

# Accessible Websites: The People and Their Tools

“Making a website accessible to visually impaired people is good business. It expands your potential user base. It can be a competitive advantage. It's good PR. And it's the law.”

This paper paints a portrait of visually impaired computer users and the problems they face dealing with websites via various adaptive technologies. It describes the most common adaptive technologies and how they shape the user experience. It offers recommendations, a list of resources for further information, and a sidebar on colorblindness. Implicit in much of the discussion is the theme of keeping things simple. Rather than talk about visually impaired users only as abstractions, this paper also offers a fictional archetypal user to help make abstractions concrete.

## The Problem

The Web is a visual medium. Your eyes tell you what's on the page, how one thing relates to another, which items are more important than others, and where to click. So for visually impaired people, doing even simple tasks on the Web is usually laborious, confusing, and frustrating.

Using desktop applications is hard enough for visually impaired users. But at least they can develop some expertise with a desktop application by using it over and over. The Web is much harder because every website is different, and only recently have web developers started paying serious attention to making it possible or easy for visually impaired people to use their sites. As a result, it might take a blind user ten minutes to get some piece of information

or do some task online that might take a sighted user 45 seconds. It's not unusual for them to invest all of that effort only to get hopelessly lost and give up.

The World Wide Web Consortium (W3C) guidelines are widely accepted as the authoritative word on how to make websites more accessible. Their Web Accessibility Initiative (WAI) guidelines give us the what and the how. But implementing those guidelines effectively requires also knowing the who and the why. The purpose of this paper is not to repackage the WAI guidelines, but to add flesh to the WAI's bones.

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## Why Accessibility Matters

About 11 million people in North America and another 100 million people worldwide are seriously visually impaired. Of those in North America, about one in ten fits the legal definition of blindness. Those numbers are growing, especially as the population ages. Every seven minutes, someone in America becomes blind or visually impaired.

Making a website accessible to visually impaired people is good business. It expands your potential user base. It can be a competitive advantage. It's good PR. And it's the law. As AOL and other major players can attest, you could get sued under the Americans with Disabilities Act for having a non-accessible site.

There are certainly cases of irreconcilable conflict between what is optimum for sighted users and what is optimum for visually impaired users. In such cases, an alternate version of the problematic pages may be the best solution. But often, design that improves accessibility also improves usability. Moreover, making a site accessible is a major conceptual step toward converting it into a form that will work on mobile platforms.

## Overview of Adaptive Technologies

Visually impaired computer users rely on three main kinds of adaptive technologies. Each technology presents information in a radically different format. In order of popularity, they are:

- Screen magnification programs (which magnify everything on the screen)
- Screen reader software (which uses synthetic voice output to read pages aloud)
- Braille display hardware (which convert text into raised dots)

These technologies are not mutually exclusive. For example, a screen magnification program may have a speech feature, and Braille displays get their input from screen readers.

Of the 1.3 million Americans and 38 million worldwide who meet the legal definition of blindness, rather few are entirely without sight. Most have some degree of residual sight. Which technologies a given individual uses depends on his/her degree of residual sight, cost, availability, and personal preference. Many users go back and forth between their screen magnification program and screen reader as quickly as a dancer does between jumping and spinning. When both programs are running at the same time (on top of the browser and the OS), the computer tends to crash infuriatingly often.

All of the technologies discussed here apply to whatever program the user is in: websites, word processing, spreadsheets, you name it. There are a number of speaking Internet browsers on the market, including IBM's Home Page Reader and PW Webspeak. But users tend to prefer a single product that serves all of their computer needs over a specialized product that applies only to the Web. After all, why buy and learn two products when you can do it all with one? Web developers may find speaking browsers to be an acceptable low-cost testing tool to get a rough sense of how a page sounds, since they are cheaper than screen readers.

Some blind people still use the Lynx text-based browser because it is accessible, even though Lynx and DOS are no longer well supported by vendors. The great majority use Windows.

