Global E-government Web Accessibility: A Case Study

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Summary

The number of persons with disabilities accessing e-government is growing, although this growth has not come without issues. Although some countries have legal protection to ensure equal access to web sites, including e-government sites, the mere presence of a law does not guarantee compliance. This research examines the accessibility of e-government web sites for 12 developing and developed countries. The research found that there were serious accessibility issues for all e-government sites, even those whose governments claimed adherence to accessibility standards or legislation. The results show a variety of accessibility problems with the sites, but most issues were centered on a minority of specific industry checkpoint errors, such as lack of providing alternate text for images. It is suggested that Web developers implement design recommendation provided in industry standards to improve the accessibility rankings of their sites and provide more open sites to people with disabilities.

ABSTRACT

As web services have increased, the number of persons with disabilities accessing e-government sites has also grown, although this growth has not come without issues. Although some countries have legal protection to ensure equal accessibility to web sites, including e-government sites, the mere presence of a law does not translate to 100 percent compliance for disabled users. This article examines the accessibility of e-government web sites for 12 countries, including a sampling of sites in developed countries as well as developing nations. The research found that there were serious accessibility issues for all e-government sites, even those whose governments claimed adherence to accessibility standards or legislation. The results show a variety of accessibility problems with the sites, but most issues were centered on a minority of specific industry checkpoint errors, such as lack of providing alternate text for images. It is suggested that Web developers implement design recommendation provided in industry standards to improve the accessibility rankings of their sites and provide more open sites to people with disabilities.

1. INTRODUCTION

In order to dissipate the digital divide that exists between individuals with and without disabilities, several initiatives have been launched in the past decade to allow people with disabilities greater access to Web content. First international standards groups such as the World Wide Web Consortium (W3C) have created design checkpoints and standards, Web Content Accessibility Guidelines (WCAG), for developers to use when creating their site content. Second, some governments and the United Nations (UN) have enacted some legislation and treaties to address Web accessibility issues.

Having a site that meets accessibility requirements will open the market to a wider range of customers and will provide people with disabilities a more positive experience and increase the value of the site. A sizable number of disabled people are using the Internet, and a study by the UK Office for Disability Studies in 2007 found that 27 percent of disabled users gave one of the reasons for accessing the Internet the ability to ‘access government or official services’ (Williams, et al., 2007). Thus, the capability for disabled persons to gain access to Web services will be an even more important way to empower this group, especially with the Internet growing in developing countries.

Even with the inclusion of worldwide industry standards, legal mandates and the knowledge that disabled constituents benefit from accessible Web content, fully accessible e-government sites remain atypical. Governments play a role in mandating legal guidelines, but individual Web developers also should work in concert with the governmental and industry entities to ensure proper accessibility when designing sites.

The there were three major aims to be addressed in this study.

1. How many e-government sites meet minimum WCAG industry-standards?
2. What WCAG priority 1.0 guidelines are violated?
3. What are the most common types of accessibility problems?

The study found that most sites do not meet certain common guidelines for design, yet some of these factors can be easily implemented by Web designers during initial site design or even retrofitted into sites that have already been developed.

2. LITERATURE REVIEW

2.1 Disability and government sites

According to United Nations (UN) statistics, approximately 10 percent of the world's population, or 650 million people, are disabled, with 80 percent of those people living in developing nations (UN, 2006). The estimated number of disabled Web users varies; the US National Institute on Disability and Rehabilitation estimating 10 percent of Web users are disabled (Salamone, 2001) while the Danish Center for Accessibility puts the estimate at 25 percent (Rønn-Jensen, 2004). Another study in the UK estimates that 42 percent of disabled UK residents are currently or have used the web in the past (Williams, et al, 2007). Irregardless of the specific study, the number of disabled Internet users is a sizable portion of the population. This large number suggests that Web sites provide assistive technology in order for disabled users to effectively access the pages. Blue (2001) states that the Internet can make a significant difference in the lives of those with disabilities, therefore, the aim of governments should be to enable as many people as possible to access the Web.

