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Mobile Interactive Knowledge Elicitation (MIKE) – Mobile Cyberscience in HCI Methods

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Abstract

Human Computer Interaction (HCI) research that applies to the advancement of mobile systems and technologies is an ever-improving area of research for the HCI community. An even more youthful area of research is the inverse of this statement, that is, research in mobile systems that supports the advancement of HCI. This paper describes the development of several tools for HCI based knowledge elicitation (KE) with the support of modern mobile Cyberscience practices.

1 Introduction

Methodologies in human knowledge elicitation and acquisition have been used for decades, largely through the field of psychology, in defining the appropriate scientific models for conducting various data collection techniques (Burge, 2001). A knowledge elicitation (KE) technique in HCI exists partly as a medium for collecting such knowledge for the purpose of assisting the design, development and evaluation stages of human-computer systems.

The field of Cyberscience relates "to the use of information and communication technologies (ICTs) for scientific purposes which asserts that ICTs will lead to qualitative changes in the content of research itself as well as the way research is conducted" (Nentwich, 2004). Thus we take cyberscience into the domain of exploring KE in HCI in relation to on-site stakeholder and user elicitation methods, with mobility, asynchronicity, and geographical dispersion yet with the aims of maintaining the integrity of the existing methodologies.

For HCI practitioners working as part of development teams, HCI researchers who are exploring new models for HCI analysis and HCI educators who are conveying the ideas of HCI theory to students, it is important to define and incur the highest standard of empirical data capture and modelling of definitive techniques. Mobile HCI methods can be potentially seen as an evolution of the current standards of empirical methods, by enabling user based experiments to become digitally assisted on-site stakeholder elicitation methods. These complement and augment existing processes rather than replace, potentially changing the nature of usability lab designs by bringing the HCI methods direct to the source in its natural environment.

By becoming a digital process they will hopefully incur faster data acquisition and processing times than humanly possible, along with large data storage and retrieval capabilities. As cyberscience methods, it has significant advantages in digital precision capture, faster to analyse than humans can facilitate, with digital archiving capabilities, network based sharing of datasets acquired and fast retrieval speed, and a permanent framework for consistent usage and improvement in the field theory domain.

2 The current State-of-the-Art

The field of HCI practitioner-specific tools for mobile and on-site stakeholder use is a relatively new direction, one in which may potentially grow in coming years. Several groups have notably contributed already to existing desktop and browser based tools that can aid in HCI knowledge elicitation. Examples include the GUIR team at Berkeley (Walker et al., 2002), which has produced tools as part of their Denim and Silk projects (Newman et al, 2003) that are used for eliciting knowledge in low-fidelity prototyping development, in early stage web site and GUI design. Also their Suede system (Klemmer et al., 2000) is a powerful speech based Wizard of Oz Prototyping tool based on speech dictation interfaces. Topiary (Li et al, 2004) allows storyboarding to be viewed on PDAs to conduct prototyping location enhanced applications, depicting spatial location elements. NIST's WebMetrics suite by Scholtz & Laskowski (1998) is a highly regarded suite of web browser tools constructed for eliciting the knowledge of HCI web developers with web-based usability testing on heterogeneous and geographically dispersed users.

WebGrid III (Gaines and Shaw, 1993) is a dynamic HTML based tool that allows repertory grids to be constructed (Kelly, 1955) and allows collaborative access via internet browsers. It is noted that these two authors are significant in the background of knowledge elicitation theory and the use of Kelly's repertory grid technique since the early 1980s.

There are also several categorisation-based knowledge elicitation tools available which are well used in the HCI community e.g. in user centred design and information architecture modelling; NIST's WebCAT (Sholtz & Laskowski, 1998) which is a web-only categorisation tool; IBM's EZSort and EZCalc (Dong et al, 2002) for windows 98; uzCardSort from MozDev and Classified for windows (Gaffney, 2004).