## Screen Magnification Programs

Because most visually impaired people have some degree of residual vision, screen magnification programs are the most commonly used adaptive technology. These are quite different from a browser's ability to enlarge font sizes. Screen magnification programs enlarge everything on the screen: fonts, icons, scroll boxes, everything.

Browsers can make type bigger, but everything else stays the same size, whereas...



Waterford "Celebration" Love Toasting Flutes  
\$ 119.00



Waterford "Celebration" Love Toasting Flutes  
\$ 119.00

...magnification programs enlarge everything.

Normal



2X



4X



8X



16X

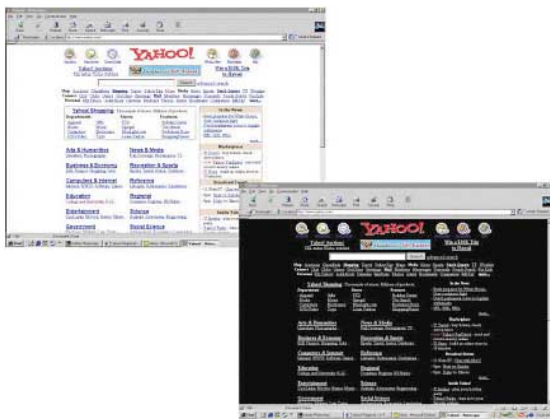


As a result, users are seeing only a small fraction of a page at a time. This fraction may not include browser navigation controls. If related information is spaced far apart, the user may have trouble associating them. For example, the content of one table cell rarely means much except in relation to the content of other cells. If table cells stretch needlessly to fill the browser window, the content of those cells (say, a date and a number that applies to that date) may move too far apart for screen magnification users to associate them. Superfluous width is an inconvenience for any user, but is a serious problem for screen magnification users, since they may have to scroll horizontally through half a dozen screenfuls to see data that is 300 pixels apart.

Date	Client	Amount	YTD
10/06/01	Newman	3,581.86	17,951.36
10/07/01	Paridouni's	6,892.57	32,465.24
10/08/01	Vogel, Ltd.	1,338.12	8,764.22
10/09/01	Danbury's	5,197.82	24,644.48

screenfuls of 4x magnification

Many users of screen magnification programs lean in to bring their eyes to within a few inches of the monitor. This helps them make out what is on the screen, but it also raises a problem: glare. While a computer screen may be fine to look at all day long from two feet away, it is too bright to look at for long from three inches away. Screen magnification users may therefore set the software to reduce overall brightness or darken bright colors. Some may reduce contrast to minimize glare, while others increase contrast to compensate for blurry vision. Many even reverse the screen: from black type against a white background to white type against a black background.



Since light colors may either disappear or all look alike, screen magnification users may set the software to enhance colors and increase contrast. This can affect meanings in color-coded graphics. A person who needs less glare may set the software to darken bright colors, which may mean completely remapping the color spectrum from an emphasis on greens to an emphasis on reds.

Screen magnification software gravitates to the pointer or anything that is blinking, moving, or highlighted. This is helpful as long as that item is substantive and serves the user's interest. But if blinking or motion is used gratuitously, it becomes a maddening distraction from the content the user wants to attend to.

Screen magnification software products include ZoomText, Supernova, Lunar, MAGic for Windows, and inLARGE for Macintosh.

## Practical implications

- Because screen magnification users are seeing a big rendition of a small portion of a page, it is important to keep related items close together spatially so screen magnification users can associate them.
- Anticipate how your page will look with white text against a black background.
- Anticipate how your graphics will look with colors enhanced.
- Never rely on color alone to convey important information.
- Avoid having anything blink or move except to call attention to critical substantive information that the user needs to attend to. Blinking and motion should never be used gratuitously or for promotional purposes and should never loop indefinitely.

## Screen Readers

A screen reader is a program that has a synthetic voice read the contents and controls of a page aloud. When dealing with a Web page, it also reads Alt tags and long descriptions aloud.

In other words, it transforms a page from its intended visual and spatial form into aural form. That's a radical transformation, and a lot gets lost in the process.

