Web Accessibility for People With Disabilities: An Introduction for Web Developers

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***Abstract*—*This article presents an overview of the topic of web access for people with disabilities. First, we describe the four basic disabilities and explain the benefits of making sites accessible, as well as the reasons that more sites are not accessible. We review the relevant laws regarding web access, and we then discuss efforts being made by vendors and professional organizations, especially Microsoft and the World Wide Web Consortium, to encourage accessibility. Finally, we describe major resources that web developers might consult to assist them in making their sites accessible to people with disabilities.*

***Index Terms*—*Accessibility, Americans with Disabilities Act, disabilities, technical communication, World Wide Web.*

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As Tim Berners-Lee, World Wide Web Consortium (W3C) Director and inventor of the World Wide Web, said,"The power of the web is in its universality. Access by everyone regardless of disability is an essential aspect" [1]. Mike Paciello, author of the accessibility resource site WebABLE!, calls the introduction of the web and its subsequent evolution the near-complete "publishing paradigm shift," one that has resulted in increased access to "a global information set never before achieved" [2]. But what began as primarily a text- and number-based medium has evolved into one laden with detailed graphics, animated pictures, and complex page layouts. Although this evolution has proved a great benefit for the average user, it has created difficulties for people with disabilities.

There are four main categories of disabilities that affect a person's ability to use the web:

- mobility, including inability to move, insufficient dexterity to operate a mouse or a keyboard, inability to control unwanted movement, and lack of limbs;
- hearing, ranging from inexact hearing to diminished hearing to no hearing at all;
- vision, including partial or total blindness and color blindness;
- cognition and learning, including various difficulties reading, understanding, staying focused, remembering, and writing.

For a discussion of these disabilities and some of the major assistive technologies (software and hardware intended to help people with disabilities), see [3].

How many people have a disability? The United Nations estimates the number worldwide at half a billion [4]. The number of people with a disability in the United States has been estimated at 43–54 million [5], [6]. The number of adults who strain to see words, letters, or colors on computer screens has been estimated at 4 million. Of

those 4 million, 44% are said to be in the workforce [7]. Similarly, *The Washington Post* has cited the number of blind Americans using computers for pleasure, education, or work to be 535,000 [8]. As the web continues to become a part of everyday life for more and more people, the number of disabled persons using computers will surely increase.

Today's web, however, is mostly inaccessible to the disabled. Geoff Freed, the director of the Web Access Project for Boston-based WGBH-TV, has said that perhaps only 1% of web developers have taken any action to make their sites more accessible to the disabled [9, p. D03]. If Freed's estimate is accurate, or even if the actual number of accessible sites were to be a little higher, perhaps 3 or 5%, these figures reveal a significant problem: as the web continues to evolve, people with disabilities are increasingly finding themselves at a disadvantage. Web developers need to be aware of this problem.

This article presents an overview of the major aspects of the web-accessibility issue for web developers. First, we explain the benefits of making sites accessible: increased readership and the ability to take advantage of new technologies as they are introduced. We explain some of the major reasons web developers offer for not making their sites accessible. We review the relevant laws regarding web access, focusing on the Americans with Disabilities Act, then discuss efforts being made by vendors and professional organizations, especially Microsoft and the World Wide Web Consortium, to encourage accessibility. Finally, we describe major resources that web developers might consult to assist them in making their sites accessible to people with disabilities.

THE NEED FOR ACCESSIBILITY

At first, the arrival of the web enabled many disabled persons to accomplish new tasks. It still does, but problems have arisen, mostly because web developers have begun to include increasingly complex multimedia and design elements in their sites. As one journalist puts it, "As more sites feature animated pictures and images, and home pages where clicking on a graphic is the only way to move from page to page, the web is not a friendly place for the visually impaired" [7].

Examples of the need for accessibility abound in the popular press. In September 1998, *The Wall Street Journal* carried the story of a blind teacher who found that, with the advent of the web and a speech synthesizer, he was finally able to "read" the newspaper. In this same article, however, he expresses his frustration in attempting to navigate a web that has become increasingly difficult for his speech device to decode [9]. Similar stories are common. A *US News and World Report* article featured a web user with retinitis pigmentosa, a debilitating eye disease that eventually causes blindness. Text-to-speech software once allowed her to navigate websites with relative ease; now she must struggle through the unreadable icons [7]. Likewise, a *Washington Post* article profiles the chief of international Braille and technology for the National Federation of the Blind, illustrating how difficult it is for blind users to navigate the web [8].