The number of e-government Web sites has increased dramatically over the past several years as national and local entities are realizing the benefits that online governmental services can have to their constituents, including those with disabilities. Freeman & Loo (2009) suggest there are three categories of benefits that governments can achieve from developing Web services: efficiency, user convenience and citizen involvement. Cresswell (as cited by Freeman & Loo, 2009) explains efficiency is gained by obtaining increased output with lower resources. User convenience is defined as being able to enjoy 24x7 access and saving travel costs. Finally, citizens can use e-government sites to provide greater participation in the democratic process of government. Thus, the author presents the case that e-government sites have many benefits. The benefits of online government services can be especially helpful to those people with disabilities. Sites have the potential to improve the quality of life for people with disabilities by providing more political participation and making government information more available (Rubaii-Barrett & Wise, 2008).

Eynon & Dutton (2007) indicate that an obstacle to effective e-government services is making those sites available to persons with physical disabilities. Their research study ranked the perceived importance of barriers of disabled constituents using e-government sites, and found that most survey respondents listed resistance to change as the most important barrier to using e-government sites, with accessibility was the least important of the nine factors surveyed. However, although accessibility was ranked low, they still found a significant number of respondents, 42 percent, who indicated that making e-government services easily accessible to those with disabilities was important. The number of disabled people using the Web is growing as they realize it can provide easier access to services and the ability to interact with other members of society in a more equal footing. Thus, with the sizable number of disabled users needing online access, it is imperative that government site administrators built their Web sites with assistive technology in order for this portion of the population to effectively access the pages.

2.1 Accessibility Standards

In order to meet the needs of disabled users of Web sites, the World Wide Web Consortium (W3C), has developed a set of standards to encourage accessibility for those with physical impairments. These international standards - Web Content Accessibility Guidelines 1.0 (WCAG) – were initially published in 1999 and serve as guidelines for Web developers on how to make Web content accessible to not only people with disabilities, but to make them more accessible to all users (W3C, 1999).

The WCAG guidelines consist of a set of checkpoints which are recommended design practices. There are three priority checkpoint levels in WCAG 1.0 that developers use to analyze the accessibility quality of their sites. Also, conformance level status is gained when different priority level checkpoints are met:

- Priority 1: A Web developer must satisfy these requirements, and this is the minimum requirement. "A" level status is met when all Priority 1 checkpoints are met in the sites. This is the most important priority level for designers to implement.
- Priority 2: A Web developer should satisfy this checkpoint, but it is not mandatory. "AA" level status is met when both Priority 1 and 2 checkpoints are met.
- Priority 3: A Web developer may address this checkpoint. 'AAA' level status is met when Priority 1, 2 and 3 checkpoints are met. (W3C, 1999)

Although there are 65 Priority 1.0 checkpoints (W3C, 1999), not all the checkpoints are equal with regards to the number of issues that may occur in most Web sites. The UK Disability Rights Commission conducted a study of 100 Web sites and found that just eight checkpoints accounted for 82% of all errors. The most serious checkpoint problems along with the specific WCAG numerical scheme were:

- 1.1 – Provide text equivalent
- 2.2 – Ensure color contrast
- 6.3 – Ensure pages are usable when scripts turned off
- 7.3 – Avoid page movement
- 10.1 – Do not cause popups
- 12.3 – Divide large blocks of information into manageable groups
- 13.1 – Identify link target
- 14.1 – Use simplest language (DRC, 2004)

Although a variety of checkpoint issues exist, there are ways Web developers can ensure they are minimized, which will provide a higher level of accessibility for disabled users. Another study of US e-government sites found similar accessibility issues across the study, including common problems with lack of text equivalent and issues with color schemes (Jaeger, 2008). Wallis (2005) states that accessibility does not preclude using technologies such as multimedia, but their use can include users with impairments by providing captions for audio or textual descriptions for visual content. The term 'disability' can encompass the impairments of people with either physical or mental issues, but Web accessibility design most commonly addresses the needs of people with particular physical disabilities including:

- People who are blind who need to use screen reading technology or refreshable Braille
- People with vision impairments who use screen magnification
- People who have a hearing impairment who need to have sound caption
- People with a physical impairment that does not allow them to use a joystick, mouse, etc. (Brophy & Craven, 2007).

