

Knowledge Representation for Information System Design: A User Based Approach

Michael Nilan and Woojin Paik
Syracuse University, Syracuse, NY

ABSTRACT

This paper will describe a conceptual framework for a user-based approach to information system design which will enable system developers to create systems based upon actual end-user behavior. The motivation for introducing a user-based approach is the chasm between the ways that people view their problems and environments and the ways that people are required to interact with systems. In other words, existing information systems are constrained in different ways than is the human mind. This chasm is virtually always addressed through end-user training; people are being required to conceptualize aspects of their lives in ways that systems dictate rather than the other way around. Because of the rapidly expanding use of information systems in society by larger and larger numbers of individuals, the not-so-hidden cost of training is becoming too expensive and, we will argue, is not at all necessary.

This paper takes Minsky's (1975) "frame-based" approach to knowledge representation in order to show a user-based approach would conceptually expand upon Minsky's; to demonstrate how methods of generating user models are consistent with Minsky as well as appropriate for generating information system design specifications; and to illustrate, via empirical studies, how this approach has been implemented at a practical level.

The paper begins with a discussion of three alternative design approaches for information systems, the traditional approach, a "user friendly" approach, and the user-based approach. The paper will then examine both Minsky's frame-based approach and the user-based in detail to show the similarities. Minsky did not provide any significant methodological guidance, however, so we will expand his model with specific conceptual and operational rationales and show their suitability for system design. Finally, the paper will give empirical examples of user models from user-based studies that looked at a help/training system for desktop publishing and the information needs necessary for end-users to learn word processing.

THREE DESIGN APPROACHES FOR INFORMATION SYSTEM INTERFACE: where users meet systems

In the past, at least three approaches have been taken to designing information systems. The traditional approach has been called the translation approach, the user-friendly approach as the enhanced translating approach, and a user-based approach as the user-based approach:

1. translating approach: building a bridge between the system and its users by engineering a device that attempts to translate system constraints into English-like or mnemonic terms that the user must learn in order to make use of the system (e.g., WordStar, DIALOG), how system designers have interpreted Minsky's approach;
2. enhanced translating approach: building a more elegant bridge between the system and user by engineering an inherently simpler device (as supported by marketing verification) that attempts to render system complexity more transparent to the user (e.g., Apples's "point & click", DEC Windows), how system designers have tried to improve on the first approach; and
3. user-based approach: studying the pattern of users' perception as they perform the activities that designers are trying to "systematize" (without prior assumptions about the existence of any particular system constraints) and then using observed cognitive processes (e.g., language, activity sequences) as system design parameters. Our approach lets user behavior dictate how the system should function before the system is created. In this manner, the user interface is created at the same time as the system is designed (Nilan, Newby, Paik, and Lopatin).

Both of first two approaches are expert- or technology-driven with little user input for system design which

makes bridging between system and user only possible within predetermined application structure and logic.

COMPARISON OF FRAME- AND USER-BASED APPROACH

We argue that systems can be made more like users. To make a system more like users, inductively derived user specifications can be established by studying users' information needs (defined as a conceptual incongruity [Ford], as when internal sense runs out [Dervin], and when there is insufficient knowledge to cope with voids, uncertainty, or conflicts in knowledge area [Horne]).

Further, because users have trouble specifying their needs in system terms and because users' information needs evolve as they progress through an information need situation, we need to look at user perception of processes as they unfold in time (Dervin and Nilan). Therefore, a "user-based approach" to develop a method for creating user-based models of information processes is needed.

Frame, a widely used Knowledge Representation scheme from the Artificial Intelligence shows similarities with our "user-based approach". Our approach use patterns in the ways users perceive problems and the ways users employ information to solve those problems to provide specifications for system designs (Nilan, Newby, Paik, and Lopatin). This notion of organizing perception into some kind of system constrained, which can be interpreted as a common view of the process of using an information system, date back as far as Kant's Critique of Pure Reason and is represented in this century by the work of Barlett (Ringland). The ideas of Kant and Barlett have been further developed by the notion of a "structured object representation" developed by Minsky as a "frame" (1975). In this knowledge representation approach, Minsky asserts that "chunks" of reasoning and the representation of language memory and perception should be larger and more organized than production rules, and frames are the device he uses to provide the structure. This structured representation and interactions between these structures are generally taken to be the essence of frames or schemata. We see our "pattern" of perception and information use as analog to Minsky's frame.

Within the range of what Minsky mentioned in his original paper, it is easy to find other similarities between his notion and our approach of studying user behavior.

Our paper goes on to describe other parallel between the two approaches and then moves beyond Minsky to methodological consideration of user modelling.

Modelling users' cognitive processes by this user-based approach produces inductively derived pictures of information needs across the users. Knowledge obtained from users can then be pragmatically represented using the language of actual users, sequenced according to an aggregation of users' perceptions of the problem the system was designed to address.

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