MIDDLESEX UNIVERSITY, INTERACTION DESIGN CENTRE

ABSTRACT

We present the work of the Middlesex University Interaction Design Centre. The group's main interest is in the theoretically grounded development and evaluation of interactive systems. We currently focus on three main application areas: digital libraries, distributed cognitive systems, and design for all. We use these applications both as complex exemplars to test and validate usability evaluation techniques and as research areas in their own right.

Keywords

Interactive system design, interactive system evaluation, digital libraries, design-for-all, distributed cognition.

1. INTRODUCTION

The Interaction Design Centre (IDC) was established in 1996 by Harold Thimbleby and Ann Blandford. In 2001/2 they left to found the University College London, Interaction Centre with which we continue to have close research links. The group is currently led by Paul Curzon and has continued to grow. It currently consists of 16 full-time academics, 2 Research Fellows and 11 PhD students. The group meets weekly for a mixture of formal seminars, and less formal presentations that provoke lively discussion over proposed or ongoing work of group members.

The main focus of our work concerns the development and evaluation of novel, theoretically grounded interaction design techniques for specific application areas. Initially we have been mainly concerned with usability, but are increasingly interested with wider aspects of user experience. We investigate how underlying theory can be turned into practical evaluation approaches appropriate for specific application areas of concern.

We have strength in evaluation approaches from two diverse background. We have particular expertise in the area of formal/semi-formal modelling approaches. In contrast, we also have a focus on methods for investigating social and cultural aspects of interaction design based on rigorous research methodologies from the social sciences such as grounded theory.

We have attracted substantial funding from EPSRC and other government funding agencies. We work with a wide range of commercial, interest group and university partners, currently including: BT, ENAV (the Italian Air Traffic Control Agency), RNIB, various NHS hospitals, Visually Impaired in Camden Group, the Enfield Vision Group, University College London, the University of Cambridge, Waikato University, Otago University, the University of Bath, Cape Town University, UWA Australia and Hong Kong University.

2. EVALUATION TECHNIQUES

2.1 Formal and Semi-formal Modelling

A particular focus of our work has been on the use of formal and semi-formal evaluation approaches. The most formal approach developed has been in the area of user error. Paul Curzon, working with Ann Blandford, now at UCL, has developed adapted formal hardware verification techniques to the area of interaction design [10]. This work was inspired by the earlier work on Programmable User modelling with Richard Butterworth [6]. In addition to the computer system and its interface, the user of a system is formally modelled as part of the system being verified. The work focuses on modelling the underlying error genotype (the cognitive cause) rather than the phenotype (the erroneous actions) at a level of abstraction appropriate for formal verification. This gives greater explanatory power. A novel aspect of the work is that the formal cognitive model used is generic: due to the focus on genotypes the underlying cognitive mechanisms can be

specified once. A new user model does not need to be hand-crafted from scratch for each new system. A verification methodology around machine-checked proof has been developed. It has also been shown how the formal model can be used as the theoretical underpinning for lightweight uses of formal methods, outside the design cycle, justifying design rules [9].

Other semi-formal approaches have also been applied. Hanna Stelmaszewska, for example, has applied the EMU methodology (a semi-formal evaluation technique for multi-modal systems) originally developed at Middlesex by Jo Hyde [14], to Musical Digital Libraries[5]. Recommendations resulting from this and Iain Connell's work at Middlesex on Ontological Sketch Modelling (a semi-formal approach to identifying user-system misfits, originally developed by Thomas Green and Ann Blandford [7], are being incorporated into a redesign of the New Zealand Digital Library Music Collection.

