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RESEARCH ISSUES IN HUMAN-COMPUTER INTERACTION IN THE WEB-BASED ENVIRONMENT

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Abstract

This article outlines research issues in human-computer interaction in the Web-based environment. The list of issues identified is not meant to be exhaustive, but rather to highlight some important areas that require further research. The issues discussed are related to Web design principles, Web usability, visual Web page design, design of trustworthy and effective Web sites for electronic commerce, and design of Web interfaces for handheld computers and mobile commerce.

Introduction

The Internet and WWW are revolutionizing our daily lives and the way business is conducted. Since 1997, the Web has gradually evolved into a true economy and a new frontier for business. In this new Internet age, the design of a quality Web site is critical to the success of businesses. To attract and retain visitors, Web sites need to be human-centered, easy and quick to navigate, and speak the visitor's language. User experience with the Web site is also important. The experience should be in line with the user's goal and should feel natural to the user. Unfortunately, principles of good Web design are not well understood, and problems such as poor navigability, slow download times, and confusing content are common among Web sites. Furthermore, Web design is complicated by the emergence of small-screen (mobile) devices, where design principles may be substantially different from those used to create traditional Web interfaces. The objective of this article is to highlight important research issues in human-computer interaction in the Web-based environment.

Web Design Principles -- How to Design Effective Web Sites?

Research is needed to provide a better understanding of the principles of Web design as well as the specific design criteria for different categories of Web sites (e.g., auction sites, content providers, virtual storefronts, individual home pages, distance learning sites). Some related questions include: What are the criteria of a good Web site? What are the guidelines and standards for designing effective Web interfaces? How can we design usable web sites, especially in B2B, B2C, C2C and C2B e-commerce environments?

Nielsen (1999a, 1999b) identifies a number of design mistakes commonly encountered on Web sites, including the following: frames that are difficult to navigate and use, use of "bleeding edge" technologies such as JavaScript that may actually turn away Web users, distraction caused by scrolling text and looping animations, "orphan pages" without direct links back to the home page, Web pages that require users to scroll through several screens to access desired information, lack of navigation support, non-standard link colors, outdated information, slow download times, and advertising that is distracting or ineffective. The basic issue underlying all of these points is, "How can we design Web pages that provide the user with a sense of control, while at the same time allowing the user the freedom to move around the site as s/he desires?"

Web Usability

What are the different approaches, dimensions and metrics to evaluate Web usability, and which approaches and dimensions are most appropriate for evaluating different Web sites? Nielsen (1994) also defines a number of general heuristics for interface

design that may be applicable to the Web. For example, the interface should always inform the user as to the system's current status. Given the complexity of many Web-based interfaces, having a constant reference point becomes essential to usability. The interface should also be consistent in terms of its labels, actions and situations. The user should be able to recognize, diagnose, and recover from errors, and the interface should speak the user's language. These and other heuristics may provide useful guidelines for evaluating the constantly evolving Web environment.

Visual Web Page Design

Recent trends in Web page design have incorporated a variety of visual tools that exploit the interactivity of the Web. For example, some automobile manufacturers provide three-dimensional images of their latest models so that prospective buyers can look a car over, both inside and out. Interactive 3-D environments are also used in educational settings and, of course, for entertainment. The issue in these cases is to understand how to design visually appealing images that not only serve the purpose of informing users about a product, service, or concept, but that also increase the sense of realism in interacting with the environment and positively affect the user's sense of involvement and desire to use the Web as a tool for purchasing decisions.

Related questions include: How to design visually easy-to-understand and attractive Web sites? What problems and concerns are associated with visualization on the Web? How can 3-D animation and visualization be used more effectively on the Web? Risdén, et al. (2000), for example, describe a 3D Web browser called XML3D. They conclude that the advantage of 3-dimensional visualizations over conventional 2-dimensional formats for search-related tasks depends on the specific type of search undertaken by the user. Therefore, future research is needed to determine for what types of tasks and users 3D visualizations would prove to be superior.

Similarly, questions remain about how to best match current navigation schemes (e.g., hierarchical or network) with specific tasks demands, or the best way to visualize a user's recent activity on the Web (Card, et al., 1999; Head, et al., 2000).