As a result, experiencing a website via a screen reader requires intense concentration and a strong memory. It's like trying to follow a chess match broadcast on radio. The more complicated the site and page, the more potential for confusion and frustration.

For example, whereas the eye is very good at ignoring irrelevancies to home in on what's important, a screen reader has no such ability. A screen reader dutifully slogs through whatever is there—the useful, the distracting, the irrelevant, the opaque. It starts at the top left and works its way down, so it may subject the user to a barrage of ads and junk before getting to the page's valuable content, search box, or other helpful elements. Dynamically changing content, such as changing banner ads or stock prices, may make a screen reader re-start an entire page.



All of this makes for pretty slow going. A screen reader might take several minutes slogging through a page that a sighted user might dispense with in twenty seconds. So many users of screen readers have developed an equivalent of

skimming: Whereas a normal conversational pace is about 100 words per minute, users of screen readers commonly crank up the voice's speed to 300 words per minute or faster. This is like listening to a chess match broadcast by an auctioneer.

A screen reader often fails to make connections that the eye readily makes. For example, it may not know that a label or an instruction goes with a certain widget. In the example at right, spacing between words and widgets might confuse the screen reader about *which* widget "Username" goes with.

If, say, three buttons are offered, a screen reader will announce all three buttons but not which one is focussed as the default. It will read each item in a listbox, but may not read the listbox label on which the wording of those items depends for its meaning. It may not know that a text entry box is supposed to be a search box if the "Search" button follows the box.

Often the screen reader is unable to decipher the type of control, listbox, button, or text entry field at all. It then just announces "graphic" or "image" instead.

Screen readers work much better with Internet Explorer than with Netscape, particularly if a page has tables or frames.

The two most popular screen readers are JAWS for Windows (JFW) and WindowEyes. Both operate more or less the same way in IE. Though their key-combination commands differ, the same basic procedures apply. Other products include Hal, WindowBridge, and outSPOKEN.

## Graphics

A screen reader cannot, of course, read graphics. It can only announce that a graphic is present and read whatever Alt text and long description are associated with it. If the graphic conveys important content or serves as a navigation element, the screen reader—and thus the user—doesn't know that unless that information is also given in the Alt tag or long description.

## Tables

Tables are often a problem for visually impaired users, because screen readers may have trouble reading them. In fact, older screen readers may not be able to read them at all.

Screen readers default to reading left to right, so they may mangle content that wraps in cells. For example, these column heads might be read aloud as

Outstanding Balance	Available Credit
------------------------	---------------------

"outstanding available balance credit." Users must issue a special command to tell the screen reader to read the content of a cell as a coherent unit ("current balance available credit").

But issuing that command requires that they know they are in a table, and often they don't.

While users of screen readers are in the midst of a table, they may forget what the column and row headers were. They can have the screen reader remind them, but only if the column and row headers are identified as such in the code.

## Frames

Users of newer screen readers have no more or fewer problems with frames than other users. Older screen readers, however, can't tell which frame to deal with. Text-based browsers like Lynx may be unable to handle them at all. The regular usability criteria for whether or not to use frames apply also to accessibility.

## Listboxes

Listboxes, or pull-down menus, are fine widgets to use, but their contents can be confusing. Often, the items on the list draw half their meaning from the listbox's label, but users of adaptive technologies may not see or hear the label and list items together.

See also the discussion later about non-mouse input.

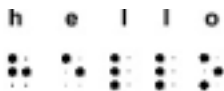
## Practical implications

- Design for JAWS and WindowEyes optimized for IE.
- Treat Alt text as an integral part of your content since, for screen readers, it is.
- Avoid tables if alternatives are available. If you must use tables, use them only to deploy tabular content; try to avoid using them to arrange art or page elements.
- In tables, avoid wrapping whenever possible, and keep cell content short to eliminate the need for wrapping. In Alt text, identify a table as such, identify column headers and row headers as such, and tell the user how many columns there are.