2.2 Social and Cultural Issues and Approaches

We are also concerned with social and cultural aspects of the usability of interactive systems. This work extends our interest beyond usability to wider aspects of the user experience. We use ethnographical studies and rigorous qualitative social science approaches, such as Grounded Theory, in the investigation of the wider issues surrounding the use of interactive systems. Elke Duncker, for example, in collaboration with Waikato University in New Zealand, studied problems with the library metaphor of Digital Libraries for Maoris[11]. She showed, using ethnographical approaches, that the use of the library metaphor raises particular cultural barriers that inhibit the degree to which Maoris are willing and able to use digital archives. This is despite there being a great deal of interest in such archives and there being reasons to suppose that their cultural background might predispose Maoris to prefer digital libraries to traditional libraries.

Several Phd projects are concerned with cross-cultural studies. Sara Gwynn is studying how, across different cultures, changes in work practices are being induced by the introduction of electronic journals[13]. Shifts at all levels have been observed. It is also apparent that disciplinary and professional culture supersedes national/ethnic culture. Continuing this theme, Elke Duncker is concerned with the introduction of electronic patient records in acute NHS trusts and how it changes work practices. Ming Nie is similarly looking at the relationship of culture to the introduction of technology. In this case the concern is with how culture affects the usage of distance learning material in a Higher Education context.

A prime example of the way the group's interests extend beyond usability is in the work of PhD student John Salisbury. He is investigating what makes an engaging experience, focussing on the specific area of interactive games software. He is working to elicit the factors that differentiate an engaging experience from an un-engaging one. Preliminary work has identified factors not previously investigated in this context that may be salient. A two stage empirical process is being followed. Initially a qualitative study will identify as wide a range of identified variables, followed by an extensive survey of the identified variables the result of which will be the input to an exploratory factor analysis. This will be used to construct a model of engagingness that can be used to inform the design process.

Another PhD student, Ravinder Bhogal, is investigating a different area of user experience [4]. A critical examination of existing models and theories of interaction with respect to changes in context has suggested that there is a very intimate relationship between the information foraging process and the realisation stages of information need. A new information foraging model has been proposed that takes the user's context into account. Ongoing work is concerned with refining and validating the model using as complex exemplars, tourist guide systems and digital conference assistants.

3. COMPLEX APPLICATION AREAS

3.1 Digital Libraries

Digital Library research has to date been the group's strongest application area. We have a close collaboration with the University of Waikato and provide a mirror site for the New Zealand Digital Library. The IDCs George Buchanan, in addition to his work on mobile ubiquitous computing, is involved in the development of the Greenstone Digital Library software [17]. We have several ongoing digital library projects in addition to those discussed in the previous section.

Suzette Keith, funded by EPSRC, is investigating the usability issues of digital libraries and the potential for known usability evaluation techniques to identify those issues. The relationship between the evaluation techniques and the specific usability issues provides the theoretical foundation for specifying a suite of usability techniques that designers can use to improve the usability of digital libraries. The BT Digital Library is being used as an environment to develop an understanding of the users' and developers' needs. The strategies of experts conducting a search utilising multiple iterations serves to highlight the difficulties faced by less skilled users who lacked strategies to take up the search refinement tools on offer. Significant modifications are being made to the usability evaluation methods, particularly to Claims Analysis, to incorporate an understanding of the information seeking task[15].

Richard Butterworth is leading an investigation into the digitisation of small-museum collections. For small specialist museums, the librarian plays a central role in the

interaction of users with the library. Furthermore small museums do not have the resources to undertake massive up-front digitisation projects. Specialist museums also have a wide and often unknown user base, utilising the resources in wide and unknown ways. An initial pilot project has identified that a key problem to be solved is how to develop a digital library with limited resources when the user group is potentially unknown. A novel methodology has been developed that keeps the librarian central to the way users interact with the library whilst developing the digital resources in a user centred way. Trials with an initial prototype have already led to the Vaughn Williams library's resources being used in a novel way that may lead to advances in historical research on the collections.

