation of the technology in that field.

2. Multiple Interactions

The mobile user "interacts in chaos" [2]. In the midst of a multitude of factors, Olsen calls for the development of new ways to model, design and evaluate mobile interactive systems. Amid the great diversity of initiatives and interactions, the challenge is to compare or group similar interactions in order to identify synergies and commonalities from practice to feed back into theory. Such an endeavour would be facilitated by a classification matrix. The value of a classification matrix would depend on its objectives [3].

Several classification frameworks focusing on mobile interaction have been implicitly and explicitly proposed. These frameworks are mostly underpinned by technology and are also strongly domain orientated [3-6]. It can be argued that the shortcomings in these domain specific classifications are that they do not facilitate inter-domain comparisons. A possible interdisciplinary classification is proposed by Ballard [7] working in Mobile User Experiences. She presents a number of different frameworks, models, and dissections that are useful in the understanding of the fractured nature of the mobile space. She extracts commonalities that characterise the mobile user and then offers device taxonomy. She further states that devices fall into four classes namely general-purpose work, general-purpose entertainment, general-purpose communication and control, and targeted devices. She posits that "the different characteristics drive how the device is used." This is a rather techno-centric view which firmly puts the mobile device in the driver's seat of the interactions. In contrast, several authors have contributed to the conceptual emergence of "context of use" [8] . Context, along with mobility, emerges as common factors framing the mobile interaction [8-17]. Thus, taking the interaction activity as the unit of analysis [18], mobile technology enables mobility [19] and interactions in context [20]. Each of these is elaborated on below:

2.1 Mobility

There is more to mobility than simply the act of moving. The term 'mobility' as applied to mobile technology, does not emerge from a clear-cut definition or understanding in the literature of MHCI. Ballard argues that "mobility refers to the user, and not the device or the application [7:3]." Oulasvirta and Brewster [21] concur with Ballard's view and state that the major phenomenon surrounding mobile HCI is the user's mobility. The user's physical movement changes the conditions of the interaction so drastically that they suggest mobility of the user as one of the key challenges in MHCI research.

The focus on the user's mobility contrasts with studies where the view of mobility includes the user's engagement in mobile activities in which there is a differentiation between highly mobile, slightly mobile and stationary interactions; capturing the intensity of mobility within the interaction [22]. This view incorporates the static use of mobile technology where the technologies are primarily seen as tools for accessing information, rather than tools for making different types of communication and sociability possible [1]. Such interactions include the ability to connect to remote information or to interact with information on the mobile device itself [23]. Mobility here refers to the potential portability of the technology rather than the mobility in the use thereof. Ballard identifies this as 'The Carry Principle' and recognizes this portability as the distinction between mobile and other platforms in that the user is able to, typically, carry the device all the time.

Ballard's definition of "mobile" has nothing to do with the device, but is instead a characteristic of the user. It's the user that is mobile and is carrying the device [7].

These two views are not mutually exclusive when analysed from an interaction activity perspective as it incorporates both. The user acting with and through the technology to accomplish a goal [18, 24].

An analysis of mobile device interaction should include the actual interaction (mobile/stationary) as well as the setting (context) in which this interaction occurs as "the tool reveals itself to us only in use" [25].

2.2 Context

Context is a complex notion to define. [26] According to Webster's New Twentieth Century Dictionary [27], context is "the whole situation, background or environment relevant to some happening or personality." In the Computer Science domain, the concept has emerged and evolved alongside context-aware computing but with little consensus on what is meant by it [26, 28]. Oulasvirta et al. [29] recognise two contrasting paradigms of thought. Realism, grounded in natural science, suggests that context is a construct. Context can be measured and if properly instrumented and programmed, computing devices can adapt to them. The constructivism paradigm, rooted in social sciences, holds that contexts are human creations, mental and social, and that computing devices ought to provide resources for managing them.

Definitions and views of context that are rooted in a positivistic philosophy share the following basic assumptions. Context is real and structured and the structure can be modelled. Contexts share properties that exist independently from human interpretation. Computing devices can recognise these properties and adapt their behaviour [20, 29]. From this perspective, Scilit et al. [30-32] identified the location of user, the identity of user and the user's proximity to resources as the focus of context. They view context as a constantly changing execution environment and offer the following broad definition for context: "[c]ontext encompasses more than just the user's location, because other things of interest are also mobile and changing. Context includes lighting, noise level, network connectivity, communication costs, communication bandwidth, and even the social situation" [30:1]. Dey et al. initially defined context as the user's physical, social, emotional, or information state and later evolved their view of context as "any information that can be used to characterize the situation of entities […] typically the location, identity and state of people, groups and computational and physical objects" [33:106, 34].