The common theory that is lacking depth in these tools is enabling HCI practitioners, researchers and educators the facilities required to take HCI knowledge elicitation techniques outside of the typical HCI user laboratory. By introducing factors of mobility and wireless connectivity that mobile cyberscience provides, HCI knowledge elicitation methods can be better conducted on-site user locations, where the quality of HCI data acquired can be potentially more accurate and representative of the scenarios of use that the HCI design enquiry is seeking.

3 Mobile Interactive Knowledge Elicitation - MIKE Tools

We define our research of several electronic KE methods under an open-for-all umbrella, named MIKE (Mobile Interactive Knowledge Elicitation)– HCI orientated software applications and combinations of mobile computer devices and internet based technologies explicitly synthesised and merged for the digital elicitation of expert and non-expert user knowledge, at anytime, and anywhere. MIKE tools are thus a generic name we have given to define software and hardware configurations for a variety of mobile platforms technologies to specifically support and enhance the capabilities of HCI practitioners, researchers and educators. Derived from research being conducted at the Centre for HCI Design, City University London, UK, it is currently in its second generation based on PocketPCs, MPEG-4 based video handheld devices, Java (J2ME) enabled smartphones, TabletPCs and even plain vanilla PC Laptops. The following tools were developed by HCI researchers, for HCI researchers at our centre. Expert iterative Participatory Design (PD) sessions were conducted to elicit the key user requirements, incorporating focus groups and interviews.

3.1 CAKE - Cardsorting in Asynchronous Knowledge Elicitation

Card sorting is a participant based knowledge elicitation technique for grouping information into categorical domains. It is useful to HCI specialists as a technique for creating and analysing categorisations of domains of knowledge. Card sorting is done by physically having several cards of information placed into groups by a participant or teams of participants that are physically present. These groups are then given a category name based on the participant's perceptions (Zaphiris & Kurniawan, 2001). Cluster analysis techniques are used in combining and comparing individual category groups. CAKE is a J2ME application which can be installed on a variety of PDAs and also run in Java based environments (Fig. 1, Fig. 2, Fig. 3) either via wireless network connection to a hosting webserver, by syncing the PDA, or by copying from a PC to a memory card in turn to the PDA. Once installed and chosen to run, a selector for a current card sort will be visible to choose a text document of cards. If a WiFi wireless network is already available CAKE can be opted to retrieve the card data online from a webserver.

3.2 SAW – Shareable Affinity Workspace

The Kawakita Jiro (KJ) diagrammatic method, similarly known as Affinity diagramming is a popular team-only technique derived from Card Sorting, whereby members in a team can organise ideas and opinions from a general topic, and break down complex concepts into more manageable atomic units, both visually and textually. It is used for giving structure to large or complex concepts and acquiring an agreement from a set of knowledge team members over the categories that should be used to represent atomic units, where the importance is placed on consensus between team members.

Figure 1:
CAKE on Zaurus SL-5500

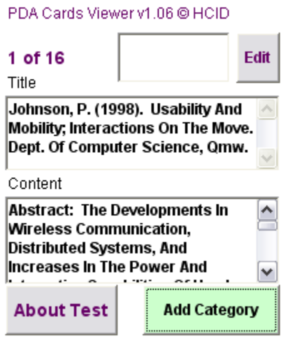

Figure 2: CAKE emulation on a Java desktop (WinXP/TabletPC)

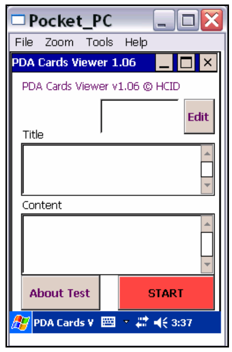

Figure 3:
CAKE on PocketPC emulation

SAW (Shared Affinity Workspace) is a TabletPC and PC laptop based tool for users to organise visual and textual element structures into categorical groups on a scalable screen display in non-linear sequences (Fig.4). Users may debate the choices of their actions until they have refined their categorical structures and then share this information with others. By dragging visual elements near each others into cluster groups, automated analysis of several affinity boards can construct cluster analysis matrices in the same format as found with CAKE, via IBM's EZSort tool.