- Put the descriptive label “Search for” before a text entry box, not just after (or clearly identify it in the code).
- Word each link to be self-explanatory when read out of context. If doing so would create unacceptable problems in the page, consider putting the necessary wording in the code, so it appears only when read aloud by a screen reader. You can also minimize the amount of underlined blue text by coding part of a link to appear on screen as though it were normal type.
- Word each item in a listbox to be self-explanatory. If you use JavaScript dropdowns, be sure each item at each level has Alt text.
- Keep each widget’s label or instruction very close to it. Avoid having multiple widgets so close to one another that it becomes unclear which label or instruction goes with which widget.
- Spotlight the data, with as little superfluous material as possible.
- Avoid spawned windows except in response to user action, since dealing with multiple windows tends to disorient users of both screen readers and of magnification programs.
- If you must use frames, provide a non-frame version accessible via links at the top and bottom of each page that displays in the main frame.

## Braille Displays

A minority of legally blind people are proficient in Braille. But for them, Braille may be their only means of reading. It is certainly their most accurate means.



While conventional writing uses characters based on combinations of straight and curved lines, Braille characters are based on combinations of raised dots. The dots are arranged on a grid of six called a cell.

Traditionally, Braille has always consisted of bumps on paper. For computer users, reading Braille requires a hardware peripheral featuring a row of metal pins that raise and lower. The peripheral converts screen text into Braille by raising certain pins. Some Braille displays offer as few as 18 characters at a time (about 3-4 words); others offer as many as 80.

Skilled users are most accurate and productive when using a combination of Braille and speech output. For speed and a general sense of content, a screen reader is best; for accuracy and serious study such as when dealing with numbers, Braille is best. All electronic Braille displays require a screen reader for navigation.

## Practical implications

Since Braille displays offer only 18-80 cells at a time—adding up to a handful of words—the more concise your text, the better. Sighted users will of course appreciate conciseness too.



## Non-mouse Input

Many visually impaired users—and some sighted users, for that matter—get around via keyboard commands rather than a mouse. If a listbox (pull-down menu) is not coded to accommodate non-mouse input, it may produce unintended results. As the user goes through the list in a listbox, each item in turn may actually get selected. If the selection launches a new page or prompts a redraw of the current one, users may get sent somewhere they may not want to go. They may give up the task before ever reaching the option they really wanted.

## Practical implications

- Anticipate non-mouse input methods. For example, code for “on select” instead of “on click,” and “on focus” instead of “on mouseover.”
- Listboxes whose selections result in new or redrawn pages should be accompanied by an appropriately worded button that executes the selection. A button is not necessary, however, if you can write the code to prevent automatic selection or if the listbox items do *not* result in new or redrawn pages.
- The listbox and its button must be right next to one another so that users know that the two items are associated when they tab to the next control after selecting the item.
- The wording of the button should clearly express what will happen when the user selects it. The text preceding the selection box and button should clearly state what the user is selecting and when the action button should be pressed. Use a ToolTip or link title to further specify what will happen.

## Links

Because using the Web is such hard work, visually impaired users have developed various efficiencies. One is to skip the content of a Web page entirely and experience the page solely as a set of links. They may do this by simply tabbing from link to link until they encounter one they want to select. Or they may order their screen magnification software or screen reader to reduce the page to a mere listing of its links. So their sole experience of a sophisticated, ingeniously architected, perfectly coded page may consist of “Link: Click here. Link: See details. Link: Order Now.” For example:



## Practical implications

- All link wording should be self-explanatory so it will make sense out of context. This may sometimes result in an excess of underlined blue type. In such cases, one option is to code all of the words to *function* as a link while having only a subset of the wording *appear* in underlined blue type. The rest of the link wording would appear in normal black type, even though it is hot. There are two disadvantages to this approach: It will not work with old screen readers, which define links as underlined blue type; and it may not work for people who tab through links.
- No two links on the same page should have the same wording. Each must be uniquely worded so it can stand alone when heard out of context.

## Alternate Pages

The discussion so far applies to pages that serve double duty, serving the needs of both sighted and visually impaired users. Not all pages can serve both constituencies equally well. If you are simply unable to make your pages accessible, W3C’s WAI guidelines do allow for alternate, text-only versions of pages.