2.3 Legislation

In 2006, The UN Assembly passed a Treaty on Rights of Disabled. This legislation attempts to protect the needs of 650 million disabled people in the world. Not only does this treaty address access to physical facilities, it also provides and impetus to improve access to information and communications infrastructures, including the Internet (Arbour, 2007). However, although 137 nations have signed the convention, only 28 have ratified the Protocol. For the countries in this research study, the following have ratified the Protocol: a) China, b) India, c) Kenya, and d) Philippines (UN, 2008). The Treaty does address communication technology such as multimedia and the Internet and providing accessible communication, reasonable accommodation and universal design (UN, 2007). The Treaty itself does not specifically address WCAG accessibility guidelines, but in order to create dialogue about Web accessibility issues and support implementation of the Treaty, the Global Initiative for Inclusive Information and Communication Technologies (G3ict) was started in 2007. This organization coordinates with groups such as W3C in promoting Web accessibility and guidelines such as WCAG (G3ict, 2009).

Although the UN Treaty attempts to provide some level of global compliance with Web accessibility, few countries have actually ratified the Protocol, and since the legislation is new, compliance and execution will be an issue for the near future, even for those countries that have signed. Besides the UN Treaty, some countries have enacted their own laws in order to improve Internet accessibility for their disabled citizens. Currently, 19 countries or coalitions have enacted their own laws on Web accessibility, including the European Union (EU), France, Germany, India, Switzerland and the UK (W3C, 2006). Of these countries, the EU and UK have enacted legislation that requires government Web sites to comply with WCAG priority 1.0 checkpoints (Shi, 2006).

3. METHODOLOGY

The research was accomplished through completing an analysis of the 12 worldwide e-government sites to determine adherence to WCAG accessibility guidelines and to determine the most prevalent checkpoint problems for these sites. The project consisted of four phases:

1. Choosing an online accessibility tool
2. Picking a list of government Web sites to test
3. Run a software accessibility analysis
4. Perform an in-depth analysis on the results

The first phase of this study was to choose a software accessibility testing tool to analyze the sites. For this study, a software product was chosen from The Centro Tecnologico de la Informacion y la Communication (CTIC). This is a non-profit group emphasizing Web research and accessibility, and their software analyzer, TAW, was developed based on WCAG 1.0 guidelines. The software can analyze accessibility errors with Web sites and can test checkpoint levels A (priority 1, basic accessibility), AA (priority 2, intermediate accessibility) and AAA (priority 3, high accessibility) (Fundacion CTIC, 2009). For each of these checkpoints, TAW provides a detailed report of both automatic and human review issues. Automatic issues are those errors that the software has checked based on the WCAG guidelines. Issues that are tagged as requiring human review are warnings that are not always accurately measured by an automated tool. Reviewing some errors requires human judgment and these checkpoints should be manually inspected by the Web designer. According to Abrahams (2006) Web developers should use a combination of automated and manual tests

when analyzing Web sites. Automated software is often better than human testing because it picks up errors more efficiently and inexpensively, and can pick up some errors that may not be visible to human testers, or may be missed. However, Abrahmans also cautions that automated tools do not test all usability and user scenarios, so it is beneficial to use both during actual development.

