



User Profiling in an Automated Environment to Promote Universal Web Usability

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ABSTRACT

The Internet is littered with dead Web sites because targeted users perceived them as virtually unusable. Though many organizations have learned from this experience by making improvements to their Web sites, they may still only satisfy a limited number of users. What is needed is a dynamic means of transforming a Web page to meet the needs of each diverse group of users. This is particularly important given the opportunities associated with the online, global marketplace. This paper describes user profiling, from a universal usability perspective, as a means of identifying Web usability requirements. An automated tool called the Usability Enforcer is introduced, which dynamically transforms a Web page based upon a specified user profile.

INTRODUCTION

The demise of dot coms and the dead Web sites littering the Internet are testimonials to the number of disgruntled users refusing to use poorly designed sites. User-oriented design, though not a new concept, seems to have been forgotten during much of the early development of Web applications. McConnell, in his discussion on the importance of the user in rapid development of software, rings a death knell for many Web applications. "Even if you build the wrong product quickly, you've still built the wrong product." (1996, p. 234). Nielsen (2000), Schneiderman (1998), and other experts in the field, have been espousing the need for a usability perspective in developing Web applications. Nielsen (1999) correctly predicted we would suffer a usability meltdown if the usability of Web sites did not improve.

No other time in history has there been the potential to reach so many users with a wide variety of wired and wireless computing technologies, as provided by the Web. To date, many organizations have been unable to take full advantage of this opportunity simply because they haven't profiled potential users in terms of what it takes to have a good online experience. As a result, they are missing out on opportunities in the international, online marketplace.

User profiling is an important first step in understanding the usability needs of online users. Most organizations will discover that there is a diverse user population, much of whom has not been targeted during the original design of a Web site. The difficulty lies in developing Web applications that can meet the needs of all potential users because of diversity in terms of age, reading and language comprehension, culture, religion, and visual, cognitive, and physical disabilities. Though this challenge is great, it can be met through the use of automated support that dynamically transforms a Web application based on a user profile. This paper describes user profiling and its use by a software tool to transform a Web page into one that meets the needs of the targeted user.

USER PROFILING

At one extreme of the Web usability spectrum, an organization knows little or nothing about the online needs of its targeted user. Many Web site failures can be attributed to being at this end of because Web applications used animation, audio, and video without taking into account the typical user's network access speed. They also used Web objects, such as frames, without considering the impact on navigational intuitiveness of the site. Information content was too complex for many users in terms of sentence structure and word choice. As a result, users found these Web sites confusing in terms of design layout and navigation, couldn't understand or comprehend information content, and didn't wait around while animated objects and images downloaded.

At the other extreme is an organization that provides a satisfying Web experience for virtually everyone. This may be perceived as supporting universal usability where, "all individuals would have equal opportunity to participate in, or benefit from, the use of computer resources regardless of race, age, religion, sex, disability, national origin, or other such similar factors" (ACM Code of Ethics as stated in Schneiderman (2000, p. 85)). An organizations may be aware of the potential for increasing the number of online customers by designing a Web site that can meet the needs of a diverse group of users. But, an organization may consciously decide to target only a limited number of users because of the breadth of user requirements that would have to be met by a Web site especially in an international marketplace.

The concept of universal usability plays an important role in understanding the diversity of online users and the potential for meeting their needs. With universal usability in mind, we identify several important user profiles in the online, international marketplace.

Older User - A satisfying Web experience by users sixty years and older is largely impacted by vision, cognition, and motor skills (Morrell et al., 2001). This fast growing user group comprises 12.7% of the US population and will constitute 20% by 2030 according to the Administration on Aging (www.aoa.gov). It also constitutes the fastest growing group of Web information seekers. For this user group, far too often Web sites are virtually unusable because of font size, type, and style, background and font color combinations, background images, text justification, and other design layout issues. The degradation of vision, in terms of acuity, is part of the natural aging process and as such impacts visualization of Web objects and readability of Web text. Typing in text boxes and precision mouse clicking on Web objects can also impact Web usability due to aging and its impact on motor skills. The vertical length of a Web page, object placement, and navigation scheme may all have an impact on Web usability in terms of cognition and aging.