Designing Effective and Trustworthy Web Sites to Support Electronic Commerce

A successful Internet store is one that attracts new and repeat customer visits. Retaining customer loyalty is crucial in electronic commerce (EC). How do we measure the impact of EC Web site design on attracting new customers and retaining existing ones? Some related questions include: What is the most effective interface design, and its related interface features, that will retain customer loyalty in Internet shopping? What is the most effective approach in implementing online community and customer relationship management to maximize customer loyalty? What specific features of an EC site are significant in promoting favorable impressions from customers? In cases where a site targets a specific consumer group (e.g., older individuals, individuals with small children, special interest groups) what characteristics are most significant in attracting and holding onto those customers?

A study by Lee, et al. (2000) demonstrates a positive relationship between trustworthiness of Web sites and customer loyalty. This relationship is even stronger for high involvement products. However, the growing use of the Web has also led to a concern over information privacy and trustworthiness of Web sites. For example, the use of cookies to track user movements has raised questions from privacy advocates about how private users' actions really are. Do users have a right to complete privacy on the Web? How do Web tracking practices affect their perceptions about using the Web? We still know very little about the impact of Web tracking software and privacy policies on the level of user trust. How do an organization's policies on informed consent affect this level of trust? What approaches should organizations use to increase users' trust, and thus their willingness to use a Web site? Do stated security and information use policies affect users' trust in a Web site? What makes a Web site credible and trustworthy?

In addition to the usability issues that have already been discussed, EC introduces a variety of design issues unique to the *process* of purchase decision making. Miles, et al. (2000), for example, suggest that Web designs for B2C EC need to address three specific types of customer activities: 1) search for products, 2) management of search criteria (adding, deleting, or revising criteria), and 3) comparison of products. As such, they propose that EC sites can serve as "decision support systems" to aid consumers in the purchasing decision. Research needs to clarify how to implement such support tools. For example, how should products be represented online to facilitate search and identification? What are the most effective types of navigation to use to allow cross-product data collection and comparison? How should criteria for comparison be represented to facilitate simple and straightforward comparisons? What criteria should be used to determine how well an EC site meets these objectives? These, and other issues, remain to be tested.

Designing Interfaces for Handheld Computers and Mobile Commerce

With the increasing popularity of mobile devices and the continuous development in wireless and mobile networks, new opportunities in mobile computing and mobile commerce are emerging. However, with the limited screen size (i.e., about 4 lines of 14 characters each) and slow transmission speed (i.e., between 9.6 to 14.4 kilobits per second) of mobile devices, new design methods are needed. These considerations include the type of data to be transmitted, the reformatting of data to fit the small screen size, and the navigation methods appropriate for wireless devices. What are guidelines for designing the content and site navigation for wireless devices? Due to speed limitation, the interfaces are mostly text-based, which raise serious challenges for mobile commerce (m-commerce). Would m-commerce be feasible with these limitations? What types of interfaces and navigation method are appropriate for m-commerce?

"Browsing the Internet" might not be suitable for wireless devices. Instead, push technology might be more suitable than pull technology, and personalization of information becomes important, particularly when it is based on location-specific information. What is the most effective way to provide and present personalized information and notification to users? What types of interface would facilitate user access to personalized information? How can intelligent agents and artificial intelligence methods be used to provide a "smart" interface?

Voice navigation or browsing is still in the development stage. Would multi-modal browsing (i.e., combination of data and voice delivery) be suitable for wireless devices? Would these two modes of interaction complement or conflict with one another?

Conclusion

Human-computer interaction in the Web-based environment is an important research area. With the popularity of the WWW and the constant emergence of new technologies designed for the Web, the amount of research that requires attention is phenomenal. A good understanding of Web-based interaction is crucial for designing usable and effective Web sites, especially in the EC context. Although the issues covered in this article are not in any way complete, they highlight some of the important areas for research. In addition to the issues that have been discussed, other related areas of research include:

- (a) studying the dynamics of mass online marketplaces and interaction on the Web in scenarios such as online auction, virtual collaboration, and virtual community networks to design more effective Web interfaces for such settings;
- (b) devising human-factors guidelines for multimedia (e.g., audio/voice) and virtual reality interfaces;
- (c) understanding cross-cultural user interface design issues;
- (d) applying usability engineering lifecycle to Web development projects;
- (e) establishing strong theoretical foundations for Web-based interaction research.

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