Designing and Evaluating Intelligent User Interfaces

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ABSTRACT
Intelligent user interfaces have been proposed as a means to overcome some of the problems that direct-manipulation interfaces cannot handle, such as: information overflow problems; providing help on how to use complex systems; or real-time cognitive overload problems. Intelligent user interfaces are also being proposed as a means to make systems individualised or personalised, thereby increasing the systems flexibility and appeal.

But in order for intelligent user interface to gain ground and be of real use to their users, more attention has to be given to usability issues. In this tutorial we shall discuss methods for design and evaluation of intelligent user interfaces from a usability perspective.

Keywords
Intelligent user interfaces, usability, design methods, evaluation

INTRODUCTION
"Why should people have to adapt to systems, systems should adapt to people instead?" is a slogan that seems intuitively appealing to many users, as well as to researchers in the field of intelligent user interfaces. Unfortunately, the slogan may lead both users and researchers astray, making them believe that an intelligent interface should behave like a fellow human being, smoothly changing its behaviour to fit with users' knowledge, abilities and preferences, usually with advanced dialogue (and multimodal), capabilities. Contrary to that, the very few intelligent user interfaces that have succeeded commercially have either used very simple adaptations based on simple knowledge of the user, or created its adaptations based on what *other* users do rather than some kind any complex inferred model of the user

Despite these commerically successful examples many human-computer interaction researchers remain sceptical to the whole concept of intelligent user interfaces and personal assistants/agents, see e.g. [Shneiderman, 1997, Suchman, 1997]. The scepticism stems from a fear that

intelligence at the interface will violate usability principles and obscure the issue of responsibility.

TUTORIAL THEME
In this tutorial we shall discuss usability issues for intelligent user interfaces. There are many ways to approach this issue: ours will be to discuss usability criteria applicable to adaptive systems, after which we shall discuss methods that can be used to design them, and finally, how to evaluate the resulting systems. As there is not yet any consensus on these issues in the research community, a special emphasis will be on evaluations of intelligent user interfaces as these are crucial pieces in the usability puzzle.

Usability criteria
Recently the intelligent user interface community has started to worry about usability issues. The discussions and panels at the latest intelligent user interface conference, [IUI'97], exemplify this. The attention has lead to the emergence of better problem definitions and some design criteria, that we shall discuss in the tutorial.

The problem with intelligence at the user interface is that it may violate many of the good usability principles developed for direct-manipulation systems. Those principles include giving the user *control* over the system, making the system *predictable* so that it always gives the same response given the same input, and making the system *transparent* so that the user can understand something of its inner workings. Systems that adapt to their users and changes their behaviour to better fit users' needs will by necessity violate, at least, the principle of predictability and possibly also not be transparent and may hinder users' control over the system.

Other usability issues that become critical with intelligent interfaces are trust and privacy.

We shall discuss ways that we can make the user feel in control through providing a sense of predictability and transparency, and thereby gain the users trust.

Design methods
When designing, in particular, adaptive help systems, it is quite common to discover that many problems could be overcome through redesigning the target system [Breuker, 1990]. This problem points at the necessity to make the adaptive (or intelligent) parts into an integral part of a good

total design of the system. The whole system design should meet users' needs - the adaptivity should not fix a bad design. As phrased by Eric Horvitz (in a panel at Intelligent User Interface'97 [1997]):

"We must remain alert to attempts to use sophisticated inference simply to get around poor design, or in lieu of better design combined with simple automation techniques."

This means that the issue of whether or not some part of a system should be adaptive or intelligent must be part of the design process already from the start. This is rarely the case in system design as it is done today – and it will not be until we provide efficient methods for how to integrate these ideas into the design process.

Unfortunately, methodology for domain analysis from the adaptive systems' perspective remains largely a field in its infancy [Benyon, 1993]. Researchers in adaptive systems often make claims about user needs that have very little to do with what will actually be of real help to users. A proper analysis of users, their tasks and needs, is therefore a necessary part of any development of an adaptive system.

In the tutorial, we shall look at a few methods (one is Cognitive Task Analysis [Roth and Woods, 1989]) that provide an interesting starting point.

Evaluation
One of the most important challenges for intelligent user interfaces is to prove that their adaptive behaviour does in fact *improve* the interaction with the user. Only through designing useful adaptations and then evaluating them with users can we be sure that we are solving the right problem. If we had many such studies showing that certain adaptations work, we could start to extract general principles for design. But evaluating systems is a difficult task, and it becomes even more difficult when the system is adaptive, and very few such studies have been performed so far.

When studying an adaptive system it is of crucial importance to be able to distinguish the adaptive features of the system from the general usability of the designed tool. This is probably why most studies of adaptive systems are comparisons of the system with and without adaptivity (e.g. [Höök 1997]). The problem with those studies is obvious: the non-adaptive system may not have been designed 'optimally' for the task. At least this should be the case since adaptivity should preferably be an inherent and natural part of a system – when taken out the system is not complete.

In the tutorial we shall go through some of the studies and discuss principles for evaluation methods. A special emphasis will be on intelligent user interfaces in information overflow situations.

TUTORIAL STRUCTURE
The tutorial will first provide a short introduction to intelligent user interfaces and then discuss the following issues:

➢ Usability criteria for intelligent user interfaces (and when to violate them)

➢ Bootstrapping the adaptivity to get it right

➢ Methods for user analysis

➢ Individual differences that matters

➢ Criteria for evaluation of intelligent user interfaces

➢ Methods for evaluating intelligent user interfaces

➢ Where to learn more in the intelligent user interface literature.

The tutorial will include demos. As the issues discussed are quite complex, ample room for discussions based on example systems will be given (rather than proper exercises).

INSTRUCTOR
Instructor Kristina Höök is a researcher at SICS, the Swedish Institute of Computer Science. She holds a Ph.D. in Computer and Systems Sciences. The thesis topic was the design, implementation and evaluation of an adaptive hypermedia system to be used in an industrial setting at Ericsson AB. Kristina also gives a course on Intelligent User Interfaces at the Royal Institute of Technology and Stockholm University in Stockholm.

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