Ethnic User - There are many ethnic groups in the US that are getting online only to find that there are barriers to Web use. One major

barrier is reading comprehension, especially when English is a second language. In the US, 15-20% of the population will have Spanish as a first language by 2010 (www.census.gov) with a potentially big impact on the use of English-only Web sites. Health literacy organizations identify reading grade level for adults to be fifth to eighth grade (UVA Health System, 2002; www.utah.edu). Yet, many Web sites contain text that requires a reading grade level of tenth grade or higher, thus rendering the site incomprehensible to many users. Slang, clichés, and slogans, also impact the Web experience, as they made not be understood by the targeted user.

There are other Web usability issues that need to be taken into account in order to meet the needs of this user group. Often times, Web sites offering a language translation option have English embedded in the translated content (Becker & Mottay, 2001). English words that are commonly not translated on Web pages include; *Go*, *Cancel*, and *Search*. Error and message boxes as well as Search results often appear only in English, though the rest of the information content has been translated to a native language.

International User - Many organizations are internationalizing their Web sites by translating an English version to various native languages. There are language translation issues that an organization needs to be aware of that go beyond syntactic translation. For example, the meaning of a word may change when it is hyphenated or wrapped during language translation to accommodate changes in screen size. The Dutch word "Hoogstwaarschijnlijk" means "very likely." When incorrectly wrapped or hyphenated, the meaning of this word changes. The following decomposition may result in meaningless jargon on the Web page.

Hoogst = highest

Waar = where

Schijn = shine

Lijk = corpse

Only when the word is left fully intact, does it maintain its meaning.

The translation of English to Hebrew, Arabic, and other bi-directional languages requires a design layout of text and Web objects that appear right-to-left on the page. There are many Web sites that have been bi-directionally translated still containing English language, and Web objects that appear left to right both of which impact usability (reference to be inserted after review). A study on global Web site usability found that many English phrases, clichés, and slogans were not translated into the native language (Becker, 2002). This lack of local sensitivity impacts reading comprehension, but may also reflect on the goodwill of the organization in meeting the needs of the local user in the international, online marketplace.

User With Disabilities It is reported that 500 million people, worldwide, have some type of disability (www.microsoft.com, 2001). These disabilities include visual, audio, physical, cognitive, and language, all of which have some impact on the use of computer technology. (Table 1 presents vision statistics to illustrate the large number of users in this target group). Section 508 of the Rehabilitation Act (www.section508.gov) identifies the federal government standards for Web accessibility in order to make the Internet accessible to all. Many organizations are unaware of changes, which can be made to a Web page to make it more accessible to users with disabilities. For example, source code changes that allow a screen reader to present the Web page in an audio format can be done with automated support. Membership in this user group will continue to grow due to longevity and the aging population.

In addition to profiling the user in terms of his or her online needs, it is important to profile the computing environment used by the targeted user. The monitor size and network

access speed associated with mobile technology, for example, both have a major impact on Web usability. Network access speed is a critical factor in the international marketplace, as many regions still rely heavily on low modem speeds compounded by low reliability due to overextended utilities. Other considerations include software, such as browser type, browser version, and screen reader software. Besides the monitor, keyboard, mouse, camera, and other devices such as a Braille reader need to be considered as part of the computing environment profile.

Table 1: Vision Statistics

According to the American Foundation for the Blind (www.afb.org) and the US Census Bureau (www.census.gov) it is estimated that in the US alone:

- Five million individuals age 65 or older are blind or severely visually impaired and this number will double by 2030.
- Eight percent (1 in 12) of the male population is colorblind.
- Ten million individuals wear glasses and are still visually impaired.
- 1.3 million individuals are legally blind.
- 93,600 students in 1996 were visually impaired or blind.
- 55% of individuals with severe visual impairments or blindness do not have a high school diploma compared to 20% among fully sighted individuals in the same group

SUPPORTING MULTIPLE USER PROFILES

User profiles may have conflicting requirements thus promoting the need for dynamic customization of a Web site. Flash technology may be used, for example, to meet the entertainment needs of a young audience. Yet, individuals with certain physical disabilities may place restrictions on the use of this technology. Flash technology with a refresh or flicker rate of 5 to 50 Hz can trigger seizures in individuals with photosensitive epilepsy (www.trace.wisc.edu). Another illustration of conflicting user requirements is the use of a background image on a Web page. A background image may be quite appropriate for a young adult in terms of corporate identification and product branding. For an older adult, however, a background image may render the site unreadable.

