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ABSTRACT

Research into 'Web 2.0 accessibility' for people with disabilities has recently gained momentum in library and information science studies. This is due to the unique problems disabled individuals face because they must rely on digitized formats. People with disabilities who use assistive technologies are often restricted by incompatibility issues involving software and hardware when retrieving Web content because they have been constructed without consideration for disabled user access. The result has been a new dilemma emerging for many information centers and libraries regarding how to provide access to Web 2.0 technologies which are not designed for persons with disabilities and are incompatible with many assistive technologies. Careful consideration must be given in the development stage of web design to the layout, navigation and compatibility of different assistive technologies used to view the site.

Making Web 2.0 Accessibility Mainstream

The global nature of Web 2.0 technology has offered unlimited potential for many people with disabilities when accessing web resources. Web 2.0 communication technologies present viable opportunities for disabled persons to collaborate online without being affected by the many preconceived stereotypes about disability. [Arrigo, 2005] But, despite the abundance of new opportunities there are significant technological barriers for those who:

- May not be able to see, hear, move, or process some types of information.
- May have difficulty reading or comprehending text.
- May not be able to use a keyboard or mouse.
- May have a text-only screen, a small screen, or a slow Internet connection.
- May not be able to speak or understand fluently the language in which the document was written.
- May have an early version of a browser, a different browser, or a different operating system. [Craven, 2007]

Research into 'Web 2.0 accessibility' for people with disabilities has recently gained momentum in library and information science studies. [Craven, 2003] This is partly due to the unique problems disabled individuals face because they must rely on digitized formats. [Gerke, 2004] In this paper, 'Disabled' is a general term which includes individuals who may not consider themselves disabled under the standard legal definition. However, these individuals do have "limitations of sensory, physical or cognitive functioning, which affects access to the Web. These limitations may be injury-related and/or aging-related conditions and they can be temporary or chronic." [Burgstahler, 2002]

Disabled individuals use computer **'assistive technologies'** to access the Web, in conjunction with graphical desktop browsers, text and voice browsers, multimedia players, and plug-ins. [Craven, 2007]

Examples of Assistive Technologies:

- Screen readers that can only read and navigate basic ASCII and HTML text, not images.
- Alternative keyboards or switches.
- Screen magnification which enlarges all or part of the screen.
- Braille Bars which represent six-dot tactile code of Braille electronically and respond to the text presented on screen.
- Talking Web browsers which convert web pages directly into speech.
- Speech input, which allows the user to speak commands or to dictate to the computer rather than using the mouse and keyboard.
- Visual notification [Craven, 2007]

In the United States, the two most common screen reader products are **JAWS** from Freedom Scientific and **Window-Eyes** from GW Micro. [Adobe, 2006] Screen readers enable disabled users to hear, rather than read, the contents of a web page; however, a screen reader can only read text, not images or animations. [Craven, 2007] Users with mobility impairments may need to rely on the keyboard instead of the mouse to navigate web pages. This would include individuals with paralysis, nerve damage, arthritis, or repetitive motion injuries who may employ touch screens, head pointers, or other assistive devices. In these cases it is critical that the essential components of a website are navigable without a mouse. [Adobe, 2006]

Web 2.0 Accessibility

"**Web 2.0 Accessibility"** is defined by the W3C's Web Accessibility Initiative (WAI) as, '*...when people with disabilities have access to and use of*

information and data that is comparable to individuals without disabilities.' [WAI, 2004]

Web 2.0 accessibility essentially means that a person with a disability can interact, navigate, and contribute to the Web. [EDNER, 2002] A multitude of accessibility issues have arisen with Web 2.0 applications because they have been constructed without consideration for disabled user access. People with disabilities who use assistive technologies are often restricted by incompatibility issues involving software and hardware when retrieving Web content. [Moonan, 2007] The result has been an increasing number of disabled individuals who have access to computers and utilize assistive technologies to access the Internet, but are unable to actually *retrieve* online resources. [Craven, 2007]

The concept behind Web 2.0 Accessibility attempts to address two issues. First, how disabled users access electronic information; and second, how web developers enable web pages to function with assistive devices used by individuals with disabilities. [Adobe, 2006] For the disabled user, the dilemma has been identifying tools that provide the most convenient access to web-based and other electronic information; and for the web developer, it has been removing barriers that inhibit web accessibility tools from functioning effectively. The proliferation of digitized resources produced by information centers and libraries has erected new barriers for disabled individuals who rely upon computer assistive technologies to access resources on the Web. The result has been a new dilemma emerging for many information centers and libraries regarding how to provide access to Web 2.0 technologies which are not designed for persons with disabilities and are incompatible with many assistive technologies. [Adobe, 2006]

Is Web 2.0 Accessibility Important?

