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A Review of Assistive Technologies

Can users access dynamically updating information?

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This report sets the scene for the SASWAT project, which aims to improve accessibility of dynamically updating Web content for visually impaired browsers, with an examination of the current state of accessibility. First it examines which technologies (Web browsers and screen readers) are used by this group: Internet Explorer and JAWS are clear favourites. Second it describes the results of an experiment, and supporting anecdotal evidence, which suggests that, at best, most users can currently reach updated content, but they must do so manually, and are rarely given any indication that any update has occurred.

HCW

Human Centred Web

SASWAT

The aim of the SASWAT project is to develop a framework for mapping the competing dynamic micro content produced by Web 2.0 technologies to audio. The SASWAT web pages may be found at <http://hcw.cs.manchester.ac.uk/research/saswat/>.

SASWAT Reports

This report is in the series of HCW SASWAT technical reports. Other reports in this series may be found in our data repository, at <http://hcw-eprints.cs.man.ac.uk/view/subjects/saswat.html>. Reports from other Human Centred Web projects are also available at <http://hcw-eprints.cs.manchester.ac.uk/>.

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1 Introduction

When personal computers first became popular, using them non-visually was not difficult: interaction was through text, using DOS or Unix command line programs, so assistive technologies merely needed to render this text into sound or braille. As HCI has advanced, however, assistive technologies have been playing a continuous game of catch-up, attempting to render increasingly graphical and non-linear information in a non-visual medium. This report looks at the current state of play in one aspect of this: Web interaction.

Recently, ‘Web 2.0’ developments have been making Web browsing an increasingly interactive experience, particularly with technologies such as AJAX (asynchronous JavaScript and XML) enabling parts of a page to update dynamically, i.e., without a full page reload. Examples can be seen on pages such as the Yahoo!¹, and iGoogle² Web portals. This report seeks to discover how accessible this type of content is. The basic question is: can the information be accessed at all, and if so, how does the user experience differ from that of a sighted user? In order to answer this, we must first understand what technologies visually impaired users are using to access the web, then we must discover how people can interact with dynamic Web pages using these technologies.

This report is divided broadly into two sections: the first gives the results of an investigation into what technologies are used by visually impaired users in the United Kingdom; the second provides some experimental, and some anecdotal, evidence about the capabilities of these technologies when used by experienced users. These two sections are followed by a brief discussion.

2 Choices of Assistive Technologies

This section examines the use of Web browsers and assistive technologies within the visually impaired community, in particular which products are used by them.

2.1 British Computer Association of the Blind Mailing List

The British Computer Association of the Blind (BCAB)³ is a UK based “organisation of visually impaired people who use Information and Communications Technology”. According to their website, its members “range from experienced computer professionals to people who are beginning to explore the use of Information and Communications Technology for leisure, study or employment”. The BCAB has a mailing list “to provide a lively and informative forum for discussing Information Communication Technologies (ICT) for visually impaired people”, which is reasonably active, with a mean of 427 posts per month for the year to the end of April 2008. The mailing list archives from June 2006 are publicly available⁴.

¹<http://www.yahoo.com>

²<http://www.google.com/ig>

³<http://www.bcab.org.uk/>

⁴<http://www.freelists.org/archives/bcab/>

In order to assess the technologies actually used by blind and partially sighted computer users, a message was posted to the mailing list asking members if they could let us know which assistive technologies and which web browsers they used. Unfortunately no replies were forthcoming, so the information was obtained through an analysis of the archives. Since many of the messages on the list are of the type: ‘I’m using screen reader Y on operating system Z, and I’m having difficulty doing X — can anyone help?’, this proved a worthwhile technique. It might be argued that the users of the BCAB mailing list may not be representative of visually impaired users more generally, and particularly that they might be more experienced computer users than average. We believe, however, that for the purposes of SASWAT, these users represent precisely the type of people who are likely to be wanting and needing to interact with Web 2.0 technologies.

Analysis of the mailing list was performed by creating a local copy of the entire archive of 10,241 messages; this allowed more rapid searching to be performed. The first stage of analysis was to identify all unique users of the mailing list. Although this could not be done with complete certainty (since some users might have posted under different user names), there appeared to be some 257 individuals who had posted to the mailing list since June 2006. Searches were then performed on the messages sent by each of these individuals, to determine the type of screen reader and web browser they were using. Below is an introduction to the range of screen readers available; this is followed by the results of this analysis.

2.2 Assistive Technologies

There are a variety of assistive technologies available, from relatively simple screen magnification tools, to screen readers and braille output devices; this report concentrates on screen readers. A list of screen readers is given in the Wikipedia⁵, and is likely to cover all popular options (indeed, our investigations have not revealed any other general-purpose screen readers). Table 1 lists those considered to be significant, i.e., current, English language screen readers capable of working with a Web browser. In addition to general-purpose screen readers, some more limited systems are available that allow Web browsing; some of these are presented in Table 2.

As Tables 1 and 2 show, there are a large number of options for visually impaired users to choose from. Analysis of the BCAB mailing list archives revealed which screen readers were used by 130 of the 257 users. These are given below. It should be noted, however, that these figures are gathered from statements made over the last 2 years, and thus may not represent exactly what is being used now. Also, it was clear that many members had experience of more than one screen reader, indeed some used more than one on a regular basis, and it is not necessarily the case that all the screen readers being used were mentioned. Furthermore, there is a possibility that the clear popularity of JAWS among members of the BCAB list might deter people from asking about other screen readers, thereby amplifying the popularity of JAWS. Nevertheless, the results are consistent with our expectations, based on our experience with organisations helping visually impaired users learn IT skills (Henshaws and Access Summit).

⁵http://en.wikipedia.org/wiki/List_of_screen_readers

Software	Developers	Platform	Notes
Blindows	Audiodata	Windows	
Edbrowse	Karl Dahlke	*nix console	
Emacspeak	T.V. Raman	Emacs on Unix	Free, open source
HAL	Dolphin Computer Access	Windows	HAL with screen magnification and Braille output.
Supernova	Dolphin Computer Access	Windows	
HT Reader	HT Visual	Windows	
JAWS	Freedom Scientific	Windows and DOS	
Linux Screen Reader	GNOME	Linux (GNOME)	
Microsoft Narrator	Microsoft	Windows	Bundled with recent versions of Windows
NVDA	NVDA project	Windows	Free, open source
Orca	GNOME	*nix	
PCVoz	EzHermatic	Windows	
Proloquo	AssistiveWare	Mac OS X	
Simply Talker	EcoNet International	Windows	
SUSE-Blinux	Novell	Linux	
System Access	Serotek	Windows	Free, open source
Thunder	Sensory Software	Windows	An online version, SA To Go, is available.
Virgo	BAUM Retec AG	Windows	Free. Preceded by LookOUT
VoiceOver	Apple	Mac OS X	Bundled with Mac OS X
Window-Eyes	GW Micro	Windows	
ZoomText	Ai Squared	Windows	Includes a screen magnifier

Table 1: A selected list of screen readers from the Wikipedia.