This approach is generally frowned upon, though, for a couple of reasons. First, alternate pages tend to be poorly maintained, rendering them obsolete. This is a major reason for the second problem: Visually impaired people tend to resent alternate pages as “the blind ghetto.” An integrated approach is generally preferred over a “separate but equal” approach.

## Practical implications

- Alternate pages are OK only as long as you make (and keep) a commitment to keep them just as current and helpful as the regular pages.
- If you have alternate pages, offer a “Text version” link in the upper right of each regular page so users encounter it as soon as the page loads and announces its purpose. If possible, code the site such that, if the user asks for the text version of two pages in a row, the system automatically delivers all subsequent pages in text version until the user selects the regular version (via a “Full version” link in the upper right corner of each text page) twice in a row.

## Color Blindness







About one man in twelve is colorblind. About one woman in two hundred is. Being colorblind rarely means seeing no color at all: It usually just means that you see certain colors either as dimmed or as shades of gray. Light shades of color that most people see just fine may vanish.

There are many different flavors of colorblindness. Some people are “red-weak,” some are “green-weak.” Others can’t tell the difference between red, orange, green, and yellow; or those colors may appear so dim as to disappear. But the most common type of colorblindness is red/green: The individual is unable to tell red and green apart. Both look gray.

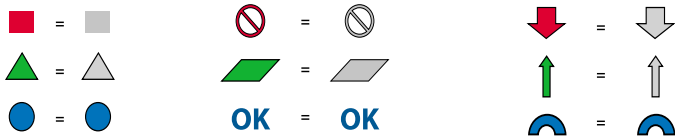
Most colors are mixtures of other colors. Violet, for example, has some red and some blue. Someone whose vision is red-weak will perceive the blue component but not the red, so violet may look indistinguishable from a shade of blue.

## Practical implications

Never rely on color alone to convey important information. For example, if you use red squares, green squares, and blue squares to represent three states (such as up, down, and unchanged), you will prevent many users from telling the states apart.

Intended		Perceived	
	=		The solution is to use multiple dimensions of difference: not only color, but also shape, size, texture, position, outline, and so on. That way, if the user does not perceive the color difference, he/she will get the information from one of the other clues. For example, a colorblind person might not be able to tell the red and green apart in a traffic light, but can tell that the <i>top</i> light is glowing and knows that the top one means <i>stop</i> . Here are some
	=		
	=		

alternatives to the three colored squares, as intended and as perceived:



Make sure your color palette varies not just in hue but also in intensity (darkness/lightness). This will help also when users print a page on a black-and-white printer.

## Conclusion

Adaptive technologies transform the experience of a website dramatically. An accessible website survives that transformation gracefully.

The single most useful all-purpose guideline for making Web pages accessible is: *Keep it simple*. Magazine-like complexity may well make for aesthetically pleasing pages, but the more complex a page, the worse it survives the transformation. Simpler pages also reduce the amount of work a visually impaired user must do, which is good usability.

## Persona: Barbara Finch



This fictional character helps make abstractions about visually impaired users concrete.

Barbara was already a successful kitchen and bath designer in San Diego when she began losing her sight to multiple sclerosis five years ago. Now 38, she still has enough residual sight to avoid bumping into chairs when she crosses a room, but she could never find her keys if she didn't always keep them in the same spot.

As her vision has deteriorated, Barbara has had to hire an assistant to handle many vision-intensive tasks, but she proudly remains the brain of her consulting business. She assesses her clients' needs and advises them about products and materials and the like. She plans her room layouts carefully in her mind, then sketches them with fat felt pen strokes on huge sheets of butcher paper tacked on her wall. Her assistant then copies her sketches into working CAD drawings.

Using a computer is laborious, awkward, and frustrating for Barbara. She can make out what is on her computer screen if she uses her ZoomText program to enlarge the image to 6X or 8X magnification and leans in to within a few inches of the monitor—so close that her

breathing often fogs the screen. That program helps, but reading only a few words at a time is tedious. So she often finds it more efficient to listen to material read by the synthetic voice of her screen reader program, JAWS for Windows.

