

*G. Szwilus, J. Ziegler (Hrsg.): Mensch & Computer 2003: Interaktion in Bewegung.
Stuttgart: B. G. Teubner, 2003, S. 21-24*

From Adaptive Hypermedia to the Adaptive Web

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Abstract

Web systems suffer from an inability to satisfy heterogeneous needs of many users. A remedy for the negative effects of the traditional "one-size-fits-all" approach is to develop systems with an ability to adapt their behavior to the goals, tasks, interests, and other features of individual users and groups of users. Adaptive Web is a relatively young research area. Started in with a few pioneering works on adaptive hypertext in early 1990, it now attracts many researchers from different communities such as hypertext, user modeling, machine learning, natural language generation, information retrieval, intelligent tutoring systems, cognitive science, and Web-based education. Currently, the established application areas of adaptive Web systems are education, information retrieval, and kiosk-style information systems. A number of more recent projects are also exploring new application areas such as e-commerce, medicine, and tourism. While research-level systems constitute the majority of adaptive Web systems, a few successful industrial systems show the commercial potential of the field. This talk will review a number of adaptation techniques that have been developed and evaluated in the field of adaptive hypermedia and applied in adaptive Web systems. It will also present several examples of adaptive Web systems in different application areas. To answer the conference motto "interaction in motion" the talk will specially address the issue of developing adaptive systems for ubiquitous computing and mobile Web. It will discuss the needs and challenges of "adaptation in motion" and present some known success stories.

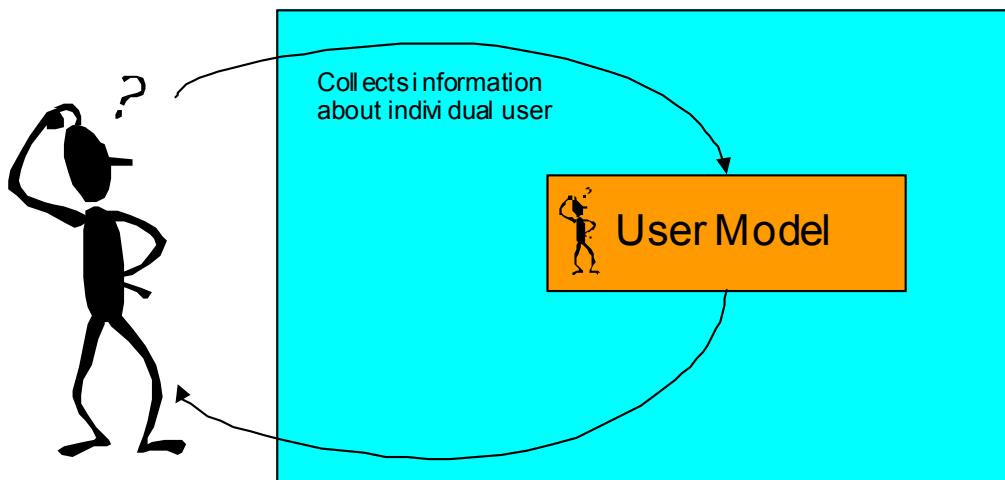


Figure 1. The structure of an adaptive software system

In different kinds of adaptive systems, adaptation effects could be different. Adaptive Web systems are essentially Webs of connected information items that allow users to navigate from one item to another and search for relevant items. The adaptation effect in this reasonably rigid context is limited to three major adaptation technologies—adaptive content selection, adaptive navigation support, and adaptive presentation. The first of these three technologies comes from the field of adaptive information retrieval (IR) and is associated with a search-based access to information. When the user searches for relevant information, the system can adaptively select and prioritize the most relevant items. The second technology was introduced by adaptive hypermedia systems (Brusilovsky, 1996) and is associated with a browsing-based access to information. When the user navigates from one item to another, the system can manipulate the links (e.g., hide, sort, annotate) to guide the user adaptively to most relevant information items. The third technology has some deep roots in the research on adaptive explanation and adaptive presentation in intelligent systems (Paris, 1988). It deals with a presentation of information. When the user gets to a particular page, the system can present its content adaptively.

Over the last 10 years, researchers in adaptive hypermedia and Web systems have explored many user modeling and adaptation methods. The first "pre-Web" generation of adaptive hypermedia systems explored mainly adaptive presentation and adaptive navigation support and concentrated on modeling user knowledge and goals (Brusilovsky, Kobza, & Vassileva, 1998). Empirical studies have shown that adaptive navigation support can increase the speed of navigation (Kaplan, Fenwick, & Chen, 1993) and learning (Brusilovsky & Pesin, 1998), whereas adaptive presentation can improve content understanding (Boyle & Encarnacion, 1994). The second "Web" generation extended the scope of adaptive hypermedia by exploring adaptive content selection and adaptive recommendation based on modeling user interests (Brusilovsky, Stock, & Strapparava, 2000). The third "Mobile" generation is now extending the basis of the adaptation by adding models of context (location, time, computing platform, bandwidth) to the classic user model and exploring the use of known adaptation technologies to adapt to both an individual user and a context or his or her work (Cheverst, Mitchell, & Davies, 2002).

A number of recent works on the crossroads of Mobile Web and the Adaptive Web demonstrate that ubiquitous computing and user modeling can benefit a lot from each other. From one side, an ability to adapt can significantly improve the usability of mobile applications. As was pointed out by Michael Pazzani (Billsus, Brunk, Evans, Gladish, & Pazzani, 2002), adaptation often consid-

ered as a luxury on a desktop computer becomes a necessity on a handheld device with a small screen and low-bandwidth connection. From another side, ubiquitous computing has helped the adaptive hypermedia community to extend the traditional borders of adaptation. Since users of the same server-side Web application can reside virtually everywhere and use different equipment adaptation to *user's environment* (location, time, computing platform, bandwidth) has become an important issue. A number of current adaptive hypermedia systems suggested some techniques to adapt to both the user location and the user platform. Most advanced technologies can provide considerably different interface to the users working on different platforms and even use platform limitation to the benefits of user modeling. For example, a Palm Pilot version of AIS (Billsus & Pazzani, 2000) requires the user to explicitly request the following pages of a news story -- thus sending a message to a system that the story is of interest. This direction of adaptation will certainly remain important and will likely provoke new interesting techniques. Adaptation to the user location is another exciting opportunity that is being explored in a number of research systems. In particular, mobile adaptive guides, a new kind of application systems pioneered by HYPERAUDIO project (Not et al., 1998) currently explore a number of interesting adaptation techniques that take into account user location, direction of sight and movements in both "museum guide" (Oppermann & Specht, 1999) and "city guide" (Cheverst et al., 2002) contexts.

Mobile adaptive Web is an exciting area for researchers and practitioners. While research-level systems constitute the majority of mobile adaptive Web systems, a few industrial research-based products (<http://www.changingworlds.com/>, <http://www.adaptiveinfo.com/>) demonstrate the commercial potential of the field.

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