Software	Developers	Platform	Notes
Connect Outloud	Freedom Scientific	Windows	Self-voicing system, including support for Internet Explorer
Fire Vox	Mozilla	Cross-platform	Firefox extension
Guide	Software Express	Windows	Not a full screen reader, but a self-voicing set of applications, including web access
WebAnywhere	University of Washington, Seattle	Cross-platform	Free, open source, self-voicing Web browser

Table 2: Other systems for non-visual Web access.

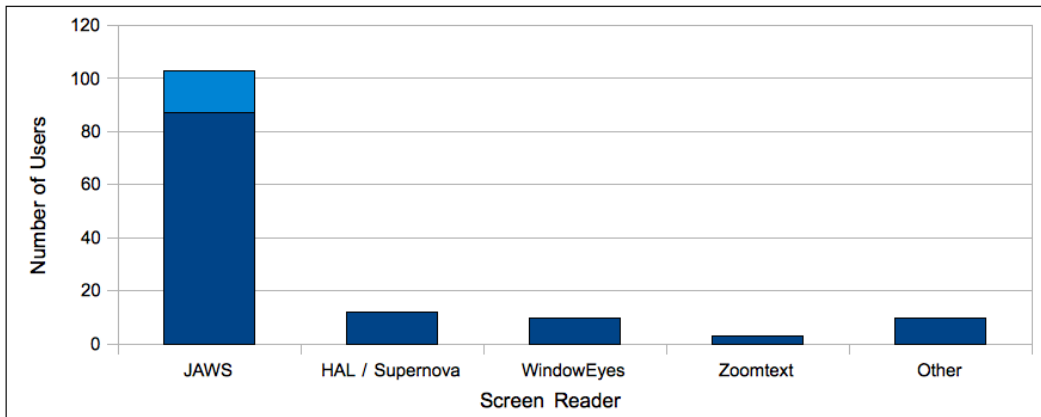


Figure 1: The popularity of different screen readers among posters on the BCAB mailing list. The bar for JAWS is split into those who certainly used JAWS (lower portion, 87 users), and those for whom it was reasonable to infer that they either used or had experience with JAWS (upper portion, 16 users). HAL and Supernova are grouped, since these differ only by the presence of a screen magnification tool.

Of the 130 users for whom information was available, some 87 used JAWS for Windows. An additional 16 users posted messages on the list suggesting that they either used JAWS, or had experience with it; this total suggests that 79% of members were JAWS users. 10 used HAL, and a further 3 Supernova, while 9 used Window Eyes. 13 people used other screen readers, including Zoomtext, Thunder, NVDA, Guide, Voiceover, and Orca. These last two, for Mac OS and Linux respectively, are notable exceptions to the predominance of the Windows operating system. It should be emphasised again that these numbers are not exclusive: several members of the list used more than one screen reader. These data are summarised in Figure 1.

There were also discussions about System Access, in particular SA To Go, a web service that provides screen reader access to various applications, including

web browsing. In particular it claims to make ‘Web 2.0 accessible to the blind and visually impaired’⁶. About 6 or 7 users appeared to use, or have used, this product. In a similar vein, there was interest in (although little to no evidence for use of) the WebAnywhere accessible browser from the University of Washington [1].

2.3 Browsers

For the general population, the market share of browsers, as measured by Net Applications⁷, is given in Table 3.

Browser	Market share
Internet Explorer	73.75%
Firefox	18.41%
Safari	6.25%
Opera	0.71%
Netscape	0.562%
Mozilla	0.08%
Other	0.16%

Table 3: Market share of Web browsers for May 2008.

Analysis of the BCAB mailing list archives indicates that the situation is not radically different for blind users. Although information on browsers could only be obtained for 27 users of the mailing list, some 24 of these used Internet Explorer (IE), 6 used Firefox, and 1 used Lynx. Note that 4 users claimed to use both Internet Explorer and Firefox; this mirrors the situation with screen readers, where multiple tools were used. The reasons can only be speculated upon, but may include one browser not being available on all computers used, or preference for one browser over another when using a certain site. If the the assumption is made that those using both browsers spend equal time on each, these figures give approximately 77% to Internet Explorer and 19% to Firefox; these are of the same order as for the figures for all users. The data are summarised in Figure 2.

The messages on the mailing list suggested, however, little use of other browsers. For example, no users claim to use Opera on a regular basis. This might be because these users are reluctant to try less common alternatives, or because it is not particularly accessible. One member said⁸:

“My brief experience of Opera suggests that it’s pretty well useless with screen readers - OK, it has its own built-in accessibility features, but they don’t meet up with everything else I use. I’ve tried NVDA, Thunder and the Jaws 8 demo with Opera, and promptly uninstalled Opera!”

Similarly, there is little mention of the Apple browser, Safari, although this perhaps reflects the apparently overwhelming predominance of Windows as the op-

⁶<http://www.serotek.com/cas.html>

⁷From <http://marketshare.hitslink.com/report.aspx?qprid=0>, May 2008

⁸<http://www.freelists.org/archives/bcab/03-2007/msg00345.html>, March 2007.