Because the World Wide Web has become an essential resource in most aspects of life due to the digitization of public services such as education, commerce and government; the

accessibility of Web 2.0 resources for the disabled has become a dominant social issue both in the United States, Canada and Europe. [Thompson, 2003] Over the past few years, the United States, Canadian and European governments have acknowledged this issue and responded by enacting legislation and legal requirements for the certification of accessible resources on the Web for the disabled.

In 1995, the United Kingdom's '*Disability Discrimination Act'*, made it "illegal to discriminate against disabled people by refusing to serve, by deliberately not providing a service that is normally offered to other people, by offering a lower standard of service, or by treating the disabled person less favorably". [EDNER, 2002] In Canada, equal access is ensured by the Canadian Charter of Rights and Freedoms and in the "duty to accommodate" as an operational requirement in federal and provincial human rights laws.[EDNER, 2002] In 1998, when the United States Congress significantly strengthened **Section 508** of the '*Americans with Disabilities Act",* its primary purpose was to provide access to and use of Federal Electronic and Information Technology (EIT) by individuals with disabilities; and in 2001, the US Congress officially applied guidelines for the "*Web Accessibility Standards"* segment of **Section 508**. [Thompson, 2003] The W3C guidelines adopted by Section 508 set the requirement for WAI compliance for all US government and public agencies at the minimum level of web accessibility. The United Kingdom Cabinet Office e-Government Unit further extended e-Accessibility legislation for WAI compliance. UK law states all web accessibility guidelines must adhere to a level slightly higher than the minimum required by the WAI to be in compliance with all government and public services websites. [Craven, 2007]

A far-reaching statistic to consider when assessing the accessibility of Web 2.0 web technologies by disabled people is the study by the US Census Bureau in 2000, which reported that out of 54 million disabled Americans, 8.7 million of them were poor. [Stewart, 2002] Since most Web 2.0 technology depends upon the speed of a person's Internet

connection this statistic would seem to indicate that there is a significant portion of disabled persons who may be unable to financially afford the cost of high-speed Internet. This is one area where the responsibility of libraries and information centers to overcome accessibility barriers on the Web becomes apparent. If a disabled person is poor, then they are more likely to use the public library to access the Internet and other online resources. Therefore, a library simply providing screen reader technology or enhanced vocalized software on their computers is insufficient to meet all of the needs of their disabled patrons.

It should be noted that Web accessibility tools also benefit non-disabled people or those individuals who may be temporarily disabled due to illness or injury. [Thompson, 2003] For example, technical support for screen reader software not only can benefit blind users, but also users who occupied with other tasks; while captions for audio not only benefit deaf users, but can also increase the efficiency of indexing and searching for audio content on Web sites. [Burgstahler, 2002]

"Web 2.0 Accessibility" is essentially a two-pronged issue: the first being the "readability" of content on the site by assistive technologies and the second is the "usability" of the site by the disabled. Recent research has shown that disabled users face significant usability problems when trying to navigate *around* web sites. This was evidenced by CERLIM's **NOVA** project which identified significant navigation problems for visually-disabled users when they attempted to maneuver around a site using assistive technologies. [Craven, 2004] Their research discovered that because the Web is designed for parallel or non-serial navigation, which offers non-disabled users multiple options within one page (i.e. frames, tables, drop-down menus, etc.); this has caused problems for disabled users who are navigating a site using assistive technologies (e.g. Screen readers).