When TAW tags automated errors or manual checkpoint warnings, the developer can pick the specific error tag, which includes a detailed explanation of the issue, based on the specific WCAG guideline for that checkpoint. The product also has other features, such as allowing a choice of analyzing one specific page of the site, such as the home or index page, or reviewing all pages on the Web site (TAW, n.d.). For this research study, the home pages of each government site were analyzed. TAW has been used in other research of Web accessibility issues, such as a 2006 study of 230 digital repositories in 16 European countries, whose results showed poor levels of accessibility and bad design practices (Rovira, 2007). Based upon the use of this product by other researchers and the ability to test various checkpoints for WCAG level 1.0, this software product met the criteria for the testing meets the needs of this project. However, one limitation of TAW is that it does not test WCAG 2.0 guidelines, so if this research was to be expanded to this level of testing, another software product would need to be used.

The second phase of the project involved choosing a list of government sites to analyze their adherence to WCAG guidelines. A total of 12 countries were chosen, four each from the EU, Asia and Africa:

- EU (UK, France, Germany, Switzerland)
- Asia (China, India, Cambodia, Philippines)
- Africa (South Africa, Liberia, Namibia, Kenya)

For each of these countries, six different federal government agency sites were selected to analyze. For the basis of some level of consistency, an attempt was made to choose similar government ministries or departments. For example, the six UK e-government sites selected were:

- House of Parliament
- Prime Minister
- Ministry of Defence
- Ministry of Justice
- Department for Business, Enterprise and Regulatory Reform
- Foreign and Commonwealth Office

For the other countries, most had Web sites had parliament, justice or defense entities, although the nomenclature may have been different. For example, the UK foreign affairs entity was called ‘Foreign and Commonwealth Office’, while a similar organization in Cambodia was named ‘Ministry of Foreign Affairs.’ An attempt was made to choose six similar entities for all governments. However, this could not be accomplished in all cases, such as the instance where China does not have a parliamentary government, so another government agency was substituted. Another criterion was that the sites chosen were English-based, or the sites had an English translation that was tested. All sites were federal-based government entities for each of the countries.

During January 2009, the third phase was completed and this consisted of analyzing the sites using the TAW tool to determine the main types of accessibility checkpoint problems. For each government home page, the software tool tabulated the WCAG 1.0 errors. The results

were compiled into reports of priority 1, 2 and 3 automated and manual errors. Based upon the WCAG guidelines, each priority level could have a specific WCAG checkpoint types. For each checkpoint type, a government site could then have a various number of errors per page. For example, TAW will tabulate seven different WCAG priority 1 checkpoint types ranging from (2.1 – color issues) to (14.1 – language issues). Within a specific checkpoint, such as 2.1, the results could range from a minimum of zero errors to a high even of thousands of color problems for each individual Web page.

The fourth phase of this study was to take the raw data from the TAW results and to compile it into tabular format. The total numbers of errors for each checkpoint within the priority 1, 2 and 3 categories were tabulated. Because of the substantial number of different checkpoint types and numbers of errors for each type, only the top three checkpoint types of errors were compiled for each priority category. These were the most common accessibility errors that were found for the various government sites.

4. RESULTS

The tables in this section show the results of WCAG accessibility issues for countries in three regions: a) Asia, b) the EU, and c) Africa. For each set of regions, there are two tables, one comprising 'automatic' issues and the next table listing errors that should be reviewed manually. For each table, the first column provides a list of priority 1, 2 and 3 error types, and the three most prevalent types of problems are listed for each error type. Although a wide variety of errors were found for each priority level, only the top three prevailing errors were included in the table results. These were chosen by counting the total number of error occurrences for each priority level. Also shown in the tables was a breakdown on the number of specific error occurrences for each country, and the number of pages with errors. Since the home pages of six government sites for each country were tested, the maximum number of 'pages w/errors' would be six. The actual number of errors could be significantly higher, as each Web page could have a different quantity of errors for each type. For example, one Web page may contain many GIF images, and each of these may have missing alternate (alt) tags, thus resulting in a high number of WCAG (1.1) error types. However, just because there were a high number of errors listed in the 'errors' column for each country, that does not necessarily mean every government Web site tested had that specific error. It is also important to review how many of the six home pages contain that specific error type. Results where all six home pages showed a specific error means a high propensity for that error across government sites.