Brown, Bovey and Chen [35] view context as location, the identity of the people around the user, the time of the day, the season, temperature and other physical attributes. Along the same lines Ryan, Pascoe and Morse [36] define context as location of the user, the environment, the user's identity and the time of the interaction. Referring to context as the environment or situation [33], Franklin and Flaschbart [37] interpret context as the situation of the user. Ward, Jones and Hopper [38] refer to the state of the application's surrounding.

Dourish [20:3] reflecting on these definitions of context, grounded in a realist paradigm, argues for a constructivism view of context which recognises multiple interpretations and understandings of context as constructed by the individual. A constructivism paradigm recognises that context is constructed socially, in interactions with agents in the world. Interpretation of context is constituted within a frame of reference. Computing devices can provide resources for people to create and maintain contexts in their actions [29:196]. Dourish holds that "the idea that context consists of a set of features of the environment surrounding generic activities, and that these features can be encoded and made available to a software system alongside an encoding of the activity itself, is a common assumption in many systems."

The concept of context, for this paper, lies in finding a workable balance between the two approaches. Not all interactions with and through mobile technology ascribes to the

notion of ubiquitous computing. Aspects of context are viewed from a pragmatic viewpoint in that the research is cognisant of an amount of uncertainty in these interactions. The acceptance of constructed context, however, will have to be incorporated in some sense, as virtual reality through mobile technology becomes a reality. For the scope of this paper, "context" is naively described as situations where the user's physical relation to space matters. High context to the interactions at hand and situations where the physical relation to space and time are less significant to the interaction. Therefore the authors argue and present the following matrix based on the theory and discourse above. This matrix presents the stance of the user and how the user engages with the mobile technology in different contexts versus different mobility possibilities.

3. A Mobile and Context Matrix

Referring to mobility and context, the following matrix for grouping and comparing mobile interactions, illustrated in Figure 1 below, is discussed to enable comparison.

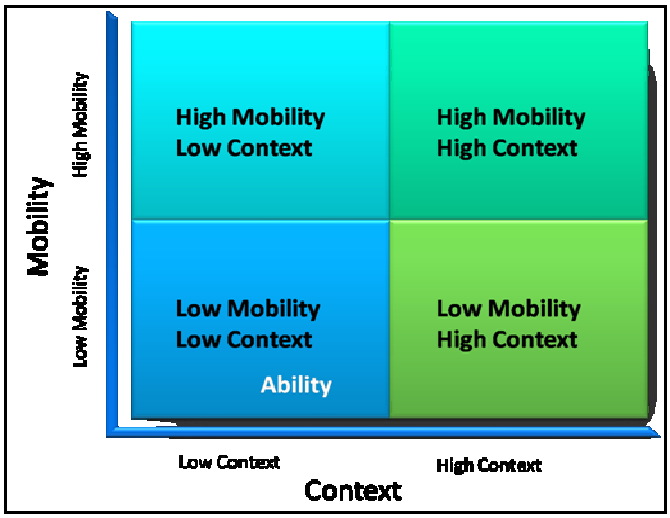

Figure 1: Mobility and Context in MHCI

- **Low Mobility**

Low Mobility interactions can be viewed as the static use of mobile technology. The potential mobility of the device or the user is not essential for these interactions and the mobile technology is primarily being used as a result of other factors. These factors include low cost, availability, convenience and restricted connectivity. Such interactions include the connection to remote information or interactions with information on the mobile device.

- **High Mobility**

High Mobility interactions are viewed as interactions in which the mobility of the technology or user is an essential element to the activity.

- **Low Context**

In a low context scenario, users do not actively use the surrounding context but act **in** context rather than **with** context. As such surrounding context can be viewed as incidental. This does not imply that the context does not influence the interaction but rather that it does not actively feed in to make the interaction significant.

- **High Context**

High context interactions are viewed as interactions in which the context feeds directly into the interactions. This context is either the context of the user (marks, browsing history, preferences, points that have been visited) or the physical context of the interaction. The latter being an example of ubiquitous computing.