Screen readers restrict disabled users to searching one frame at a time on a web site. [Craven, 2003] This causes the screen reader to 'read out' each hypertext link on a page one by one; a process which is both confusing and time-consuming for the disabled

user. These issues were researched further in a 2004 study of Internet accessibility by researchers at City University in the UK who found that out of a sample of 196 respondents, 20 percent of them were visually or physically disabled. [Pilling, Barrett, Floyd: 2004] The results of the study revealed that disabled users would like Web sites to have the following:

- Guides on the home page informing people about the site's contents.
- Less cluttered pages
- Fewer graphics and advertising
- Links to be clearer and fewer
- Print size and colors to be easily changeable
- Greater standardization of assistive technology formats
- Search to be more clearly marked and more precise
- Better accessibility for voice recognition system user [Pilling, Barrett, Floyd:pg.34-36]

Physical Barriers to "Web 2.0 Accessibility"

Currently, most Web 2.0 applications have physical **'accessibility barriers'** that make it difficult or impossible for many people with disabilities to use them. Previous studies have indicated that although adaptive software can aid someone who is physically or visually disabled access the Web, many Web 2.0 technologies are incompatible with the current adaptive software. [Ryder, 2004] People who use assistive technologies also cited problems they experienced when accessing the Internet as primarily being related to distorted screen reader magnification and lack of support and training using assistive technologies. [Pilling, Barrett, Floyd: 2004]

Other physical barriers to Web 2.0 Accessibility include:

- Keyboard access involving the use of shortcut keys, tab navigation, and/or keyboard navigation when the site has been designed to be navigated using a mouse. Most Web 2.0 technology depends upon the speed of a person's Internet connection while

the majority of disabled or elderly persons use dial-up and may be unable to financially afford Broadband or DSL. [Craven, 2007]

- Dynamically created websites using PDF, FLASH, Ajax and JAVA are inaccessible. Ajax is being used on an increasing number of web systems, (e.g. Google Apps and Gmail), while JAVA is predominantly used in business applications. [Craven, 2007]

- The increased use of video and graphical displays on most websites which assistive technologies have a difficult time translating. Videos and graphics are being used more and more to augment web content without providing textual alternatives. [Epp, 2006]

- Incompatibility across **assistive technologies.** Ideally, all Web pages could be read by all screen readers. However, most assistive software and hardware systems are not compatible with each other. [Epp, 2006]

- Security issues arise when disabled users, in particular the visually impaired try to logon to certain websites. Websites try to prevent '*bot'* attacks by requiring sighted users to type in an encrypted display of letters or numbers to verify login authenticity. This is a measure used to prevent '*bots'* from reading the characters. These characters are deliberately made ambiguous and it is almost impossible to see them if you are visually impaired. [Zajicek, 2007]

Universal Accessibility

The term **'Universal Accessibility'** has been defined by the WAI as, *"the ability to make the Web available to all people, whatever their hardware, software, network infrastructure, native language, culture, geographical location, or physical or mental ability."* [WAI, 2002] The W3C Consortium's *Web Accessibility Initiative* (WAI) submitted techniques and guidelines which provide technical recommendations for 'Universal Accessibility' on the Web. [Adobe, 2006] These

guidelines include descriptions of accessibility solutions for web authors and developers and are widely considered the international standard for Web accessibility. While most of these guidelines focused on the needs of people with visual disabilities, they also addressed the needs of people with hearing, learning, and physical disabilities. [WAI, 2002] The W3C and WAI have provided an important framework for ensuring accessible Web design development, and assessment.

Current WAI guidelines for *Universal Web 2.0 Accessibility* are as follows: [WCAG, 2008]

Guideline One:
- Provide text alternatives for all non-text content.
- Provide synchronized alternatives for multimedia.
- Ensure that information and structure can be separated from presentation.
- Make it easy to distinguish foreground information from its background.

Guideline Two:
- Make all functionality operable via a keyboard interface.
- Allow users to control time limits on their reading or interaction.
- Allow users to avoid content that could cause seizures due to photosensitivity.
- Provide mechanisms to help users find content, orient themselves within it, and navigate through it.
- Help users avoid mistakes and make it easy to correct mistakes that do occur.

Guideline Three:
- Make text content readable and understandable.
- Make the placement and functionality of content predictable.

Guideline Four:
- Support compatibility with current and future user agents (including assistive technologies).
- Ensure that content is accessible or provide an accessible alternative.

Design-for-All

"Design-for-All" is defined as *"the process of planning for access to electronic resources as they are being developed to ensure that they are accessible to people with a wide range of abilities or disabilities."* [W3C, 2008] Careful consideration must be given in the development stage of web design to the layout, navigation and compatibility of different assistive technologies used to view the site. This type of 'forward-thinking' web development forms the basis for the principles of *'Design-for-All'*. The overall idea behind the concept of Design-for-All is inclusiveness in the design of Web 2.0 technologies wherein every possible audience member regardless of ability can access, navigate, and contribute to the Web. Website designs which follow this concept are far less expensive to implement than developing accommodation strategies once a person with a disability requires access.