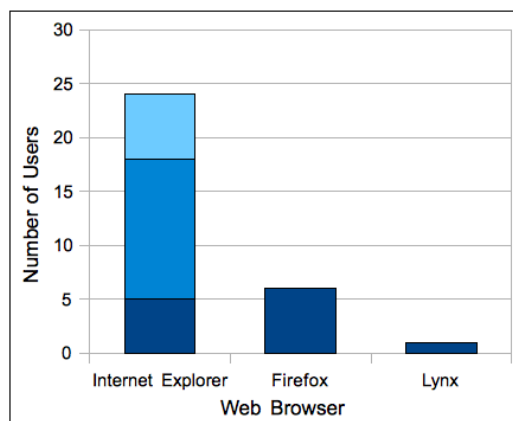


Figure 2: The popularity of different browsers among posters on the BCAB mailing list. The bar for Internet Explorer is split into three: the upper portion shows users of version 7, the middle portion version 6, while the lower portion shows those for whom the version could not be determined.

erating system of choice. The same member as above said of Safari (beta version, on Windows, June 2007)⁹:

“Having a first go with it last night, the main menus will spark off a screen reader, but you start getting into problems if you try to read other things, such as your bookmarks or the list of plug-ins.

Visually it’s horrible, with a log of tiny fonts on grey backgrounds. You can zoom the actual window, though the key-strokes Ctrl and plus and Ctrl and minus don’t seem to work. The mouse wheel does to some extent. Firefox is far ahead of this in accessibility terms.”

While these quotes only reflect the opinion of a single user (and the extent to which the capabilities of the browsers were tested is unknown), the lack of other comments suggests that, even if they are accessible, these browsers are not widely used by visually impaired users.

2.4 Specialist systems

While the majority appear to browse the Web using a standard browser in conjunction with a screen reader, this is not necessarily the case for all. Some specialist programs are available, including WebbIE, Guide, IBM Home Page Reader, and Fire Vox.

WebbIE is “a web browser for blind and visually-impaired people, especially those using screen readers”¹⁰. It also enables other Web activities such as listening to Internet radio, downloading podcasts and reading RSS feeds. WebbIE is an Internet Explorer-based browser which is stand-alone, but is required for web browsing with

⁹<http://www.freelists.org/archives/bcab/06-2007/msg00181.html>, June 2007.

¹⁰<http://www.webbie.org.uk/>

the Thunder screen reader (and comes installed with it). For this reason, and taking into account the results of the survey of screen readers, we can conclude that it is used by at least 2 or 3 members of the BCAB mailing list.

Guide¹¹ is essentially a self-voicing set of applications, including email, document editing and Web access. It is also possible to change the visual characteristics of the display, e.g., to increase contrast or size. As noted above, this was used by very few — evidence could only be found for one person using this software.

IBM Home Page Reader was software from IBM that ‘reads Web pages, the Windows desktop, and selected other applications’. Apparently it is no longer supported. The only comments on this in the mailing lists were with respect to its ability to read PDF files.

Fire Vox¹² is an extension to the Firefox Web browser. It gives screen reader-like access to this browser, and is developed for Web 2.0, supporting ARIA (Accessible Rich Internet Applications [2]) markup. It did not, however, appear to be used by members of the BCAB list, and, although there were discussions about it, these were relatively negative (e.g., ‘what’s the point?’¹³).

3 Current Technologies and Dynamic Updates

This section looks at what users experience when they use their chosen browser and screen reader to view Web pages with dynamically updating content. A set of test pages were created that updated in different ways. Participants were asked to view these pages and report what they found. In support of this, some anecdotal evidence is also given, in the form of quotes from mailing list discussions about people’s experiences with dynamic Web sites.

3.1 Method

Ten Web pages were written in HTML (HTML 4.0 Transitional). Eight of these contained dynamically updating content (using JavaScript, XMLHttpRequest, and, in some cases, PHP), one gave an introduction to the experiment, and a final page indicated the end of the experiment. The pages were kept as simple as possible, generally comprising a heading, a few paragraphs of text, and a link to the next test page. The first four test pages also had a link that initiated the update. The final page asked for comments on, and gave links to, external sites with dynamic content, and gave email addresses for participants to send their experiences to. Note that the content removal and rearrangement pages (pages 3,4,7 and 8) did not use XMLHttpRequest — these pages used plain JavaScript to modify the DOM.

Each of the eight test pages updated according to one class in the taxonomy of updates. That is four pages updated automatically, while the other four updated as a result of the user following a link. Each set of four pages had one page where content was added, one where content was removed, one where it was replaced,

¹¹http://www.softwareexpress.co.uk/read_more_about_guide.asp?P=GBP

¹²<http://www.firevox.clcworld.net/about.html>

¹³For example, see the thread ‘Firefox accessibility’ at <http://www.freelists.org/archives/bcab/04-2007/threads.html#00036>

and one where it was rearranged. The pages used in the experiment can be viewed online¹⁴.

Participants were asked to give feedback about what happened when viewing the pages, and encouraged to give as much detail as possible. The instructions also gave some indication as to what the users should expect, and the type of information desired from them:

“The first four pages update when a link is followed. In this case, please read the page to the end so you are familiar with its content, then go back to follow the link (these pages contain only two links, one to initiate the update, the other to move to the next page in the test). Note what happens directly after the link is clicked: for example, the page is read from the beginning and new text is found; new text is read straight away; nothing happens. If nothing happens, are you able to detect any changes to the page?

The second four pages should update automatically within 10 seconds of loading (and possibly again after that) - please read the page and note what happens. Does anything appear to change after approximately 10 seconds?”

Since this experiment was purely investigatory, there were no hypotheses to be tested.

Participants were recruited by posting a request for volunteers on the BCAB mailing list, the dolphinusers Yahoo! group, and through the Mozilla accessibility developers group. 13 participants responded, having tested 16 systems.

3.2 Pages

This section briefly describes the content of the pages, and the changes that happened on them. In order to make the pages interesting and, to a certain extent, realistic, content was taken from the Wikipedia, with pages selected using the random page generator.

Page 1: London College of Music This page described the London College of Music. On clicking a link, the section below the link (which described the creation of the College) was replaced with a paragraph about its former principals.

Page 2: The Oval Office This page described the Oval Office of the White House. Between a description of the layout of the room and a section about its history, was a link; when followed this inserted (between the link and the history section) a section giving the dimensions of the room.

Page 3: Bristol Type 138 High Altitude Monoplane After the title and an introductory paragraph was a section entitled ‘Specifications’. Below this was a link — following this link removed the section on specifications, leaving a section about the history and development of the plane.

¹⁴<http://hwc.cs.manchester.ac.uk/research/saswat/experiments/atreview.html>

Page 4: List of state leaders in the British Isles, 629AD This gave a bullet list of state leaders. A link allowed the list to be rearranged: this simply moved the person at the top of the list to the bottom.

