Issues in designing for e-science

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Introduction

E-Science offers a special set of challenges for interactive systems designers. Whilst e-science has many different meanings, its key characteristics are that it deals with science that is distributed, asynchronous, and involves multiple participants (whether they be scientists or data gatherers). This makes it inherently different to desktop systems for single or a few users, and so we need to consider whether existing design approaches are adequate. This paper outlines three areas in which e-science and usability combine in interesting ways.

Modelling systems in social settings

When creating interactive devices, especially for specific groups of people, designers tend to focus on the identified user needs and tasks of the target audience, and the user's capabilities and limitations, and produce individual solutions to those needs. However, we all exist in a complex web of professional, personal and social relationships, all of which provide a wider context for our actions and which provide information into, and feedback about, our every interaction. Any devices we design will, if they are used at all, exist within this web of interactions, and it is often the influence of these unseen forces that drives people to use the technology in new and unforeseen ways – which in itself is often not a bad thing.

Within the e-science community, projects currently use tools often designed for one user, or for a limited number of users, and try to integrate numerous different resources, tools and systems in order to bring together the resources and results necessary to implement and develop the e-science work. It is often these seams between existing systems that cause issues for the project - different notations and syntax attached to semantically identical elements; single user systems that overwrite data rather than combining it when used in a multi-user way, and so on.

What we should aim to do is to model this wider environment – the different groups of scientists, subjects, the linked group of professionals and so on that interact around an e-science project. By modeling and understanding these wider networks, we can then incorporate this information into the design of our systems and technologies, so that they better integrate with the e-science project. This situating of design into a wider social setting has to be supported by models which we can then use to test the implications of new systems and technologies, to see where they augment and disrupt the existing structures, so as to better understand their potential benefits and drawbacks before they are actually rolled out.

There is a research question here: can we effectively model the social network and interactions that we exist within, and, once modeled, how can we incorporate that knowledge effectively into our knowledge of HCI and use it to inform our design process? We are addressing this by using UML and MDA modeling techniques, already applied to capturing good HCI design patterns (Beale and Bordbar, 2005), to social network modeling, and developing techniques and approaches to the general problem as well as specific models of typical scenarios. We then need to develop a methodology to show how these models can be used to assist the design of specific systems, by providing an environment in which the effects of the new device can be understood in their wider context.

Design approaches for social systems

It is clear that there needs to be a focus on users, and user-centred research approaches are needed to better elucidate the problems and issues. However, we believe that this does not imply a user-centred *design* process. We discuss why below.

Usability is not always king - as Doug Englebart once said
"If ease of use was the only valid criterion, people would stick to tricycles and never try bicycles".

We need more than usability to make things work appropriately. Design is (or should be) a conversation between the users and the experts, between the desired outcomes and the side-effects, and we have to ensure that the needs of one are not subsumed by the demands of another. In the bad old days, the systems programmers built the system based on what they thought the users wanted, and it didn't work too well. In these more enlightened times, we have user-centred design which gives far greater weight to user experience and desirability. The classic approach is given

by Norman and Draper (Norman and Draper, 1986), with a modern perspective available online (IBM, 2004). Users are involved and consulted at every stage of the process, validating or questioning the decisions of the programmers and designers – and as the results of Vrendenburg *et al* (Vredenburg et al., 2002) show, this has had a demonstrable effect in improving systems. And whilst any design tends to be an instantiation of tradeoffs, these are made more explicit within a user-centred approach.

So why would we want to consider moving on from this inclusive process? Because it doesn't always deliver the best possible system. For a start, user-centred design is grounded in current behaviour, which is often less than optimal. Unusable systems often highlight a discrepancy between the users' approach to and model of their task and that of the systems(Blandford and Young, 1996) – but it is not necessarily the case that it is the system that is wrong. There is also a problem in defining who the system is being built for. There are often competing (and sometimes diametrically opposed) goals depending on whether one consults the people who sit down in front of the system and are focussed on everyday activities, or whether you are talking to the scientists who are collating the results and analysing things from a broader perspective. For example, users may be often interrupted in their work and so may really need a system that allows them multiple windows so that they can multitask effectively. But from a scientific perspective, it may be the case that entering incorrect information into the wrong record would be a significant problem, and the new multitasking approach increases the chances of this. As Englebart implied, moving to a new level of performance, opening up new ways of doing things, may well require more than current usability approaches typically deliver.

Ethical issues

For distributed science to work, we need the participation of multiple people and sites. Recently, a number of innovative projects have demonstrated the potential for non-researcher participants, i.e. the general public, to take part in large scale collection of data, using specific metrics for gathering data and dedicated tools for submitting that data. Notable examples include the BBC's *Springwatch (BBC, 2005)*, which asked people across the country to submit observations of the appearance of specific species of animals, and RSPB's *Big Bug Count (RSPB, 2005),* which required participants to count how many insects they found on their car number plates. This kind of data collection has a promising future, especially when one considers the potential for mobile devices such as phones and PDAs to provide multimedia data.

In initial experiments, the novelty of participation provides sufficient participants, but as time goes on there is no guarantee that there will still be such a willing pool. In such a scenario, scientists need to engage with the public morethan ever: they are now not only funding our activities, and maybe benefiting in the long term from them – instead they are key players in the science itself. We need to be able to explain the results of what we have learned, and provide them with feedback at least, dialogue ideally, about how their contributions have added to the whole. But if we are collecting information on epidemiology, should we be releasing information that one local area has a much higher incidence of cancer than another. Or that the crime rate in one county is correlated with incomes? What rights do the participants have to accessing this information? What responsibilities do we have: to the participants, to society, and to other scientists who also need the cooperation of the wider public?

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