One development that appears promising in assisting web developers interested in utilizing the Design-for-All method is a combination of the commonly used web application 'Ajax', DOM scripting, and basic HTML mark-up called, "Hijax".[Keith, 2006] "Hijax" was developed by a British web developer named, Jeremy Keith. Keith, who is also a member of the *Web Standards Project*, a group which advocates for the advancement of "web standards," developed the "Hijax" code to facilitate web accessibility on any site published on the Internet. Jeremy Keith used his expertise in web development to design a code that utilizes existing Ajax applications and also adds a layer of progressive enhancement. [Keith, 2006] The specifics of his research go far beyond the scope of this paper, but simply defined, "Hijax":

- Uses (X)HTML to mark up content on a web page.
- Uses CSS to describe how the content should display.

- Uses DOM Scripting (JavaScript and the Document Object Model) to describe how it should "behave". [Keith, 2006]

Keith's method ensures the 'degradability' of a web page or web application by using unobtrusive JavaScript applied to Ajax. [Keith, 2006] The main objective behind using "Hijax" is to ensure that web pages and web applications work for disabled people who don't have JavaScript or ActiveX on their browsers. [Keith, 2006]

Principles of Design-for-All

When creating accessible electronic resources, the principles of Design-for-all should be employed. [8] The WAI published a comprehensive list of guidelines to aid in the production of accessible web sites which adhere to this concept of "design-for-all" and the guidelines are available in three categories: accessibility of Authoring Tools (ATAG), User Agents (UAAG), and the Web Content Accessibility Guidelines, or (WCAG). [Craven, 2007] The primary recommendations for ensuring the Design-for-all of Web 2.0 resources are: [Craven, 2007]

1. Create unobtrusive JavaScript. [WebAIM, 2005]
2. Page organization: for layout and style be consistent whenever possible by using Cascading Style Sheets or Extensible Stylesheet Language. [Craven, 2007]
3. Images and animations: provide meaningful descriptions using the ALT text tag. [WebAIM, 2005]
4. Sound files: provide captioning for all sound files. [Craven, 2007]
5. Colors: must be contrasting with consideration for people with visual impairments. [WebAIM, 2005]
6. Fonts: use plain fonts because they are easier to read, avoid italics and heavily scripted fonts. [WebAIM, 2005]
7. Font size: the most readable font size for visually impaired persons is 14pt-this size can be adjusted to suit the individual user. [WebAIM, 2005]
8. Tables: make sure text can be clearly read line by line and cell by cell. [WebAIM, 2005]

9. Frames: must be labeled properly or ideally the site should include a *No Frames* version. [WebAIM, 2005]

10. Hypertext links: use meaningful text to describe a link, avoid vague instructions like "click here". [WebAIM, 2005]

11. Charts, graphs, and statistical information: use the "D" link or "Longdesc" attribute. [WebAIM, 2005]

12. Check your work, validate,-use tools, checklist, and guidelines at: http://www.w3.org/WAI/Resources. [Craven, 2007]

A comprehensive list of the guidelines are available on the current WCAG 1.0 working document which has been the standard used the past few years, however, the new WCAG 2.0 recommendations were released by the WAI in April 2008 and will soon become the next standard working document. [WAI, 2008]

The current working draft for version 2.0 consists of four design principles: [WAI, 2008]

- Content must be perceivable.
- Interface elements in the content must be operable.
- Content and controls must be understandable.
- Content must be robust enough to work with current and future technologies.

Each WCAG 2.0 design principle is given with a number of check points which should be applied independently of the technology used for the Web site. WCAG 2.0 represents an important shift in paradigms since the implementation of WCAG 1.0 because WCAG 2.0 now evaluates web accessibility from the end user's standpoint. [Craven, 2007] This means that web accessibility is no longer evaluated by the information sent by a web server, but whether or not the information is retrievable to the end user.