Page 5: Weather Report This page gave the temperature, wind speed and sky conditions in Lilliput. Every 5 seconds the temperature and wind speed were updated with a randomly generated number (the random number generation was done by the server, and was called by JavaScript XMLHttpRequest).

Page 6: Live Cricket Coverage: England vs. Australia This automatically appended paragraphs of commentary about a cricket match. The first paragraph was added after 5 seconds, subsequently every 12 seconds, inserted near the bottom of the page, between the most recent commentary and a footer sentence.

Page 7: History of Jamaica This gave some history of Jamaica. At the top of the page, between the title and the text, was a warning that the page was believed to contain errors. This warning disappeared after 8 seconds.

Page 8: Most popular news stories This displayed a list of news stories. Every 5 seconds, two items in the list changed places, to represent a dynamic list of the most popular news stories.

3.3 External Pages

Participants were also asked to interact with three external pages: Google Suggest¹⁵, iGoogle¹⁶, and Yahoo!¹⁷. The following instructions were given:

“The previous 8 pages have used Web 2.0 technology to modify the content. The content has been made deliberately simple, to make it easier to determine if the changes are detected. It would also be useful if we could have feedback on how assistive technologies work with the same technologies on ‘real’ sites. Feedback on the following sites would be appreciated:

Google Suggest: We are particularly interested in what happens when text is entered into the search box

iGoogle: Are you able to access any preview information about the CNN.com stories. Would you find this useful?

Yahoo: Can you read the information in the ‘World’ news section of this page?”

¹⁵<http://www.google.com/webhp?complete=1&hl=en>

¹⁶<http://www.google.com/ig>

¹⁷<http://www.yahoo.com/>

3.4 Responses

The responses received are given below. These are direct quotes from the participants, although typographical errors have been corrected. Before the comments, the browser and screen reader used by the participant are given in italics.

3.4.1 Participant 1

Windows XP, IE7 and Jaws 9, latest update.

The experiences of the first participant were summarised as follows:

“The only page that gave me a clue about any of the things you suggested was, surprisingly Yahoo, in that when I hit enter on World News, it said ‘world news’. I could then read the headlines. I could read the headlines on the CNN page on Google, but nothing else. None of the other pages gave me any update info at all. However, in all cases, I could review and notice the changes to the page, apart from the Jamaica page, which seemed to stay the same anyway. It was the instruction on the Google page that made me realise I could use the arrows to select things. Jaws reports this as an edit, not a rich edit or edit combo.

In fact, I’ve found things I can click that Jaws doesn’t even know are controls, but I can still use them as such and review the information.”

When questioned further about these results, this participant explained that the expansion button on the Google Page (the CNN headlines) appeared as a link (which says ‘void0’), and hitting this brings up the preview — this appears under the link and you need to navigate to it. The participant also said that the statement about errors on the Jamaica page always seemed to be there (this should be removed after 8 seconds).

3.4.2 Participant 2

Windows XP Home Service Pack 2, JAWS version 6.10, IE 6.

Page 1 Pressed enter on link Principals, first time the page remained on that link, and above it said ‘display details of’. Pressed enter on the link a second time, and the page then showed the former Principals.

Page 2 Pressed enter on view dimensions link. Needed to press this twice to get the dimensions.

Page 3 Pressed enter on hide specifications link, and the specs were hidden. No need to press a second time.

Page 4 Pressed enter on rearrange order link, and it put England at the bottom of the list.

Page 5 It said auto replace at top of page, and refresh was definitely on, but nothing happened.

Page 6 Again nothing happened, so the scores were not updated.

Page 7 Again nothing happened.

Page 8 Again nothing happened.

External Pages Google suggest took me straight to the search edit box. I searched for Attenborough. It took me to the top of the page. Nice simple search page with ten headings for the first ten results and links to next pages. Pressing H in JAWS takes you from heading to heading.

Igoogle. Could not access preview information about CNN.com stories. I would not find this particularly useful. I much prefer the BBC site for news.

There were a lot of check boxes on this page, and CNN was checked, but so were some others, so I unchecked them. Pressed the search preferences button, but could not find what I was looking for.

Yahoo. I went down to the heading for news navigation, pressed the world link, and the computer froze.

3.4.3 Participant 3

Windows XP Pro SP 2 with the latest build of JAWS 9 as my screen reader and IE7 as my web browser.

Page 1 The list of former principals appears but it has to be deliberately read as opposed to reading automatically when ENTER is pressed on the link

Page 2 Same behaviour as page 1 with oval office dimensions.

Page 3 Same as page 1 and 2.

Page 4 Same behaviour as pages 1, 2 and 3. rearrangement is only discovered by a deliberate read.

Page 5 The updates are read by the screenreader when interrogated but are only automatically read when the virtual cursor mode is switched off.

Page 6 JAWS can see the updated text but doesn't give indication that the text has changed except when the virtual cursor mode is switched off. Even here, I'm not sure how reliable it is in giving the updates.

Page 7 The warning about errors can only be read once. I assume from what JAWS tells me that it disappears.

Page 8 Arrowing up and down the list, it is clear that the stories have been rearranged. When the virtual cursor mode is switched off, two headlines are read. I assume these are the ones changing place on the list. However, this is merely an assumption.

External Pages In Google Suggestions I was able to arrow down and find various suggestions when text was entered. This is known behaviour so didn't take me by surprise. I was able to find CNN stories. In the Yahoo! world News, JAWS didn't automatically read the updates but they could be read when the screen was interrogated.

3.4.4 Participant 4

Windows XP, JAWS 6.0, IE 6.

Page 1: After pressing ‘principals’ the page title is spoken and the link label is spoken. the cursor remains on the label. Starting from the top, I note that it now has a list of principals (e.g., I note Noddy Holder was chief until recently). I wouldn’t have noticed without exploration.

Page 2: Link label repeats itself, but I notice no other difference.

Page 3: The heading ‘history and development’ is spoken after clicking the link. I note that like last time, the link was ‘visited’ on the first reading..., before I had visited it. I noticed no other changes, but then I didn’t read the whole page, just above and below where I was located.

Page 4: Link and heading spoken after link visit. List re-arranged to alphabetical order.

Page 5: Nothing appeared to happen, but I suspect the temp changed from 17 to 15 deg C and the wind changed as well, but I can’t remember.

Page 6: Nothing happens.

Page 7: Nothing happened spontaneously; did the dates change?