Information in tables 1 and 2 show the WCAG accessibility issues for four Asian government sites: a) Cambodia, b) China, c) India and d) the Philippines. The most significant problem with accessibility for both automatic (Table 1) and manual (Table 2) concerns for priority 1 was WCAG error type (1.1) – lack of providing text equivalent. All of the countries had issues with both automatic and manual errors. Most of the countries had either five or six government sites with problems, except for the Philippines, where there were three home pages with manual problems. All of the pages listed had numerous alt text problems, indicating that few (if any) of the multiple images found on each page contained text, which would add meaning to the image. The next most common priority 1 automatic errors, shown in Table 1, were not found in abundance in most pages. These were WCAG (6.2), ensure equivalents for dynamic content are updated when content changes, and (6.3) ensure pages are usable when scripts are turned off. For priority 2 manual issues, the second and third most

common types were WCAG (5.1) and (5.2) shown in Table 2. Both of these deal with data table issues and were found in either four or five government sites per country.

For priority 2 issues, the most common problem in the automatic arena were WCAG (11.2), using deprecated elements or attributes. All countries had either five or six pages containing errors, with the numbers ranging from a low of 376 total problems for Cambodian sites to a high of 1200 for Chinese sites. With manual priority 2 problems, the most common was a lack of using style sheets to control layout (WCAG 3.3), with a low of 122 total errors in five pages for Cambodia to a high of 417 errors in all six pages for China. The other two common errors were WCAG 2.2a (ensuring foreground and background color combination provide sufficient contrast) and 5.3 (do not use tables for layout or provide alternate equivalent).
Most automatic priority 3 errors involved WCAG (5.5), which indicates the sites should include summaries for tables. Indian government pages had the fewest errors (68 total) while all Chinese sites had this error, with 337 total. The two other most prevalent automatic issues shown in Table 1 were: WCAG (1.5), not providing redundant text links and (4.3), needing to include the primary natural language. Like the results of priority 3 automatic errors, Chinese sites showed the greatest number of errors in the most common category: WCAG (10.3), until user agents provide correct side-by-side text, use linear text for tables. Other common errors were WCAG (5.5), providing table summaries and (10.5) until user agents render adjacent links distinctly, including non-link characters.

Chinese sites showed the highest levels of total errors for both automatic (2919) and manual (2460). The country with the second highest number of automatic errors was India (1072), which is significantly lower than the number of Chinese problems. Cambodian sites contained the second highest level of manual issues with 1123 total errors.

Table 1. WCAG 1.0 Automatic Errors – Asia

	Cambodia		China		India		Philippines	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	66	5	319	6	141	5	6	2
(6.2) Ensure equivalents	1	1	5	2	1	1	2	2
(6.3) Ensure pages are usable	0	0	8	1	0	0	0	0
Priority 2 Error Type								
(11.2) Avoid deprecated features	376	6	1200	6	443	5	505	5
(3.4) Use relative units in markup	122	4	1029	6	368	6	337	4
(3.5) Use header elements	5	5	5	5	6	6	6	6
Priority 3 Error Type								
(5.5) Provide table summaries	75	4	337	6	68	5	117	4
(1.5) Provide redundant text links	3	1	11	1	39	2	0	0
(4.3) ID primary natural language	5	5	5	5	6	6	5	5
Totals	653	31	2919	38	1072	36	978	28