Simple Evaluation of Web 2.0 Accessibility

The Disability Rights Commission (DRC) in the United Kingdom issued a report of the findings of a study they conducted in 2004. The study conducted accessibility assessments of 1,000 web sites and found that over 81 percent were non-compliant with the most basic

WAI WCAG requirements. [DRC,2004] The DRC study also reported that the visually-impaired and other disabled individuals who rely upon screen-readers were the most affected by poorly designed Web sites. [DRC 2004] The report suggested that this was due to pervasive misconceptions of cost, lack of knowledge and interest, and "perceived commercial obstacles" by Webmasters. [DRC, 2004] In 2004, a similar, study was conducted of 175 Webmasters in the United States and they gave coinciding reasons for non-compliance with Web accessibility guidelines. [Craven:2007]

Although, misconceptions are prevalent among Web developers that accessible sites are unattractive, boring, or expensive; it is possible to develop visually appealing, dynamic, interactive web sites without extraordinary cost or sacrificing accessibility. [DRC 2004] Web developers who want to build and maintain accessible web sites can access inexpensive – and sometimes free – applications. Likewise, web authoring tools have even begun to aid developers in the creation of accessible sites with their "Accessibility Preferences" options built directly into the web design application.

Website Validation Tools

Validation tools check a site for compliance with WAI guidelines and accessibility standards. [A-Prompt, 2008] One example of this is ***A-Prompt,*** which was created through the joint efforts of the University of Toronto's Adaptive Technology Resource Centre (ATRC) and the TRACE Center at the University of Wisconsin. [A-Prompt, 2008] ***A-Prompt,*** *is* a licensed software tool which enables Web authors to create Web pages which are more directly accessible by disabled users. **A-Prompt** also provides Web authors the ability to make repairs and are compatible across different assistive technologies. [A-Prompt, 2008] Other free web-based validation tools which provide valuable checks on potential accessibility problems have been produced by WebAIM and the W3C. WebAIM's product is the **WAVE 3.0 Validator** and the W3C tool is the

HTML Validator; both application check whether web pages are accessible to people with disabilities and are validated to accepted standards. [W3C HTML, 2008]

Assessments of web accessibility can be done using a variety of methods, but this is only a part of the overall process of assessing web site accessibility. Results from automated testing are often misinterpreted and do not provide a complete analysis of web site accessibility. [Craven, 2007] It is recommended that combination of measures should be utilized as suggested by the W3C section "Evaluating Websites for Accessibility". [Craven, 2005]

The suggestions included:

- Semi-automatic and automatic testing using validation tools (which validates markup) and accessibility checking tools (to validate accessible mark-up has been used).

- Manual evaluation using relevant criteria for assessment such as the Web Content Accessibility Guidelines (WCAG) checkpoints and priority levels.

- User testing of specific features of a Web site; this should include people with a mixture of disabilities, different technical abilities, and users of assistive technologies. [W3C, 2004]

Implementing Basic Web 2.0 Accessibility

Before an information center or library can make their website accessible, they must understand accessibility, be committed to ensuring accessibility, learn how to implement accessibility, and understand their legal obligations. [Epp, 2006] Information centers and libraries should follow a six-step process to provide accessible content on their Web sites:

1. Adopt a Web accessibility policy.
2. Develop a plan to implement that policy.

3. Broadly disseminate the policy and train anyone developing Web pages, including faculty and students.

4. Include a reasonable timeline in the plan for implementation of Web accessibility.

5. Include measures for enforcement in the plan.

6. Make training and resources on accessible Web design available to Webmasters. [Epp, 2006]

Conclusion

In response to the legal requirements mandated by the 1990 *'Americans with Disabilities Act'* US public institutions widened doorways, added handicapped parking spaces and built wheelchair ramps; ensuring equal access to information through the design of accessible web sites is an extension of the same process. Web sites, like buildings, can be designed or redesigned to meet the needs of all people, including those with disabilities. Libraries and information centers in the public and private sector are discussing and designing mechanisms for adherence to internationally accepted standards of Web accessibility that facilitate online resource sharing. The implementation of *'Design-for-All'* principles in the development and procurement of web technologies in information centers and libraries is an important step towards ensuring patrons with disabilities are provided full access to online resources. Information centers and libraries which are actively involved in researching various disability and rehabilitation technologies can contribute a variety of expertise and opportunities for enhancing the implementation of Section 508 and legally pressure producers of assistive technologies to provide more accessible formats. Libraries and information centers are well positioned to be leaders in the development and promotion of policies for the procurement, development, and use of accessible web technologies.

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