Page 8: Saw no re-arrangement.

3.4.5 Participant 5

Debian Linux, Orca, and Firefox 3.

This participant was using very recent releases of assistive technologies for the Linux operating system. This included a development release of the Orca screen reader (version 2.23.3) and Firefox 3 (release candidate 2), plus a Baum SuperVario 40 braille display.

Page 1: On selecting the link, Orca speaks the newly inserted text. The focus does not change. It is possible to read the new text with the braille display, line by line. Clearly, the ‘Creation’ section was replaced by the ‘Former Principals’ section (including the heading and the following paragraph). The number of students is present both on the original and updated versions.

Page 2: When the ‘Dimensions’ (heading, level 3) and the following list are inserted, they are spoken, and can be read with the braille display.

Page 3: Upon activating the link, nothing apparently happens (nothing is spoken and the braille display continues to show the text of the link). If I then press the down-arrow key, I am placed at the beginning of the document, i.e., the heading at the top. It is then possible to read the text and thereby eventually discover that the specifications section has indeed been deleted by the JavaScript function.

Page 4: Upon activating the link, nothing appears to happen. Specifically, there is no spoken feedback and the braille display remains on the text of the link. By reading through the subsequent text in the document, it is possible to discover that the items are no longer sorted alphabetically by state.

Page 5: Whenever an update occurs, the new text is spoken immediately. The text presented on the braille display remains unchanged, however; thus a braille user wouldn’t be alerted to the updates. Whenever an update is performed and the down-arrow key is pressed, the ‘temperature’ line (i.e., the first modified line in the

document) is spoken and displayed in braille. Experimentation shows that focus moves here whenever an update takes place.

To read the wind speed with the braille display, I have to press down-arrow quickly in between updates so as to succeed in moving the caret.

Page 6: Whenever an update occurs, the new cricket score is spoken, and the down arrow key always places the caret on the line containing the score, i.e., the first line in the document that has changed. Attempting to move the caret to later parts of the document is difficult due to the updates, which makes it infeasible to read the remainder of the text.

Page 7: When I read the first line after the heading, which warns that the page contains errors, an update occurs. The braille display presents a series of question marks and nothing is spoken. If I then try to navigate the document, I find that focus is on the 'next page' link, and I can go back and read the text about the history of Jamaica.

Sometimes, while reading this page I get caught up in the bookmarks menu, so there are obviously odd effects taking place here.

Page 8: The list items are periodically rearranged by the script. The problem which this poses was identified earlier: when the down arrow key is pressed in an attempt to read through the document, and an update occurs, the focus is moved back to the first item in the list.

3.4.6 Participant 6

Windows XP Pro (SP2), IE 7.0 and Jaws 9.0.

Page 1: Clicked Principals. Link. Jaws gave no indication of any changes to the site. However, reading from the above link onwards displayed the new text.

Page 2: Same as per page 1.

Page 3: Clicking the 'hide specifications' link brought me to the first heading on the page.

Page 4: Clicking link results in no info from Jaws. It is possible by reading the page to see the list has been rearranged.

Page 5 – 8: Automatic updates. No indication given at all by Jaws that the page has changed.

External Pages Google suggests: No indication given of suggestions as you type. You need to leave forms mode in Jaws and arrow down to the suggestions to read them. iGoogle: Don't find anything about CNN.com but there are previews on BBC news stories. Yahoo world news: Had no problem reading the recent world news links as taken from the major news sites.

3.4.7 Participant 7

Windows, Supernova 701, IE 7.

Page 1: Reads fine, clicked next and was taken to the heading of the oval office automatically.

Page 2: Reads fine, clicked next and was taken to the heading about the mono-plane.

Page 3: Reads fine - just like all other pages; next took me to the top heading of 4.

Page 4: Reads fine including the list, clicking the link gave no indication that the list had been changed, but since the list was the first thing that is announced after the link in both cases, this doesn't matter.

Page 5: When giving focus to the temperature line, the temperature is read, supernova then thinks that a frame has finished loading. The temperature changes are not announced until I move away from the temperature line and go back onto it, when the same happens again.

Page 6: The first time I read this page, no coverage was announced. I got to the bottom, pressed up and got to the bottom line of the coverage. Pressing control home (top of page) and reading the page again seemed to read it fine.

Page 7: Reads fine - seems to be just a normal page.

Page 8: Reads but the frame is being announced again and one story seemed to be announced twice. I just looked back and I was able to see that it had changed but supernova hadn't announced the completely different list to me the first time.

3.4.8 Participant 8

Windows XP Home, Supernova 6.53, IE 6

This participant used screen magnification in addition to speech:

“I use both speech and magnification. The magnification doesn't move automatically but can be manipulated to show different areas of the screen or the magnification factor can be raised or lowered e.g. if you are using a factor of say 2 times you can increase this to a factor of up to 60 times or down to 1.2 times. By the way I don't use a mouse.”

Page 1: No problems, except new text has to be read after going back to start of page.

Page 2: No problems except as above. As I have some sight I can see this but someone using HAL and being totally blind might not realise what had happened.

Page 3: No problems and went back to the beginning on its own after clicking the link.

Page 4: Great fun as the focus landed back on 'here' as in the examples above. So one could go on changing the order for ever!

Page 5: The changes in temperature and wind speed were announced if one went down and up the list but they were not automatically announced. Again, my bit of sight helped here.

Page 6: I don't know what the E.C.B. would have thought of this but it worked well.

Page 7: The warning message disappeared almost at once. The rest of the page read easily.

Page 8: The changing order of the news stories was rather rapid but otherwise no problems.

External Pages Google Suggest: I typed the word ‘nothing’ into the Google Suggest text box and a drop down list of phrases relating to it appeared. If I entered on one it then appeared in the text box. iGoogle: I had to use the Dolphin Links List utility but this took me straight to the item to be read and after that no problems. Yahoo!: as above — I used the Links list utility and could read the World News.

3.4.9 Participant 9

Windows, NVDA, Firefox.

This participant did not give findings per page, but gave the following comments:

“To start with, none of the updated content gets flagged in any way. You have to look. So on the pages under manual update and change you click the link then cursor to find the changes. If you did not know it was there, you would assume the link did nothing. This of course is using Firefox, as nvda is not working well with existing content in IE as yet.

The pages on auto update the same is true. For example on the temperature on the forecast page, continual up and down cursoring is needed to read the changes as they come in every couple of seconds or so.