Table 2. WCAG 1.0 Manual Errors - Asia

	Cambodia		China		India		Philippines	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	431	5	369	6	245	5	165	3
(5.1) For data tables, ID row	52	4	195	6	37	4	47	4
(5.2) For data tables, use markup	53	5	195	6	38	5	51	4
Priority 2 Error Type								
(3.3) Use style sheets	122	5	417	6	187	5	313	4
(2.2a) Ensure color contrast	249	5	341	6	179	5	93	3
(5.3) Do not use table for layout	77	5	366	6	53	5	117	4
Priority 3 Error Type								
(10.3) Provide text alternative	75	3	366	6	66	5	117	4
(5.5) Provide table summaries	52	4	195	6	38	5	51	4
(10.5) Include non-link characters	12	2	16	2	6	2	35	3
Totals	1123	38	2460	50	849	41	989	33

Tables 3 and 4 show the accessibility error results for four countries in the EU: a) the UK, b) France, c) Germany and d) Switzerland. The most common priority 1 error, both in the automatic and manual categories, was WCAG (1.1) - lack of providing text equivalent. This was the same as the most common priority 1 issue shown in the statistics for the Asian countries. Table 3 shows that only French and Swiss sites had (1.1) priority 1 automatic error types, while Table 4 illustrates all countries possessing many (1.1) manual errors on most pages. The second and third types of automatic errors are WCAG (6.2) and (6.3). Results show that few EU sites contain either error. This is similar to the results for Asian countries, where these two errors also are also ranked number two and three, with few pages displaying these problems. The other common priority 1 manual errors are WCAG (6.1) organize documents so they can be read without style sheets and (6.3).

For EU government sites, the majority of priority 2 automatic errors dealt with WCAG (11.2), avoiding deprecated features and the majority of sites for all countries showed this error type on their pages. For priority 2 manual errors, the most frequent is (2.2a); ensuring foreground and background color combinations provide sufficient contrast. Five German pages contained this error type while all pages for the other three countries displayed the error.

The most common priority 3 automatic error type for EU sites was (5.5), providing table summaries, which was also the most prevalent error in this category for Asian countries. However, compared to their Asian counterparts, fewer EU sites did have large numbers of errors within pages or each specific country results. France had three pages with errors, while Switzerland had two and the rest only one each. All six pages for every country contained priority 3 manual error type WCAG (14.3), creating a style of presentation consistent across pages.

France had the greatest number of issues for both the automatic category, with 412 errors and 25 total pages with errors, and the manual category with 424 errors and 49 pages with problems. Switzerland displayed fewest overall errors with 80 automatic and 400 manual. Germany did well with the fewest pages with errors (11) in the automatic category. The UK had the least number of pages (43) in the manual table.

Table 3. WCAG 1.0 Automatic Errors - EU

	UK		France		Germany		Switzerland	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	0	0	28	2	0	0	4	3
(6.3) Ensure pages are usable	0	0	4	1	0	0	3	3
(6.2) Ensure equivalents	0	0	1	1	0	0	0	0
Priority 2 Error Type								
(11.2) Avoid deprecated features	80	5	180	5	81	3	48	5
(3.4) Use relative units in markup	10	2	134	4	4	3	14	3
(3.5) Use header elements	2	2	5	4	1	1	3	2
Priority 3 Error Type								
(5.5) Provide table summaries	22	1	52	3	1	1	2	2
(10.4) Holding characters	2	3	5	2	5	3	5	5
(4.3) ID primary natural language	0	0	3	3	0	0	1	1
Totals	116	13	412	25	92	11	80	24

Table 4. WCAG 1.0 Manual Errors - EU

	UK		France		Germany		Switzerland	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	106	5	233	6	269	6	85	6
(6.1) Organize documents	45	6	259	6	125	6	121	6
(6.3) Ensure pages are usable	34	5	69	5	38	6	46	5
Priority 2 Error Type								
(2.2a) Ensure color contrast	118	6	157	6	160	5	69	6
(6.4) Event handler for scripts	61	5	43	5	41	6	25	5
(13.1) Identify link target	32	6	54	6	40	6	32	6
Priority 3 Error Type								
(14.3) Create presentation style	19	6	30	6	23	6	18	6
(10.3) Provide text alternative	22	1	53	4	3	3	2	2
(10.5) Include non-link characters	8	3	26	5	21	3	2	2
Totals	445	43	424	49	720	47	400	44