3.1 Low Context Low Mobility Interactions

These interactions are characterised by a general broadcasting of information to a select grouping of users or individuals. Users can give their full attention to the interaction. The focussed and stationary state of the user allows for some complex activities to be successfully navigated (for example charging airtime through USSD). The use of SMS as an advertisement in commerce [39, 40], the use of SMS to inform parents of school activities, the announcement of clinic hours, local market prices, sport results and the changing of lecture times or support of distance students are additional examples [41-43]. This interaction moreover incorporates the access of information or applications on the mobile device [44]. The technology is used for other reasons in that its mobility and interactions are about the ability to connect to remote undirected information. The mobile device is used because it is conveniently accessible, affordable and/or connected. Many ICT4D interventions fall in this category.

3.2 Low Context High Mobility Interactions

The portability of the device and the mobility of the users are facilitated in the interaction but the physical context does not feed into the interaction. Examples of these interactions are characterised by activities on the move [45], learning in a train, watching mobile TV on the bus or sending English text to second language learners [46, 47]. These interactions are characterised by users that cannot give their full attention to the interaction and they happen against a dynamic, often noisy backdrop. Content delivered is to the point and short snippets of information.

3.3 High Context Low Mobility Interactions

In these interactions the user has a virtual context or history. Some examples would include the stationary access to a personalised virtual profile in a lecture room or class that is linked to the specific user's context within the learning experience [48] Medical records accessed in hospitals [49, 50] or clinic records being filled in by primary nursing staff, Classroom m-learning that allows for personalised learning and scaffolding [51-54] and the creation of ad-hock classrooms [55] are all examples of high context low mobility interactions. These interactions are characterised by user attention and often structured physical environments. The feedback needs to be instant as the user is waiting for a system reply. This type of interaction is often part of a formal environment and access is through a dedicated network specifically aimed at supporting the interaction. Many of these interventions are top down organisation initiated and users are supplied with identical devices.

3.4 High Context High Mobility Interactions

In these interactions the context whether physically or virtually feed into the interaction that is on the move. Pervasive learning environments [56-58]; embedded learning in natural environments, GPS based games and collecting data in field studies with GPS based coordinates [59] are some of the examples. These interactions are typically restricted to higher end devices and demand some technical skill from the user due to design limitations.

4. Discussion

Users and devices are not restricted to interactions in a single quadrant but move from one type of interaction to another. Device limitations and social limitations would restrict the type of interactions possible. For example, lower end mobile devices would not be able to have High Context High Mobility interactions.

Love refers to mobile computing and states that the concern is in "understanding the users, their capabilities and expectations and how these can be taken into consideration in the mobile systems or application design [60:2]." The categorisation framework supplies a medium to deconstruct mobile interactions across domains as well as intra domain, allowing for a common reference system. This in turn would facilitate a rapid feedback from practice to theory, further articulating implicit design and interaction criteria.

To illustrate, consider the Education Domain where MHCI underpins Mobile Learning. By evaluating several case studies [61-70] over time it can be concluded that there is a vast difference in the way mobile technology is applied in North America, Europe and Africa. North American research mostly reports on initiatives that are *Low Mobility High Context.* Europe's case studies reveal a tendency towards *High Mobility High Context* interactions and Africa generates *Low Mobility Low Context* interactions. Consequently, the individual understanding and appropriation of mobile devices are very different and no single approach to applying these devices can be formulated. This is supported by the different definitions of M-learning that have been presented from the individual areas. Additionally, lessons learnt from facilitating *Low Mobility Low Context* interactions in education, can inform similar applications in m-government, m-health and m-business as can be testified by the similar research results and conclusions that resonate in literature [40, 41].

5. Conclusion

The interdisciplinary nature of MHCI has the potential to silo results and research to domain specific investigations and theory development. The dynamic and volatile nature of the practice which is driven by rapid development in the commercial product market has far reaching effects for research. The practice demands the rapid formulation of a relevant research base to reflect on. In order for relevant academic and practice discourse to become a reality, researchers will have to move on from writing about mobile usage as if they discover a new continent with unchartered landscapes. The categorisation framework that is presented aims to prompt discourse across domain distinctions in order to facilitate reflection beyond mere technology based solutions.

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