From an international perspective, culture, religious, and language issues need to be taken into account when developing Web applications. Depending on a local region or country, the color "red" for instance, has many different cultural meanings ranging from warning to happiness. Symbols and icons that are associated with religion, such as a Christmas tree, may be appropriate on US sites but sacrilegious on other localized Web sites. Cultural and religious markers, inclusive of images and colors, must be used appropriately or removed from a localized site because the targeted user may deem them offensive.

Animation is another issue that needs to be addressed because local regions may have network access speeds that are too slow or unreliable to effectively display highly animated Web sites. Localized Web pages that are highly animated could be transformed into non-animated pages in order to make them viable for downloading in a localized market.

THE USABILITY ENFORCER TOOL

As part of our sponsored research, we are developing an automated toolset that promotes universal usability based on user profiles. One of the tools, currently under development is called the *Usability Enforcer*. This tool provides a means of dynamically transforming a Web page to meet the needs of a targeted user. The tool would allow the user to select a user profile (e.g. older adult) or develop a customized profile to specifically meet his or her online needs. Once the profile has been set up, it is used to dynamically transform a Web page. Conflicting usability requirements, associated with diverse user groups, would no longer be an issue in the design of a Web page. The dynamic customization of a Web page, via the Usability Enforcer tool, allows for multiple Web designs each meeting the needs of a targeted user group.

Usability rules are associated with a user profile or some aspect of the profile and then used to dynamically transform elements on a Web page. Usability rules, for example, have been developed to represent an older adult (sixty years and older), based on the usability guidelines provided by the National Institute on Aging (www.nih.nia.gov). The older adult profile would be selected and then usability rules, such as: "font size must be 12 point or greater," "no background images," "no italicized text," and "left justified text," are used during the transformation process. The Usability Enforcer produces a Web page that would be compliant with the usability guidelines as specified by the National Institute on Aging.

Other usability rules enforced by the tool are based on previous research and industry practices on Web usability and accessibility (e.g., www.trace.wisc.edu and www.usability.gov). Some of the usability rules are currently based on our industry experiences in conducting Web site usability assessments, as validated research in Web usability is limited. For example, the "vertical scrolling" usability rules in Table 2 have an

Table 2: Usability Rules for Older Adult User Profile

Font Size	Browser Size	Usability Rule	HTML Enforcement
Size	640 x 480 or greater	Minimum 12 point font	Font size 3 or greater allowed
	240 x 128, 320 x 240, 160 x 100 or 96 x 64	Minimum 10 point font	Font size 2 or greater allowed
	ALL	ALL	ALL
Style	ALL	No italics	Remove all italics tags from HTML
	ALL	Sans serif	All font face is Arial, Helvetica, or Geneva
	240 x 128, 320 x 240, 160 x 100 or 96 x 64	All colors	None
Color	240 x 128, 320 x 240, 160 x 100 or 96 x 64	Only dark colors	In a font color "rrggbb," ensure that rr, gg and bb are all less than 55 in Hexidecimal
	ALL	ALL	ALL
	ALL	ALL	ALL
Scrolling	Browser Size	Usability Rule	HTML Enforcement
Vertical	640 x 480 or greater	Maximum 3 vertical pages in length	Split HTML document into 3 vertical page increments
	320 x 240 or 240 x 128	Maximum 5 vertical pages in length	Split HTML document into 5 vertical page increments
	160 x 100 or 96 x 64	Maximum 7 vertical pages in length	Split HTML document into 7 vertical page increments
Horizontal	ALL	NONE	Resize any element if the width is greater than the width of the screen
	ALL	ALL	ALL
	ALL	ALL	ALL