On TabletPCs, users can quickly annotate clusters with pen based ink notes. The tool features cloning cards for multiple group instances – something that paper cannot replicate quickly and easily (without drawing it out again/photocopying) and can merge prior affinity diagrams by overlays. The Affinity workspace board can be resized to varying scales to give large "virtual" space even though the direct field of view on a screen is not as large as regular wall whiteboard thus allowing it to handle large numbers of visual images as cards. The workspace is asynchronously shareable with others across networks. Of key importance is that all affinity decisions are tracked and can be rolled back to prior times, e.g. to compare what people think of group clusters at different temporal instances during consensus and agreement facilitation. This was a design requirement when being used mobile during onsite experiment sessions with in situ participants.

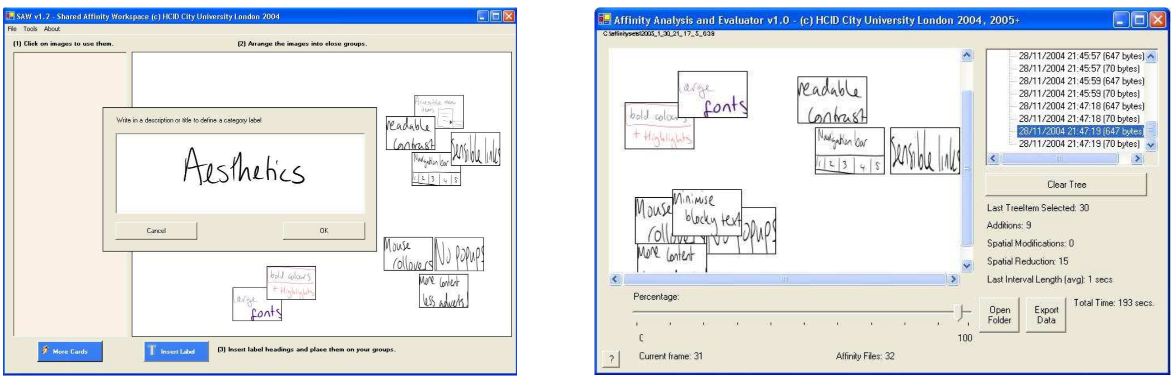

Figure 4: SAW enables users to contribute cards and enables practitioners to view all temporal and spatial actions

3.3 PROTEUS – low fidelity Prototyping Environment for UI Studies

Paper Prototyping in HCI uses simple materials and equipment to create a paper-based simulation of low fidelity prototyping views to an interface or system with the aim of exploring user requirements. It is common to illustrate recognisable features of an interface with consistent elements on separate pieces of paper, e.g. menu bars with triangles on both ends, and rectangular buttons for actions. On separate pieces of paper these element become movable so that the members of your team will discuss effectiveness of position and size and purpose. It is also common to label features and visual elements, with descriptions of their purposes.

PROTEUS is a TabletPC based pen input system for simulating the metaphoric actions of a low fidelity paper prototype being constructed (Fig. 5), e.g. as a drawing view with the capabilities to manipulate (e.g. select, move, colour) ink strokes whilst reusing and sharing visual elements drawn as templates with others. In particular it also constructs temporal roll-back views of the prototypes creation via ink stroke and action timestamps, such that every action of manipulation of the paper prototype can be evaluated at a later date. This allows us to elicit potential weaknesses or strengths at various stages of creation, mediation and refinement of particular low fidelity artefacts in the prototype design process.