Veronica Perkins' PhD concerns the digitisation of historic photography collections. She is performing a wide ranging comparative study of methodologies used in different museum and library digitisation projects, with a focus on user (both end-user and custodian) expectation as a criteria of success. A critical study is under way regarding differences between the original photograph and its digital surrogate, considering social as well as technical issues. Cultural implications of this "convergence" of technologies on areas as diverse as future research into the history of photography, our own visual histories and the development of digital libraries are to be examined.

Middlesex University funded Anne Adams (now a Visiting Academic at Middlesex) to work with Ann Blandford investigating both usability issues and social impact issues of digital libraries when introduced in a clinical setting[2]. Recent work looked at the effect of a project to support evidence-based medicine. A clinical librarian worked as a core member of the medical teams to support their use of a Digital Library. Based on interviews with a wide variety of staff, the project was identified as supporting and encouraging a positive motivation towards evidenced based medicine (EBM) that without this support was perceived as a chore. The clinical librarians' role within the team acted as an external force and guidance for support and social pressure to adhere to these initiatives. It also resulted in more positive interactions with regard to team cohesion, goals, knowledge management and patient interactions. This in turn provided higher job satisfaction, as the clinicians perceived professional and knowledge development both for themselves and the team.

3.2 Design for All

Early work on assistive technology for people with disabilities tended to be polarised into those starting with the technology and those starting with the client group. In collaboration with the University of Cambridge, Ray Adams is investigating an interactive approach that iterates between the two based on advanced IT [3]. The project aims to provide client-centred

assessment methods for people with acquired cognitive problems producing tailored assistive technology solutions. Interviews and discussions are not sufficient on their own: due to their impairments the client may not be aware of the extent of their problems. Our approach is instead based on a simple model of cognition combined with a hypothesis/test based assessment methodology. The assessment is based on a series of validated tests of cognitive ability. The approach and the core tests have been validated using exemplar case studies. The results of assessments can be used: as the basis for the selection of appropriate assistive technology in the design of interfaces tailored to specific problems, and in the selection of appropriate computerised assessment tools for further tests.

In collaboration with the RNIB, Gill Whitney is leading research evaluating mobility aids for the blind[16]. For example, in a recent study with Suzette Keith and Judy Wilson, the RNIB REACT InfraVoice receiver used to trigger speaking sign systems was evaluated with a representative sample of blind and partially sighted people. The aim of this system is to combine the different information (direction and location) provided by the two sign systems: a need identified in an earlier project. It was shown that the system is suitable for use in semi-supported situations, but that changes would be needed if it were to be used in a general-purpose way.

3.3 Distributed Cognitive Systems

Work on distributed cognitive systems is concerned with understanding how artefacts are used and manipulated in complex, often multi-user, interaction situations such as command and control rooms. Early work in this area that is in collaboration with University College London and the University of Otago investigated the interaction of artefacts and staff in an ambulance control room.

More recently Bob Fields and Paolo Amaldi, in collaboration with ENAV, have been studying an airport control tower as a distributed cognitive system, analysing the way artefacts function as representations[12]. Early work has produced an ethnographical account of the tower based on interviews, observations and video and audio records. Early results have shown how "clumsy" introduction of new technology has caused adverse consequences to work patterns. For example, changes to the physical layout has disrupted the flow of interactions and led to miscommunications. The next stage of this work will involve modelling the observed work practices with the aim of being able to predict how work processes may be transformed on the introduction of new technologies.

PhD student Saif Rehman is using cognitive task analysis to inform the design of simulators for laproscopic surgery.

This work is in collaboration with St Mary's Hospital, London.

Judy Wilson and Paul Curzon are looking at Navigation / Route-following Scenarios as a distributed cognitive system. This is building on earlier work that highlighted a range of interaction design issues with respect to in-car navigation aids [5]. One issue is the extent to which such aids aim to complement rather than replace other navigational aids and the user's person's cognitive map. Ongoing work is looking at how a person's cognitive map can be actively supported by technological aids. A theoretically grounded evaluation technique for transport systems, including technological support, is being developed that treats such systems as distributed cognitive systems.

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