The page with errors I could not figure out what was going on except that at one point during an auto read from a load it jumped so a sentence made no sense at all.

On the outside pages, for some odd reason the CNN stuff only appeared by going down and over the top to the content, not if you went up and then came down again, so to speak. In both the Yahoo and Google pages there is far too much crap to actually wade through. A complaint we often have as the sighted simply skim up and down but we have to either cursor about, and if more than one link is per line this can take a looooooong time and you tend to lose the will to live and go somewhere more convenient.

Whatever happened to hierarchical nested indexes?

I could not find what you wanted us to look at on Yahoo, but it was the only page to say clickable on some apparently otherwise invisible features on the page. Mind you Yahoo are famous for their stupid page designs.”

As a final comment, this user highlighted the problem of notification:

“As I have said before. The most crucial thing is that nobody tells us anything has occurred. Its going to be a hard job to actually second guess which lines are updating if they are doing so like an ongoing cricket score. I mean simple scrolling messaging programs do my head in!”

3.4.10 Participant 10

Windows Vista, Windoweyes 7.0 beta 2, IE 7.

This participant noted that “MSAA is reloaded by turning browse mode off then on (Control+Shift+A)”. MSAA (Microsoft Active Accessibility) is “is a COM-based technology that improves the way accessibility aids work with applications running on Microsoft Windows”¹⁸.

Page 1: When I clicked principals, page is silent. I press the up arrow and I hear ‘downloading page’ and nothing else. I press alt+tab and alt+tab again to return to the page and the page is now in the MSAA buffer the Former principals heading with text is displayed and the bottom text. The Creation section initially there is gone.

Page 2: When I click dimensions the page is silent. I press the up arrow and I hear ‘downloading page’ and nothing else. I press alt+tab and alt+tab again to return to the page and the page is now in the MSAA buffer the Dimensions text is inserted and the history section is moved down.

Page 3: Click hide specifications. I press the up arrow and I hear ‘downloading page’ and nothing else. I press alt+tab and alt+tab again to return to the page and the page is now in the MSAA buffer the specifications are hidden as desired and the hide specifications link disappears and the History section is still at the bottom

Page 4: Click rearrange list. I press the up arrow and I hear ‘downloading page’ and nothing else. I press alt+tab and alt+tab again to return to the page and the page is now in the MSAA buffer England is now down to the bottom of the list.

Page 5: No indication of page change. I manually reload the MSAA buffer and the weather change is then reflected.

Page 6: No indication of page change. I manually reload the MSAA buffer and the commentary addition is then reflected.

Page 7: No indication of page change. I manually reload the MSAA buffer and the errors warning is gone.

Page 8: No indication of page change. I manually reload the MSAA buffer and the story list is reordered.

Google suggest: I type ‘law lab’ no feedback; I turn on the MSAA browse and the following is in the buffer: “law labs; 12,900,000 results; close”. If close is a link it is not usable. I cannot use the arrows to navigate as suggested.

IGoogle: Are you able to access any preview information about the CNN.com stories. No. Would you find this useful? Probably.

Yahoo world news: Can you read the information in the ‘World’ news section of this page? Yes.

This participant made a final comment:

“One big problem is that web page text which is supposed to be hidden to the eye is read by a screen reader in the MSAA buffer. For example, if you use a tab control from the Ajax Toolkit, the contents of all tab panes even those invisible to the sighted viewer is read in the buffer instead of

¹⁸<http://msdn.microsoft.com/en-us/library/ms697707.aspx>

just the one tab pane that is selected and only visible to the sighted viewer.”

3.4.11 Participant 11

Windows XP, Firefox (latest version) with Webvisum add-on, Windoweyes 7.0.

This participant used the WebVisum add-on for Firefox. This add-on “is a unique browser add on which greatly enhances web accessibility and empowers the blind and visually impaired community by putting the control in your hands!”¹⁹. No claims are specifically made about dynamic pages or AJAX, although its features include “Numerous under the hood page tweaks designed to help screen reader users”. The following comments were made about the test pages:

“I’m not a particularly competent computer user; I access the screen by speech and a refreshable braille display. I had no trouble with any of the pages. It appears that Window-eyes read the info. However, I don’t know what was meant by the ‘background information’ on the news stories on Google. I was able to click links to read about the ‘dragon on wall of China’ etc. I was able to access the world news link and click on it to get a list of news stories to choose from on the Yahoo page.”

This participant found the updated information immediately available, and did not need to reload MSAA (unlike participant 10, who was using IE 7).

3.4.12 Participant 12

This participant gave brief comments on four different combinations of browser and screen reader. These are given below. Further correspondence with this participant indicated that JAWS 10 did not present the test pages any differently with IE6 than JAWS 9 (the ‘info at the top of the page’ referred to is the context around the link, e.g., ‘show specifications’), although presentation of the Google Suggest auto-suggest list was less verbose.

Windows XP Pro, IE6 and Jaws 10 beta build 300.

No problem with your own pages all functioned fine and the info at the top of the page told me what was going to happen either auto or when I clicked something and all functioned nicely. Google search: typed ‘Manchester univer’ into the search field and started arrowing through the results and got plenty till it hit the bottom one then it jumped out of the edit field and left me on the search button. iGoogle: did not see any CNN stories but saw plenty Australian stuff as it defaults to Australia. Yahoo: yes I could read the stories.

Windows XP Pro, IE6 and Jaws9.

¹⁹<http://www.webvisum.com/>

All your test pages performed fine. Google suggest: it works but it's a bit more verbose as it says 'Google search edit' before giving me each option (in 10 it just read out the options). iGoogle and Yahoo: both as above.

Windows XP Pro, Firefox 3 and Jaws 9.

Results same as Jaws 9 and IE.

Windows XP Pro, Firefox 3 and Jaws 10 beta build 300.

Much more flaky but not yet supported properly in the beta.

3.4.13 Participant 13

Window Eyes 6.1 on a XP SP2 with Internet Explorer 6.0

Page 1: When I clicked Principles link it seems that they was a click sound but nothing happened as far as the data on the page is concerned, then I refreshed the page buffer and then I could here the principal details.

Page 2: Read correctly, when dimensions were clicked then it read the appropriate data.

Page 3: When the hide link was clicked, the data along with the link was hidden.

Page 4: The link for sorting sorted the list of kings.