Tables 5 and 6 show the results for four countries in Africa: a) South Africa, b) Liberia, c) Kenya and d) Namibia. Similar to the outcomes shown in both EU and Asian sites, the predominate automatic and manual priority 1 error type is (1.1), lack of providing text equivalents. Overall, there were a greater numbers of problems listed for the manual errors located in Table 6, compared to a smaller, but still significant number of automatic error problems in Table 5. For the manual issues, Namibia showed the fewest, only 2 pages with 247 total errors. All six pages for the other countries contained this error type, with South African sites containing the most manual errors (527). The number of priority 1 manual errors was much higher than the automatic priority 1 errors.

Table 5. WCAG 1.0 Automatic Errors - Africa

	South Africa		Liberia		Kenya		Namibia	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	196	4	132	5	76	4	59	2
(6.3) Ensure pages are usable	7	4	6	2	1	1	0	0
(12.1) Title each frame	0	0	0	0	0	0	7	4
Priority 2 Error Type								
(11.2) Avoid deprecated features	933	6	62	5	525	6	160	3
(3.4) Use relative units in markup	263	6	34	2	260	6	37	4
(3.5) Use header elements	5	6	6	6	6	6	6	6
Priority 3 Error Type								
(5.5) Provide table summaries	151	6	7	1	143	6	5	2
(4.3) ID primary natural language	6	6	5	5	6	6	6	6
(5.6) Provide abbreviations	0	0	0	0	18	3	0	0
Totals	1561	38	252	26	1035	38	280	27

Table 6. WCAG 1.0 Manual Errors - Africa

	South Africa		Liberia		Kenya		Namibia	
	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors	Errors	Pages w/ errors
Priority 1 Error Type								
(1.1) Provide text equivalent	527	6	188	6	218	6	247	2
(6.1) Organize documents	126	6	54	6	111	6	6	3
(5.2) For data tables, use markup	84	6	4	1	84	6	2	2
Priority 2 Error Type								
(2.2a) Ensure color contrast	379	6	167	6	173	6	148	2
(3.3) Use style sheets	208	6	102	5	112	6	7	2
(5.3) Do not use table for layout	151	6	7	1	143	6	5	2
Priority 3 Error Type								

(10.3) Provide text alternative	151	6	7	1	146	6	5	2
(5.5) Provide table summaries	84	6	3	1	84	6	4	2
(10.5) Include non-link characters	42	5	25	3	10	1	0	0
Totals	1752	53	557	30	1081	49	424	17

5. IMPLICATIONS AND DISCUSSION

Evaluation results in the six tables show that the most prevalent automatic and manual checkpoint priority 1 error was the lack of providing text equivalent, or alt tags. WCAG guidelines for alt tags require that text alternatives be provided for any non-text data (such as images or videos) so that people who use assistive technologies, such as Braille readers, can access this content (W3C, 2008). Alt tags convey the text equivalent of the image display, and are necessary to those with disabilities, as they may not have the ability to physically 'see' the image. For most Web designers, implementing these features is not difficult and will not change the layout or appearance of the Web pages (Will County, 2003). It is important to provide alt tags because not all users may have the ability to 'see' the images, or non-disabled users on slow dial-up may decide not to download images due to slow transfer times ("Europe-wide survey," 2006).

Although the W3C does not mandate priority 2 checkpoints in efficient accessibility design and only 'recommends' use of these checkpoints, Web designers should incorporate them into their sites. Use of deprecated features and problems with color contrast were common priority 2 errors in this study. WCAG guidelines for contrast and luminosity exist to make it easier for people with disabilities to see content by better separation of foreground from background (W3C, 2007b). One way this can be done is by the effective use of color contrast. For example, color-blind users may have trouble reading red text on a green background, so a black and white color scheme may be more effective for contrast. Luminosity of the text is also an important design factor, and the guidelines for minimum luminosity contrast ratio of at least 5:1 (W3C, 2007a). Designers can use color contrast analyzer tools to check against the W3C ratios for contrast and luminosity. Use of deprecated features should be avoided so Web pages are compliant with current browsing technology and the latest version of HTML, thus increasing accessibility (W3C, 2000b).