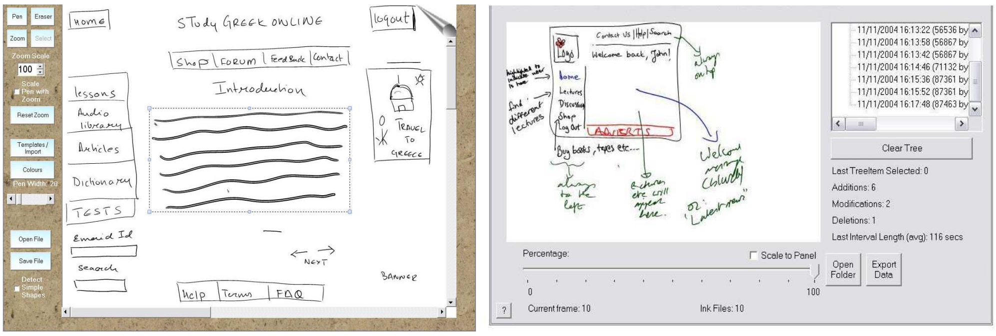

Figure 5: PROTEUS enables users to draw UI designs and enables practitioners to view all temporal and spatial actions

3.4 MUSE - Mobile User Surveys Environment

Constructing survey forms and questionnaires are usually an indirect form of eliciting knowledge although they can be done in the presence of the KE investigator. Collecting this knowledge is time consuming to transfer to a digital form for comparative studies (Backstrom & Nilsson, 2002). MUSE (Fig. 6.) is a PocketPC tool intended as a survey builder and executor for HCI surveys. Constraint Information Visualisation principles were applied to ensure accessible and readable questions on simple to use interfaces. In addition, newer generation PDAs which can handle screen rotation and high-resolution VGA modes enable practitioners to deploy more of their survey's per screen than before in prior PDA survey tools. Templates constructed with MUSE are stored in XML which are transferable to other MUSE users, with on-site data collection easily imported into MS Excel for analysis.

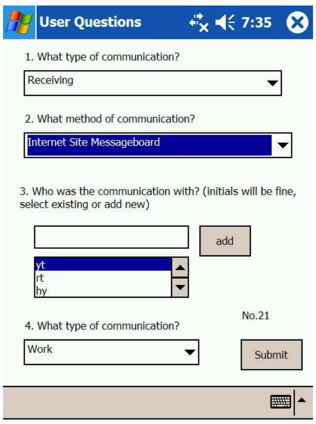

Figure 6: MUSE tool for mobile surveys

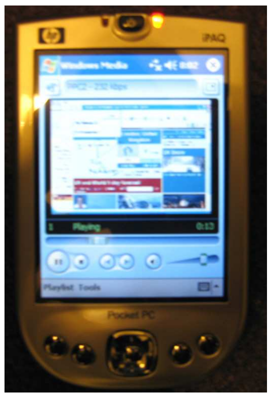

Figure 7: ViVID playback of screen recorded actions

3.5 Virtual Video capture with ViVID

Remote observation techniques and recording of user actions is one of the most widely used HCI methods. There are many useful technologies already existing for this, including VNC based technologies (Richardson et al, 1998) for real time visual distribution and commercial screen recording tools such as Lotus ScreenCam. The Microsoft Windows Media SDK 10 provides a useful developers interface into the encoding engine for the Windows Media library formats. ViVID is thus a participatory designed software tool with a simple task based interface that uses this existing library to encode screen and microphone audio simultaneously to multiple bitrate resolutions, some of which can be streamed via wireless networks in a broadcast manner onto mobile devices such as Media Player compatible SmartPhones and PocketPCs (Fig.7) for mobile review.

4 Conclusions

We are keen to see the evolution of electronic HCI methods that can aid in the automation of often repetitive tasks in HCI and we acknowledge that this is an area for research growth. We have briefly explored some of our mobile software developments which have been designed in mind with user centred HCI, for HCI practitioners, researchers and educators. It is notable that there is an extensive list of KE methods that are used in the HCI community (Burge, 2001), and MIKE defines an open term for mobile tools that aid those methods.

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