The accessibility barriers on the average webpage are numerous. The World Wide Web Consortium [10] lists seven common accessibility barriers:

- images without alternative text
- imagemap hot spots without alternative text
- misleading use of structural elements on a page
- uncaptioned audio or undescribed video
- lack of alternative information for users who cannot access frames or scripts
- tables that are difficult to decipher when linearized
- sites with poor color contrast

As technology continues to evolve, the web is becoming more and more exclusionary. Unless we consider universal design as we construct our sites, greater numbers of people will find themselves barred from participation and contribution. According to Cynthia J. Waddell, a California attorney and major proponent of web accessibility, "The growth and success of the emerging digital economy requires that attention be paid to the mechanism for enabling dynamic participation" [11]. This mechanism is an accessibility standard.

There are three main reasons to make sites accessible to people with disabilities.

Making Sites Accessible is the Right Thing to Do The quotation from Berners-Lee presented at the start of this article encapsulates this point. The driving force behind the World Wide Web is a desire to make information available to everyone, including people with disabilities. Access to information opens opportunities for all people by empowering them. For obvious reasons, people with disabilities, more so than other people, can benefit from the enormous resources available on the web. A United Nations report puts it this way: "Accessibility is the right thing to do. It helps achieve societal goals of full participation and equality" [4].

Making Sites Accessible Opens Vast Potential Markets Almost one in five people are disabled. That proportion will increase as the population ages because whereas only 10% of those aged 21 or under have a disability, 25% of those aged 50 do, almost

half of those aged 65–79 do, and more than 70% of those aged 80 or older do [12]. People with disabilities have tremendous economic resources. According to the President's Committee on Employment of People with Disabilities, consumers with disabilities control more than $175 billion in discretionary income [13].

Making Sites Accessible Has Spillover Effects for All Users Making a site accessible to people with disabilities makes it accessible to people in noisy, poorly lit, and hands-free environments, and to people who use mobile devices with small screens without a keyboard or a mouse. Accessible sites are also attractive for people with slow modems or people who turn off images to speed downloads (most people outside the U.S. who pay for dial-up access by the minute). Accessible sites that adhere to coding standards will work well with tomorrow's technology like web telephones.

Why Most Organizations Are Not Accessible

If there are clear advantages to making sites accessible, why don't more organizations do so? Some web developers offer the following rationales.

- "*We aren't interested in this market.*" A recent survey of 30 major shopping, financial, auction, news, and search sites by *PC World* found that only a few sites were interested in the topic. An electronics retailer wrote, "That's not a market we've thought about pursuing" [14].
- "*Making the site accessible makes it boring.*" Some web developers incorrectly think that an accessible site can contain no graphics or multimedia. The accessibility features built into HTML 4.0 accommodate nearly every kind of advanced technology while still preserving the page's accessibility.
- "*We don't want to spend the money.*" Many web developers think that making a site accessible involves a tremendous investment in time and money. According to Kynn Bartlett, director of the HTML Writer's Guild Accessible Web Authoring Resources and Education Center, however, making a site accessible adds about 1 or 2% to the cost [14]. Moreover, new technology is continually reducing the cost of making sites accessible. Sun Microsystems' Java Accessibility API enables screen readers and voice-recognition software to recognize Java applets. The web-captioning editor MAGpie, from the National Center for Accessible Media and WGBH, makes it easy to add captions to video [14].

The Legal Status of Web Accessibility

Are web developers required by federal law or regulations to make their sites accessible to people with disabilities? As is the case with many aspects of law related to the Internet, the answer is not yet clear. In 1996, the Justice Department ruled that a website, like a brick-and-mortar store, is a "public accommodation" and therefore must meet the standards of the Americans with Disabilities Act [15]. As of this writing, this ruling has not been tested in court.

In the past decade, the federal government has enacted a number of laws and regulations affecting web accessibility for people with disabilities. No single statute encapsulates all of this information, and no single agency or department is charged with overseeing the government's efforts. (For an entry point on this vast and complex topic, see the General Service Administration's Federal IT Accessibility Initiative [16].)

Following is a brief overview of the major laws and regulations that affect web accessibility for persons with disabilities.

The Americans With Disabilities Act Enacted in 1990, the Americans with Disabilities Act (ADA) requires that businesses with 15 or more employees make "reasonable accommodation" for employees or potential employees with disabilities. According to the ADA, covered entities must "furnish appropriate auxiliary aids and services where necessary to ensure effective communication with individuals with disabilities" [15]. Because the ADA was drafted and passed in 1990, before the birth of the World Wide Web, there is no explicit link between the two.