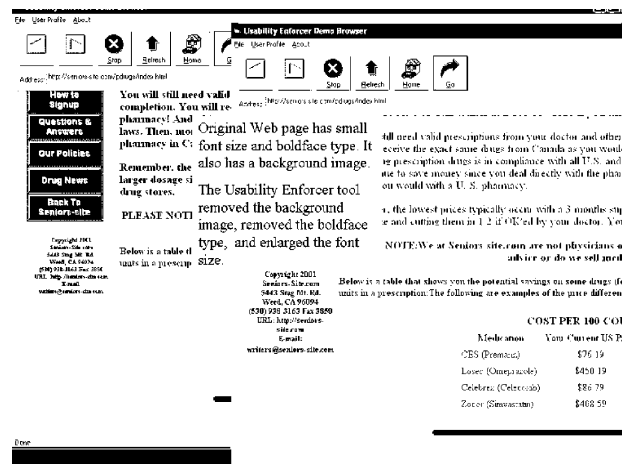
upper limit that is based on our usability experiences. There is currently no validated research to back these rules, which needs to be done as future research.

In most cases, a usability rule cannot be enforced independently of its computing environment. Notice in Table 2 that when a monitor size is very small (160 x 110), the font size is reduced to 10-point font. The user specifies his or her computing environment at set-up time, in order for the correct set of usability rules to be selected. In addition, the user can specify a custom profile for each computing environment being used. Thus, the usability rules associated with a user using a mobile device would differ than when using a computer workstation.

The implementation of usability rules by the Usability Enforcer is illustrated in Figure 1. In this example, an older adult profile was used as a basis for dynamically transforming a Web page. The original Web page has a font size that is too small, as shown in the lower left corner of the page. It has a background image that drastically reduces the readability of the text overlaying it, especially for a person with vision problems. The text is presented in boldface, which also impacts readability for the targeted user. The Usability Enforcer tool has dynamically generated the improved Web page, which is presented on the right side of Figure 1.

The Usability Enforcer was used on fifteen home pages of Web sites targeting older adults. The tool was used to transform the design layout of each home page using the usability rules associated with older adults. These included font size and type, background images, and font and background color combinations. Two-thirds of the sites required a transformation of font size to meet the usability rule of 12-point or greater font size. In many cases, the links were presented in an 8-point font requiring a transformation to make the links visible to an older adult. Over 25% of the Web sites had a background image removed, as

Figure 1: Usability Enforcer's Transformation of a Web Page



these images interfered with the visibility of text overlaying them. Thirteen percent required a color combination change such that the font and background colors were modified for improved readability. One of the Web sites required a font type change and another a font color change, both of which improved readability for the targeted users. Only one of the fifteen home pages (www.DrKoop.com) required no modifications, as it met the NIA usability guidelines for older adults.

These results illustrate the need for usability improvements on Web sites targeting specific users. Each of these Web sites provided valuable information to older adults. But, usability impediments, font color, size, and type, use of background images, and color combinations of text and the background, may render the site too difficult to use for many older adults particularly those with reduced vision.

FUTURE RESEARCH

The Usability Enforcer tool supports the concept of universal usability in that it dynamically transforms a Web page to meet the needs of a specific user profile. However, there are usability rules that need to be defined, especially for user profiles that represent local users in an international marketplace and for users in the US for whom English is not a native language. The tool has incorporated usability guidelines provided by the National Institute on Aging, as many of these have been validated through research efforts. However, there are few usability rules for the other user groups that have validated research to support them. The Usability.gov Web site offers some guidance on usability research, but much more work needs to be done. Future research will include the validation of usability rules that have been based on our industry experience. Future research is also needed to profile other user groups not addressed in this paper. Children and youth, for example, have not been profiled and there is little research on Web usability for these targeted user groups.

Our research is also being extended to include literacy issues associated with information content on a Web page. This is particularly important for adults for whom English is not a native language in the US and in the international marketplace. Our goal is to focus on reading comprehension such that usability improvements can be made regarding the reading grade level, sentence composition, and paragraph structure of a Web page.

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