Proceedings HCI International '95, Yokohama, Japan, 155-157, 1995.

Supporting User Interfaces for All Through User Modeling*

Alfred Kobsa
Human-Computer Interaction Division
Institute for Applied Information Technology
German National Research Center for Computer Science (GMD)
P.O. Box 1316, D-53731 St. Augustin, Germany,

and

Department of Computer Science
Universität - Gesamthochschule Essen
Schützenbahn 70, D-45117 Essen, Germany

1. USER MODELS

For adapting computer systems to the needs of different users, so-called "user models" are most often needed (Kobsa & Wahlster 1989, Kobsa 1991, McTear 1993, Schneider-Hufschmidt et al. 1993). User models are collections of information and assumptions about individual users (as well as user groups) which are needed in the adaptation process. This holds true for the "manual" adaptation of the interface by the system developer according to the requirements of specific user groups or individual users; it is even more necessary if a system is supposed to automatically adapt to the requirements of the current user (Dieterich et al. 1993).

* Some of the research described here has been carried out while the author was affiliated with the University of Konstanz, Germany. This work is supported by the German Society for the Advancement of Science (DFG) under Grant No. Ko 1044-4.

2. USER MODELING TECHNIQUES

In the field of user modeling, numerous techniques have been developed for representing various kinds of information and assumptions about the user in appropriate formal representation schemes, for inferring additional assumptions about the user based on initial hypotheses, for maintaining consistency in the user model, and for infering conclusions about the user based on his or her interaction history with the system (for a survey, see Kobsa 1993 and McTear 1993).

2.1 Stereotypes

A frequently employed user modeling method is the so-called "stereotype approach" (Rich 1979, Rich 1989). Stereotypes contain typical characteristics of user groups in the application domain of the system. Often they also contain so-called activation conditions which represent key characteristics that allow one to identify an individual as belonging to the respective user group. Stereotypes become applied to the current user if they are "manually" assigned, or if their activation conditions match available information about the user (automatic classification). As a consequence, all characteristics in the corresponding stereotypes are attributed to the user. Stereotypical assumptions about a user can be supplemented, or even overridden, if additional information pertaining to this individual user is available. The resulting collection of assumptions forms the individual user model, which should be taken into account when adapting the system to the user.

2.2 Interaction history

Another very different user modeling method (which does not require an advance analysis of the target user population) is to record users' interaction behavior, to cluster the interaction data and associate each cluster with a user group or a task step, and to generalize the data in each cluster to "interaction patterns" (Pitschke 1994, Mathé & Chen 1994). When a new user becomes classified as belonging to a specific cluster, the associated navigation pattern resulting from previous users of the same cluster can be employed for guidance. A more controlled approach (which often seems to turn out to be more feasible than completely unsupervised clustering) is to first assign users to groups, based on limited key information about them, and then to generalize their interaction behaviors into patterns for each group (cf. Kaplan et al. 1993, Sherman and Shortliffe 1993).

3. USER MODELING SHELL SYSTEMS

Since the development of user models is quite time-consuming and expensive, so-called user modeling shell systems have recently been developed (Finin 1989, Kay 1995, Kobsa & Pohl 1995, Orwant 1995). They provide a number of services for application systems, including user model representation, inference on the basis of the user model, consistency maintenance, and automatic user classification. A few shells also allow the user to inspect and possibly modify the user model (Cook & Kay 1994, Orwant 1994). User modeling shell systems facilitate user modeling in application systems if their services meet the user modeling needs of the application. The shell systems have to be filled with application-dependent user modeling knowledge (e.g., what the user groups and their key characteristics are, which assumptions can be made if the user performs certain actions at the interface, etc.). The resulting "filled" shell can then form the user modeling component of the application system.

4. TOWARDS USER INTERFACES FOR ALL

Work in user modeling has so far mostly been concerned with "normal" users. User characteristics which have been modeled include users' domain knowledge, goals, plans, interests, preferences and misconceptions. The adaptation takes place at the level of the content of the provided information (as opposed to the level of information presentation at the interface). Recent research efforts extend the scope of user modeling towards modeling the characteristics of all users, including those with communication and interaction difficulties. In doing so, the modeled user characteristics must be extended to also include abilities, and the adaptation must take these abilities into account when presenting information to the user. The adaptation to users with communication and interaction difficulties can take place at design time (e.g., a generic user interface is "compiled" into one that specifically caters to a specific user or a user group), at the time when the user starts the interaction with the system, and continuously during the interaction. Many classical user modeling techniques can be used for modeling all users (e.g. stereotypes for modeling the default abilities of certain user groups). Others will possibly have to be added.

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