Page 5: Read the data on screen. Did not think that anything changed on the screen.

Page 6: The title description appeared but I had to refresh the page buffer to get the ball by ball details. Refreshed the page again as the next page link was not coming, now I can here the link.

Page 7: There was a warning line but when I refreshed the page and then also the page buffer that line went away.

Page 8: When I refreshed the page buffer the stories came out sorted in a different order.

External Pages: No problems while entering data. IGoogle does not sees to respond f I click something I clicked menu an nothing happened, certainly not a site that can be used dietly without twicking and also the Internet Explorer window hanged and I had to close it with help of Windows Task Manager. The YAHOO world news, I could not find it there was a Loading work after which there were some news lines, not sure what they were.

Note: I have used Page Buffer refresh it is using my screen reader I refreshed the data buffer its called MSAA in WinEyes.

3.5 Other Comments

In addition to the more formal tests described above, unsolicited comments relating to Web 2.0 were identified during the analysis of the BCAB mailing list archives. Further, less rigorous, searches were performed on the access-uk and jaws-uk mailing list archives. Although these are not completely up-to-date, they do represent

relatively recent comment from real visually impaired users. These are presented here simply as a set of quotes, intended to illustrate what users understand about how to work with dynamic information on the Web.

3.5.1 WebbIE and AJAX

It is claimed²⁰ that WebbIE is already attempting to deal with AJAX technologies, although how this works in practice is not entirely clear:

“I’m interested, of course, because of WebbIE. WebbIE detects JavaScript attached to elements like links, and automatically refreshes its rendering of a page after a user event that is likely to update the page content (e.g. selecting something from a dropdown list). AJAX accessibility (which is really JavaScript accessibility) is a hot topic, but I’d appreciate any suggested sites where the AJAX components are a problem for users.”

This quote was taken from a discussion about AJAX on the BCAB mailing list²¹.

3.5.2 Google Suggest

Comments on the access-uk mailing list²² suggest that Google Suggest is already quite accessible with JAWS, if one knows how to work it:

“Coincidentally, I’ve just been taking a look at Google suggest which I believe actually uses AJAX. Basically, Google suggest works like predictive text when in keying your search words in the edit field. So, for example, I just typed the letter C and the edit field was prefilled with currency converter. I then added letter A and the field changed to cars. The predictive nature is based on your previous Google searches and then the most popular search strings as used by the general population. You can arrow up and down in the edit field and you’ll see similar search terms to what you’ve keyed. Another example, is that I’ve just keyed the letters d and o and it prefilled with dogs. I pressed down arrow to find the field chane to download.com

No doubt there will be some implementations of AJAX that may cause some accessibility issues but the Google suggest implementation of the technology looks to be very accessible with JAWS.”

3.5.3 JAWS and ‘On Mouse Over’

Some dynamic events are initiated by hovering the mouse over an image or text (e.g., the weather and radio buttons on <http://www.yahoo.com/>). It would appear that these actions are now accessible to non-mouse users. JAWS announces ‘On Mouse Over’ when reading a link which is activated by mouse hover. One user reports this as being very irritating, but others point out that it is useful:

²⁰<http://www.freelists.org/archives/bcab/07-2007/msg00307.html>

²¹<http://www.freelists.org/archives/bcab/07-2007/threads.html#00285>

²²<http://www.freelists.org/archives/access-uk/05-2006/msg00544.html>

“It means that things happen when the mouse is hovered over them that can’t be done any other way, and if you have the latest update to jaws, pressing jaws key plus control plus enter has the same effect for us. You will find all sorts of hidden treasures there. It’s something I’ve been saying Jaws needs to do for a long time and something that Sight and Sound and Freedom Scientific haven’t bothered to tell us about, while Window Eyes has a better way altogether of handling the same problem.”

3.6 Summary

Although the participants who completed the experiment only gave feedback on a selection of the possible combinations of browser and screen reader, it is possible to discern some trends, and to gain an impression about the current state of technology. In general, it was noticed that older versions of the screen readers (which were more likely to be used with older browsers) coped relatively poorly with dynamic information. Newer versions have changed, first by actually making all the updated information available, then by making changes more obvious to the user. Table 4 summarises the results.

Screen Reader	Browser	Results
JAWS 6	IE 6	Only link-initiated updates seen. No notification.
JAWS 9	IE 6	Updates all seen. No notification.
	IE 7	Updates all seen. No notification.
	FF 3	Updates all seen. No notification.
JAWS 10	IE 6	Updates all seen. No notification.
	FF 3	“More flaky, not properly supported”
Orca 2.23.3	FF 3	Updates all seen. New content spoken immediately.
Supernova 6.53	IE 6	Updates all seen, but user needed to return to start to see new content.
Supernova 7	IE 7	Updates all seen. User taken to new content for link-initiated updates.
NVDA	FF	Updates all seen. No notification.
Window-Eyes 6.1	IE 6	Updates available after refreshing page buffer.
Window-Eyes 7	IE 7	Updates all seen after reloading browse mode. “Downloading page” spoken during AJAX update.
	FF 3	Updates all seen.

Table 4: Summary of screen reader / browser performance.

Clearly the most important attribute for the combination is that the user can actually get to the updated information. From this experiment, it would appear that all combinations tested (apart from the oldest version of JAWS — version 6) are capable of coping, to this extent, with dynamic updates. The fact that the new

information is available, if the user searches for it, suggests that the ‘model’ the user interacts with is refreshed to cope with new information (although in some cases this needed to be done manually).

Although participants in this experiment could identify the changes in many cases, it was rare that they were given any implicit or explicit information about changes. It will be remembered that they were aware not only of the fact that the test pages were dynamic, but also how the update was triggered: it is likely that without this information many of them would not have been aware that the pages had changed.

The functionality of the screen readers, in terms of notifying users about updates, is clearly improving. The latest Linux system — Orca with Firefox 3 — offers some implicit notification, in that the new information was spoken immediately. Content rearrangement was not announced, and could only be inferred, and removal of content seemed to cause some confusion. When page content was replaced, however, the user was able to understand the changes and access the new information easily. Version 7 of Supernova / HAL has some implicit notification for updates triggered by clicking a link, again by taking the user to the new information. Unfortunately no users of the latest version (version 9) participated in the experiment, but listed in the new features for this version is “New DOM support”²³. Window-Eyes only seems to notify by speaking ‘downloading page’, and when used with IE 7, it would appear that it is necessary to refresh the buffer to even read the updated information. Using Firefox 3 and the Webvisum add-on seemed to remove the need to do this. Current versions of JAWS, however, offer no notification, and it appears that JAWS 10 (still beta software — as of August 2008, the latest version on the Freedom Scientific website²⁴ is 9.0.2169) is no different.