Table summaries, text alternative and natural language concerns were the common priority 3 checkpoint problems. WCAG guidelines require changes in natural language must be clearly identified. A specific example of a problem would be if the predominant language of the site is English, and some other content or text is written in another language like French. Most screen readers or speech synthesizers would attempt to translate the content into the default language, and attempts by Web designers to use other languages on the site would result in problems with translation or accent. Thus, designers should use the HTML "lang" attribute to define a secondary language used on the site (W3C, 2000a).

Priority 3 checkpoint 10.3 error "Until user agents render side-by-side text correctly provide a linear text alternative (on the current page or some other) for all tables that lay out text in parallel, word-wrapped columns" (W3C, 2000c) was another common problem. Correcting this problem will allow those people using assistive technology that does not handle columns to be able to read alternative text. Table summaries should be provided to provide better

readability for people with assistive technologies, who may find tables without headings or summaries difficult to navigate (W3C, 2000d).

Accessibility errors found in this study were also issues in other research studies of global government sites. Several of the main problems found in the Disabilities Right Commission (DRC, 2004) study and the 2005 Chinese government study (Shi, 2006) were also main issues with the government sites in Asia, Europe and Africa. The major error for both the Shi and DRC studies was WCAG 1.0 checkpoint 1.1, which mandates text equivalents (alt tags) for non text items. Exclusion of alt tags is one of the most common errors in Web accessibility design, yet it represents one of the easiest fixes from a technical perspective (Guenther, 2002). The DRC (2004) survey also indicated that checkpoint 2.2 (color issues), was a major problem, and this checkpoint issue was also found in many of the government sites in this research.

Although government Web site sites should be designed with adherence to WCAG guidelines and specific country-based disability law, this study shows that this is not the case. These findings show that certain errors consistently show up in government sites across the world, whether or not those countries laws mandate Web accessibility. Some of these errors, such as lack of using alt tags, can be relatively easy to modify within the sites, and Web designers should make these a top priority when implementing page updates. Also, other critical priority 1 checkpoints should be modified when prioritizing which changes to apply first. Those changes which could affect the entire look and feel of the Web site, are difficult to implement or are lower-ranked WCAG Priority 2 or 3 checkpoints could be changed later.
Another point to consider in this study is that only the home page for each of the government sites was tested with the TAW software product. Therefore the results of this study would seriously underestimate the magnitude of the accessibility problem for each site. If the study had analyzed all pages or levels of each government site, the number of errors would have been much larger. In addition, only WCAG level 1.0 checkpoints were included as criteria due to the limitations of the TAW functionality. Additional checking of level 2.0 WCAG checkpoints would have expounded the seriousness of the problems.

6. CONCLUSION

On the basis of the results of this research, a preponderance of global e-government sites are not meeting WCAG accessibility guidelines. Testing using an automated software analyzer provided a synopsis of the checkpoints errors that were common across the range of sites. The most prevalent errors involved lack of text equivalent, deprecated features and problems with color contrast, leading to problems for disabled persons having comparable access to sites compared to users without disabilities. This accessibility checkpoint problems identified by this research should encourage Web designers to understand current WCAG industry guidelines, as well as any local governmental legislation, for proper Web accessibility design when initially developing their sites. In addition, many of these errors, such as lack of text equivalent, could be easily fixed by Web developers during periodic updates to their sites. They should use accessibility testing tools to review errors, and then prioritize changes to be made to their Web pages based upon criticality of the checkpoint errors and the difficulty or ease of making the updates.

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