The one thing most likely to make Barbara swear is a confusing Web site. As a professional who charges for her time, she deeply resents having to spend ten times as long as a sighted person to get any given piece of information. So she sets her screen reader's voice faster and faster and faster to whip through pages. Sometimes she skips the content entirely and just tabs from link to link or brings up a list of the page's links in hopes of finding something worthwhile. She complains bitterly about information arrayed in tables, since it sometimes comes out garbled ("date transaction description amount available balance"; "seven one three dollar six nine two point four four dollar one eight five one point seven three"). If a site has graphics with no meaningful ALT text, she just hears "Graphic. Graphic. Graphic." If a site has links on words like "click here," she gets a list or verbal recitation of "Click here. Click here. Click here." When she uses ZoomText, she complains about Web developers who scatter related items around the screen, so she can never see them together.

### Barbara's Goals

- Grasp a website's content aurally
- Easily associate related pieces of information
- Get through her online tasks in minimum time with minimum aggravation

## Resources

### World Wide Web Consortium’s accessibility guidelines

[www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/](http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/)  
[www.w3.org/WAI/](http://www.w3.org/WAI/)

### Collections of links to accessibility resources

[www.vibug.org/access.html](http://www.vibug.org/access.html)  
<http://home.pacbell.net/paulh52/resource.htm#disability>  
[www.abledata.com/index.htm](http://www.abledata.com/index.htm)  
<http://home.pacbell.net/paulh52/>  
[www.hicom.net/~oedipus/blind.html](http://www.hicom.net/~oedipus/blind.html)  
[www.navh.org/links.html](http://www.navh.org/links.html)  
[www.afb.org/i\\_res.html](http://www.afb.org/i_res.html)

### Making applications accessible

[www.afb.org/technology/accessapp.html](http://www.afb.org/technology/accessapp.html)

### Screen readers

[www.afb.org/technology/fs\\_speech.html](http://www.afb.org/technology/fs_speech.html)

### Screen magnification programs:

[www.afb.org/technology/fs\\_mag.html](http://www.afb.org/technology/fs_mag.html)

### Colorblindness

[www.designmatrix.com/pl/cyberpl/cftcb.html](http://www.designmatrix.com/pl/cyberpl/cftcb.html)  
<http://members.aol.com/nocolorvsn/color.htm>

### World Health Organization data on visual impairment

[www.who.int/pbd/pbl/data.htm](http://www.who.int/pbd/pbl/data.htm)

### American Council of the Blind

[www.acb.org/](http://www.acb.org/)

### American Foundation for the Blind

[www.afb.org/](http://www.afb.org/)

### National Center for Accessible Media

<http://main.wgbh.org/wgbh/pages/ncam/>

### Royal National Institute for the Blind (UK)

[www.rnib.org.uk/](http://www.rnib.org.uk/)

### US agencies for the blind

<http://info.rnib.org.uk/exe/Agencies/browse2.pl?United+States+of+America>

### AccessAbility (SF vendor of adaptive technology for visually impaired people)

[www.4access.com/](http://www.4access.com/)

### Visually impaired computer users groups

[www.upshawinst.org/cug.htm](http://www.upshawinst.org/cug.htm)

## Contact eFORCE

800.295.1914  
 510.265.5800  
[sales@eforceglobal.com](mailto:sales@eforceglobal.com)

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<b>American Express</b>	<b>Charles Schwab</b>	<b>France Telecom</b>	<b>Hoover’s</b>	<b>Lucent Technologies</b>	<b>Reuters</b>
<b>Avaya</b>	<b>Compaq</b>	<b>GE Capital</b>	<b>Intel</b>	<b>MasterCard</b>	<b>Visa USA</b>
<b>Bank of America</b>	<b>Credit Suisse</b>	<b>GTE Genuity</b>	<b>Janus</b>	<b>Mitsubishi</b>	
<b>British Telecom</b>	<b>FedEx</b>	<b>H&amp;R Block</b>	<b>Johnson Controls</b>	<b>Nortel Networks</b>	