However, Deval Patrick, Assistant Attorney General, ruled that the ADA does extend to the web. Patrick wrote:

> Covered entities under the ADA are required to provide effective communication, regardless of whether they generally communicate through print media, audio media, or computerized media such as the Internet. Covered entities that use the Internet for communications regarding their programs, goods, or services must be prepared to offer those communications through accessible means as well [15].

In other words, businesses with 15 or more employees that sell goods or services through the Internet are required to follow ADA accessibility guidelines. Does this ruling have the same effect as law? Advocates for people with disabilities say yes, whereas others (see [17]) say no.

Recently, some organizations have filed suits based on the ruling. For instance, the National Federation

of the Blind (NFB) sued America Online (AOL), charging that AOL violates the ADA because its software cannot accommodate screen readers. However, NFB eventually dropped the suit when AOL agreed to make its software accessible by screen readers. The NFB also reached an agreement with the Connecticut Attorney General that will require four manufacturers of online tax-filing services to make their products accessible by screen readers [14].

Section 508 of the Rehabilitation Act Section 508 was amended most recently in 1998. The Department of Justice describes the main intent of Section 508 in these terms: "Section 508 prohibits federal agencies from procuring, developing, maintaining, or using EIT (electronic and information technology) that is inaccessible to people with disabilities, subject to an undue burden defense" [18]. Section 508 requires that each federal agency or department report to the Department of Justice, every two years, on the state of its own systems' accessibility to persons with disabilities.

The portion of Section 508 that refers specifically to websites makes clear that the Act applies only to "Federal web sites but not to private sector web sites (unless a site is provided under contract to a Federal agency, in which case only that web site or portion covered by the contract would have to comply)." In addition, Section 508 makes clear that the Act does not prevent the use of graphics or animation: "Instead, the standards aim to ensure that such information is also available in a format that is accessible to people with vision impairments." The Act recommends the use of text labels and descriptors for graphics [19].

Section 255 of the Telecommunications Act The Telecommunication Act, which was enacted in 1996, was amended in 1999 [20]. The overview of the amendment of Section 255 defines its intent:

> a manufacturer of telecommunications equipment or customer premises equipment shall ensure that the equipment is designed, developed, and fabricated to be accessible to and usable by individuals with disabilities, if readily achievable. Second, a provider of telecommunications service shall ensure that the service is accessible to and usable by individuals with disabilities, if readily achievable. Finally, whenever the requirements set forth above are not readily achievable, such a manufacturer or provider shall ensure that the equipment or service is compatible with existing peripheral devices or specialized customer premises equipment commonly used by individuals with disabilities to achieve access, if readily achievable [20].

As seen above, the federal government has already made it mandatory that all technology used by or created for them incorporate accessibility measures for the disabled. The scope of Section 255, as it relates to websites, however, is quite limited.

Six states—Arkansas, California, Maryland, New York, Texas, and Virginia—have enacted their own laws and regulations concerning web accessibility. In California, for example, there have been two notable cases in which students at state universities filed complaints to the Office of Civil Rights because of inaccessible computer resources [21], [22]. These cases and others were settled out of court.

A number of nations have addressed the question of web accessibility. For links to those sites, see [23].

MAJOR ACCESSIBILITY EFFORTS

Although most sites are not accessible, a number of vendors and industry groups are making significant efforts to help web developers make their sites accessible. This section first provides a brief overview of some of these efforts and then describes the major efforts made by Microsoft and the World Wide Web Consortium.

Apple is representative of major hardware and software vendors in its efforts to produce products that make it easier for people with disabilities to view websites. The Apple Macintosh computer [24], for example, includes screen-magnification software, system software to help people with motion disabilities, electronic documentation, text-to-speech synthesis, voice recognition, and visual alert cues.

IBM offers Home Page Reader [25], a text reader that uses the company's ViaVoice Outloud text-to-speech synthesizer. A visually impaired user can use Home Page Reader to speak text, frames, image and text links, alternate text for images and image maps, form elements, tables, graphics descriptions, text in tables and columns, and data input fields.

Adobe [26] has announced that it will support the Microsoft Active Accessibility (MSAA) Application Programming Interface (API) in future versions of Acrobat software. Microsoft Active Accessibility is an API that allows programs to expose information about their content and user interface to assistive technologies.

Microsoft's Accessibility Program Among vendors, Microsoft has perhaps the most extensive accessibility program. Because of the company's

dominant position in the operating system, office-productivity, and browser markets, its position on accessible design affects many people. Microsoft's accessibility policy, called Enable, was adopted in 1995. Its four goals are to make accessible products, build strong bonds with the disabled community, equip developers, and inform customers about the accessibility of products [27].