4 Discussion

These evaluations have highlighted the difference between making information technically accessible, meaning that the information is there if the user searches for it, and making it accessible in a way that allows the user to interact with it in an efficient manner. While recent technology manages the former (older technology does not even appear to provide the most basic level of accessibility), it certainly does not manage the latter.

While it is possible to get to the information provided by updates, comments from visually impaired users demonstrate that this is merely bare necessity, and is not sufficient for true accessibility. What is also important is that users are aware that an update has occurred: considering the ability of the visual system to detect changes, lack of notification to screen reader users would mean they must interact with these sites in a significantly different way. Two quotes from visually impaired users illustrate the problem. The first is from participant 9 (section 3.4.9):

“As I have said before. The most crucial thing is that nobody tells us anything has occurred. Its going to be a hard job to actually second

²³<http://www.dolphinuk.co.uk/productdetail.asp?id=5&z=3>

²⁴<http://www.freedomscientific.com/>

guess which lines are updating if they are doing so like an ongoing cricket score. I mean simple scrolling messaging programs do my head in!”

The second is from one of the BCAB members; it is taken from a discussion about problems finding contacts on the Friends Reunited Web site²⁵:

“Actually, the Friends Reunited website is an interesting case study for us on this list at the moment as it is now highly dynamic. In fact, if you work out how to use it, it is perfectly accessible, but Jaws, as usual, is rather rude and doesn’t tell you when things have been updated. You just have to presume they have been as if you’re telepathic, and go and find the updates. But you can get to absolutely everything if you’re prepared to use the hover keystroke and the links list.”

It was noted above, however, that users are often left unaware that any change has been taken place, and must rely on contextual clues around the link, good memory, and experience to deduce that a change has taken place. As noted above, the ability of the participants to notice and describe changes will probably have been improved by their expectations — they knew in advance that the pages would be changing.

This may be contrasted with the situation for visual browsers. The visual system is very efficient at detecting relevant changes: Jingling and Yeh [4] noted how, if relevant, new objects appearing abruptly in the visual scene were attended quickly. Assuming, therefore, that a change occurs on a visible part of the page, is pertinent to the user’s current task, and is a sufficiently large change, it might be expected that sighted users become aware that an update has occurred almost instantly. Indeed, this is supported by the eye-tracking studies reported in the user review document [3]. This study used eye-tracking to monitor users attention while they performed tasks using dynamically updating Web pages, and concluded that users attended some types of update rapidly. The report offers some suggestions for factors which influence whether an update is attended to by the user: the main ones are how the update was initiated and how important it is to their task (these factors are, of course, related).

If they noticed a change (or expected one, as was the case in all of these pages), users were often able to deduce correctly how the page had changed. Certainly, new information was generally recognised as such, and replacement of chunks of text was also noticed. The pages used in this experiment were designed to be simple and, in the case of the user-initiated updates, the page changed in close proximity to the link that initiated it. It is not clear how the users would have fared (both in identifying that a change has occurred and identifying how the page had changed) if the effect was more distant from the cause — potentially a problem given the differences between visual layout and the order of the source code and/or the order in which the screen reader presents the page. The external memory afforded by a visual display is likely to make change detection a significant advantage for sighted users.

²⁵<http://www.freelists.org/archives/bcab/05-2008/msg00355.html>

Having examined how screen reader users are able to identify when a change has happened, and what has changed, the next consideration is how users can determine whether the information provided in the update is useful to the user. This is beyond the remit of this review of assistive technologies, but it should be noted that the ability to overview information is generally greatly restricted for non-visual users, compared to those able to make a visual glance.

Perhaps one of the more significant problems faced by users was when updates occurred too often to allow the content to be read. For example, participant 5 commented:

“I agree that deletions were a problem, but so were focus issues on the pages that received time-based updates. From my point of view, the latter problem was the more serious, since it interfered with reading the text.”

This is a general problem as it is not specific to any particular screen reader or browser, but results from the fundamental differences between visual and non-visual interaction with information. It is at least partly caused by the difficulties screen reader users have in glancing at new content (to assess whether or not it needs proper reading), as well as the actual reading speed. This is a known problem, and the potential for ARIA to deal with situations like this has been examined by Thiessen and Chen [5]. They found that ARIA has limited ability to make frequently changing pages (their example was a chat room) accessible.

In conclusion, it can be seen that modern screen readers and browsers are evolving to allow non-visual access to the information on dynamically updating pages. Unfortunately, however, the ways in which visually impaired users must currently recognise, access and understand that information, do not allow the level of efficiency necessary to allow these users to significantly benefit from dynamic Web pages.

References

- [1] Jeffrey P. Bigham and Craig M. Prince. Webanywhere: a screen reader on-the-go. In *Assets '07: Proceedings of the 9th international ACM SIGACCESS conference on Computers and accessibility*, pages 225–226, New York, NY, USA, 2007. ACM.
- [2] Becky Gibson. Enabling an accessible web 2.0. In *W4A '07: Proceedings of the 2007 international cross-disciplinary conference on Web accessibility (W4A)*, pages 1–6, New York, NY, USA, 2007. ACM.
- [3] C. Jay and A.J. Brown. User review document: Results of initial sighted and visually disabled user investigations. Technical report, University of Manchester, 2008.
- [4] Li Jingling and Su-Ling Yeh. New objects do not capture attention without a top-down setting: Evidence from an inattentive blindness task. *Visual Cognition*, 15(6):661–684, 2007.

- [5] Peter Thiessen and Charles Chen. Ajax live regions: chat as a case example. In *W4A '07: Proceedings of the 2007 international cross-disciplinary conference on Web accessibility (W4A)*, pages 7–14, New York, NY, USA, 2007. ACM.

5 Associated Files

The HCW Data Repository Contains an archive file (zip) that contains the source files for the experiment described in Section 3. The files contained within this archive are the html, php, and Javascript required to serve the test pages. Within this archive, the file `notes.txt` explains the requirements for serving the pages, and the role of each file in the archive.