Intelligent Interface Technology

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ABSTRACT Applying intelligent interface technology (IIT) will increasingly become an option for the interface designer. Although there have been many applications of IIT there are few general principles, guidelines or methods as to when designers could and should use IIT. This tutorial looks in detail at applications of IIT and at the techniques which it employs. It covers the construction of user, domain and interaction models and looks at how these have been applied in adaptive hypermedia systems, intelligent multi-media, agent-based interaction and other intelligent user interfaces. The tutorial follows on from the introductory tutorial and illustrates the methodology presented there. It also covers the enhanced methods of analysis and design which are needed in order to make effective use of IIT. Given a better understanding of both methods and structure, IIT not only becomes a solution to some usability problems, it opens up new horizons for a radical change in HCI through the use of interface agents and a more equitable sharing of domain knowledge.

KEYWORDS Intelligent user interfaces, Agent-based interaction, Adaptive systems

The Problem

A particularly stubborn problem in human-computer interaction (HCI) is that users change their knowledge and behaviour over time. Computer systems also have to deal with a diverse, heterogeneous user population. Thus any system which has a fixed interface will be more or less ill-adapted to interact with individual users at particular times. The fundamental nature of this problem prompted some early interest in adaptive systems (e.g. Edmonds, 1981, Benyon, 1984, Rich, 1979). Since then the idea of including intelligence at the interface has gained more acceptance as the publication of a number of books and journals can demonstrate (Chignell and Hancock, 1988; Sullivan and Tyler, 1991; Browne, Totterdell and Norman, 1990; Schneider-Hufschmidt, Kuhme and Malinowski, 1993; Gray, Heffley and Murray, 1993, *AI Review*, 1993, *Knowledge-Based Systems*, 1993, *CACM*, 1994). Researchers with backgrounds in artificial intelligence, expert systems, intelligent tutoring and human-computer interaction have begun to recognise some common ground (e.g.

Kobsa and Wahlster, 1989). Although some HCI researchers criticise the idea of adaptive systems (e.g. Thimbleby, 1990) they have apparently been outpaced by recent developments. Agent-based interaction (e.g. Kay, 1990) and computer-supported co-operative working (e.g. Connolly and Edmonds, 1993) are demonstrating not just the feasibility and desirability of building intelligence into the interface, but also the necessity.

The Solution

This tutorial sets out to place the theory and practice of adaptive systems in an HCI context. It begins by accepting the existence of knowledge-based techniques and by recognising a fundamental problem for HCI; dealing with the variety and changeability of users. It argues that by employing knowledge-based techniques in HCI, that is by developing adaptive (or intelligent) systems, this problem can be effectively tackled. It concludes with an agenda for HCI research which arises from such an application of intelligence at the interface.

There has, of course, been a large amount of research in artificial intelligence and knowledge-based techniques. Similarly there has been a lot of research in human-computer interaction. This tutorial does not seek to replicate any of this work. It takes as given the existence of various algorithms, heuristics and knowledge structures which may be used to implement intelligent or adaptive interfaces.

The contribution which the tutorial makes is to elucidate the what?, where? and when? questions surrounding the application of intelligence at the interface. The tutorial is rooted in the desire to improve human-computer interaction and in the contribution which knowledge-base techniques can make to that end. It seeks to identify where intelligent interface technology may be employed, what adaptive systems are like, when designers should consider using them and what types of analysis and design activities are required in order to construct them.

Any application of IIT must abstract aspects of the interaction by forming a dialogue record. It uses this, along with its internal representations, to make inferences about the user, to adapt aspects of the interaction and to evaluate its own operation. One of these representations is the user model. The structure and content of user models - particularly models of cognitive characteristics - is considered. The tutorial summarises the work on domain models and establishes a structure for these representations. Given this understanding of the structure and functions of adaptive systems, the tutorial looks at how intelligent interface technology can be used to improve the interaction and contribute to the usability of systems. In particular, the tutorial examines adaptive hypermedia and intelligent multi-media systems. Finally, the tutorial considers the wider impact which these developments may have on HCI and identifies a number of items which are now on the HCI research agenda.

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