This accessibility policy can be seen, for example, in Microsoft's Internet Explorer (IE) products. IE 5, building on accessibility features in previous versions, has new features, such as AutoComplete, AutoCorrect, and AutoSearch, that reduce keystrokes, typing mistakes, and mouse clicks. IE 5 also has a Web Accessories Kit that lets users customize features by adjusting fonts and colors for text, backgrounds, and links, using the keyboard for navigation on a page, creating their own Cascading Style Sheets for viewing pages, and using screen readers to display ALT text [28]. See [29] for Internet Explorer Accessibility, which covers principles of designing websites for people who will be using the Microsoft browser. Microsoft also presents a Checklist for Testing Your Web Pages for Accessibility, as well as examples of recommended code.

The Microsoft site contains numerous other resources, including articles, step-by-step guides, descriptions of assistive technologies, accessible documentation and support, and a valuable set of procedures that developers can use to make their products more accessible.

World Wide Web Consortium's Web Accessibility Initiative The World Wide Web Consortium (W3C), an organization interested in all aspects of the web, sponsors the most extensive set of programs and initiatives devoted to the issue of web accessibility for people with disabilities. W3C's main umbrella under which these efforts are collected is known as the Web Accessibility Initiative (WAI). According to the W3C, the WAI

> is pursuing accessibility of the Web through five primary areas of work: addressing accessibility issues in the technology of the Web; creating guidelines for browsers, authoring tools, and content creation; developing evaluation and validation tools for accessibility; conducting education and outreach; and tracking research and development [30].

The WAI has published many documents of interest to web developers. The three major sets of guidelines regarding web accessibility are the following.

- *Web Content Accessibility Guidelines*. These Guidelines [31] are based on two themes: "ensuring graceful transformation" (making Web content accessible and clear despite a person's disability and the limitations of any hardware of software he or she is using) and "making content understandable and navigable" (by using clear language and navigation so that people with disabilities can quickly and easily orient themselves in a page).
- *Authoring Tool Accessibility Guidelines* These Guidelines [32], addressed to developers of web authoring tools (including web editors, word processors, desktop-publishing software, and software for turning desktop-published documents into HTML), are intended to ensure that authoring tools be accessible to authors regardless of disability, that they produce accessible content by default, and that they assist the author in creating accessible content.
- *User Agent Accessibility Guidelines*. These Guidelines [33] are addressed to developers of browsers and other software that presents websites on a user's screen. A user agent that adheres to these guidelines will be accessible by virtue of its own interface and by virtue of its ability to communicate with assistive technologies.

Developed by the W3C as part of the WAI, the Web Content Accessibility Guidelines 1.0 is the most comprehensive and far-reaching accessibility policy created thus far. Specifically, the "Content Guidelines" presents 14 critical accessibility measures that authors and designers should be aware of when designing web content [31].

1) Provide equivalent alternatives to auditory and visual context.
2) Don't rely on color alone.
3) Use markup and style sheets and do so properly.
4) Clarify natural language usage.
5) Create tables that transform gracefully.
6) Ensure that pages featuring new technologies transform gracefully.
7) Ensure user control of time-sensitive content changes.
8) Ensure direct accessibility of embedded user interfaces.
9) Design for device independence.
10) Use interim solutions.
11) Use W3C technologies and guidelines.
12) Provide context and orientation information.
13) Provide clear navigation mechanisms.
14) Ensure that documents are clear and simple.

Each individual guideline has checkpoints that illustrate how the guideline applies to site design. The number of checkpoints per guideline varies; guideline 2), for instance, has only two checkpoints, whereas guideline 3) has seven checkpoints. Further,

each checkpoint is assigned a priority.

- Priority 1 checkpoints are top priority, and to ensure that one or more disability groups do not encounter impossible situations on the web, these checkpoints must be satisfied.
- Priority 2 checkpoints should be satisfied, or the designer risks making navigation difficult.
- Priority 3 checkpoints are areas a designer might consider fulfilling to remove minor accessibility obstacles.

The Guidelines also present a conformance matrix.

- Conformance Level "A": all Priority 1 checkpoints are satisfied.
- Conformance Level "Double-A": all Priority 1 and 2 checkpoints are satisfied.
- Conformance Level "Triple-A": all Priority 1, 2, and 3 checkpoints are satisfied.

Importantly, each checkpoint is linked to the WAI "Techniques Document," allowing the web designer to view examples of how the checkpoint can be fulfilled.

In addition, the WAI includes other useful documents:

- technical documents focusing on the accessibility features included in such features and languages as Cascading Style Sheets, Synchronized Multimedia Language, and HTML 4;
- links to accessibility policies and documents from the federal government, U.S. states, and foreign nations;
- links to alternative browsers and assistive technologies popular among people with disabilities;
- links to evaluation and repair tools that help developers diagnose the accessibility of their sites and fix them;
- a comprehensive and easy-to-use self-guided tutorial, titled *Curriculum for Web Content Accessibility Guidelines 1.0*, that presents the guidelines, checkpoints, and sample code for the Web Content Accessibility Guidelines document.

The W3C Web Accessibility Initiative provides the single most comprehensive and useful set of resources for web developers who wish to make their sites more accessible to people with disabilities.

RESOURCES FOR WEB DEVELOPERS

There are numerous resources available for web developers interested in making their sites accessible for people with disabilities. The first thing a web developer might do is determine the extent to which the site is accessible. Two sites perform accessibility audits at no charge:

- Bobby, a diagnostic program from Center for Applied Special Technology [34];
- HTML Validation Service, from W3C, checks for conformance to HTML and XHTML Recommendations and other HTML standards [35].

Also, see W3C's Evaluation, Repair, and Transformation Tools for Web Content Accessibility [36] for links to a number of other diagnostic and repair tools available on the web.

Many academic and nonprofit groups have long been involved in developing and promoting accessible technology. Following are the major sites that address web-accessibility issues.

- W3C's Web Access Initiative [37] is the motherlode of web accessibility information. Start here.
- The Federal IT Accessibility Initiative [38], a program of the General Services Administration, is the best point of entry to the federal government's information about Section 508 and other relevant federal agencies and rulings.
- The Center for Applied Special Technology (CAST) [39], founded in 1984, is a not-for-profit organization devoted to increasing educational opportunities for people with disabilities through the development and innovative uses of technology. CAST sponsors Bobby, the diagnostic program.
- The Trace Center [40] is a research organization at the University of Wisconsin-Madison. In addition to contributing to the W3C's "Web Content Accessibility Guidelines," the Trace Center has also created programs such as the Cooperative Electronic Library on Disability and technology such as the touchscreen accessibility feature called "EZ Access."
- The Web Access Project [41], founded in 1996 by the CPB/WGBH National Center for Accessible Media (NCAM), "researches, develops and tests methods of integrating access technologies (such as captioning and audio description) and new Web tools into a World Wide Web site, making it fully accessible to blind or deaf Internet users." The Web Access Project is a leading organization in researching ways to make multimedia accessible to people with disabilities.
- WebABLE! [42] is an organization promoting web accessibility through education and research. This site has an extensive accessibility-resource database (which can be searched by disability, by type of organization, and by

country) as well as workshop and conference listings and discussion boards.

- HTML Writer's Guild [43] sponsors AWARE (Accessible Web Authoring Resources and Education), a resource center for web developers interested in accessibility issues. AWARE offers online courses and links to resources about accessible design. In the Accessible Web Author's Toolkit, AWARE offers links to evaluation tools, correction and repair utilities, web-authoring software, and browsers. The Accessible Web Design Community links to organizations and online forums.
- Microsoft's Enable program [44] contains articles of interest to software developers about how to make products accessible. See, in particular, the Web Guidelines [45], which include guidelines, tools, a checklist, and examples of accessible sites.

CONCLUSION

There is no question that the World Wide Web is largely inaccessible to people with disabilities, and that it will remain so for some years. However, we are optimistic about the long-range prospects for web accessibility, not principally because we think web developers will suddenly conclude that making sites accessible is the right thing to do but because the pragmatic benefits of accessibility far outweigh the relatively modest costs. When developers begin to understand how smart it is to make their sites accessible—and how inexpensive it is to do—they will start to implement the suggestions of the W3C and other interested organizations.

The key to making the transition to accessibility, we think, lies not in the threat of legal compulsion, although there will continue to be lawsuits filed against owners of inaccessible sites. As we have seen, legal compulsion appears to be primarily a means of motivating site owners to sit down at the table with plaintiffs and work out solutions. The most promising route to full accessibility would appear to be collaboration among vendors, advocacy groups, and the government. Vendors such as Microsoft, Apple, Java, and IBM clearly see the wisdom of making their products accessible, and they are working with experts in the advocacy groups, such as W3C, the Trace Center, and WebABLE!, to create practical tools and techniques for achieving accessible sites. One example of this sort of cooperation is Microsoft's recent announcement that it will offer a series of courses to help federal IT managers and contractors who oversee federal accounts to work toward compliance with Section 508 of the Rehabilitation Act [46]. This sort of cooperation promises to create a win–win situation—not only for people with disabilities but also for all users of the web.

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