

Evaluating Government Website Accessibility: A Comparative Study

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Abstract

Even though efforts have been made to reduce the informational gap resulting from web inaccessibility, websites from virtually every type of organization have major accessibility problems. This study used an automated software tool to evaluate the accessibility of four Korean government and four U.S. government websites. Results were compared between the Korean and the U.S. government websites and between the websites published in 2004 and 2007. Finally, common web accessibility problems and potential errors from the automated software tool are discussed.

1. Introduction

Several studies have focused on evaluating the accessibility of websites developed by different types of organizations. Unfortunately, these studies' results have repeatedly shown that websites' accessibility to people with disabilities is disappointingly low. Private and non-profit websites [3], for-profit commerce websites [4], U.S. state websites [1], and even U.S. Federal websites [6] were all found to have major accessibility problems.

The Web Content Accessibility Guidelines (WCAG), developed by the World Wide Web Consortium (W3C), is an internationally accepted de facto standard consisting of guidelines and checkpoints that provide specifications on how to develop an accessible webpage. Based on each checkpoint's impact on accessibility, these checkpoints are grouped into priorities 1 (web developers *must* satisfy these checkpoints), priority 2 (web developers *should* satisfy these checkpoints), and priority 3 (web developers *may* address these checkpoints).

As the WCAG became the norm for web accessibility evaluation, various software tools (e.g., A-Prompt, Bobby) have been developed to evaluate websites based on the WCAG. Such software tools automatically crawl through a website and identify various coding solecisms, such as malformed Hypertext Markup Language (HTML) or the absence of tags essential to assistive technologies. In addition, it has been recommended that any test of web accessibility must be viewed as a process that combines automated software tools with human judgment [2, 5].

By applying both the automated software tool and a human review of web content, this study has three objectives. First, the study compares websites of U.S. and Korean government organizations to assess their web accessibility. Second, the study identifies webpage components that could pose severe accessibility problems. Third, as a result of the human review of web content, the study identifies potential problems with using software tools for automated compliance monitoring.

2. Research Methodology

2.1 Evaluation Clauses and Subjects

Checkpoints specified in WCAG priorities 1 and 2 were selected as the evaluation clauses to examine the mandatory items for web accessibility in this study. Priority 3 checkpoints were not included because most of them are related to usability, rather than accessibility.

Given the human judgment method used in this study, the number of websites evaluated was limited to eight, four from each country. The Korean websites selected as subjects for evaluation in this study were the Korean Ministry of Health & Welfare (www.mohw.go.kr), the Korean Ministry of Education & Human Resources Development (www.moe.go.kr), the Korean Ministry of Labor (www.molab.go.kr) and the Korean Ministry of Government Administration and Home Affairs (www.mogaha.go.kr). These four Korean government websites were selected because these four agencies were considered to be leaders in promoting web accessibility.

For comparison, four U.S. government websites similar to the selected Korean government websites were evaluated for web accessibility. These include the U.S. Department of Health and Human Services (www.hhs.gov), the U.S. Department of Education (www.ed.gov), the U.S. Department of Labor (www.bls.gov) and the U.S. Department of State (www.state.gov).

The information content provided in websites can be in both text and non-text formats. This study categorized non-text information on webpages into six major content groups for accessibility evaluation, including image, table, frame, navigation, applet/script and flicker (see descriptions in Appendix A).

2.2 Evaluation Method

The evaluation method used in this study consisted of an initial evaluation using an automated software tool, and a second evaluation conducted manually and involving human judgment. The first evaluation assessed the accessibility of each selected website's main webpage (i.e., homepage) by using A-Prompt 1.0 English version and A-Prompt 2.0 Korean version for the U.S. and the Korean websites respectively.

The second evaluation involved counting the number of non-text information items in each of the six content groups for each selected website's homepage. Then human experts analyzed the HTML code line-by-line for accessibility errors on each homepage, especially for the errors reported by the automated software tools in the first evaluation. The human experts also used the tab key on the keyboard and the IBM Home Page Reader to verify the errors they found. The IBM Home Page Reader is a talking web browser that uses the power of speech to allow users to access webpages non-visually (www-03.ibm.com/able/solution_offerings/hpr.html).

Finally, the degree of accessibility problem in each of the six content groups was assessed for each website. The "accessibility error rate" was calculated as the ratio of the "number of non-text information items with accessibility problems" to the "total number of non-text information contents." This "accessibility error rate" was used as the basis to compare accessibility between the U.S. and the Korean government websites. The current 2007 accessibility error rate was also compared to the 2004 accessibility error rate to review how much web accessibility has improved over the last two and a half years.

3. Analysis and Results

3.1 Web Accessibility in 2004 and 2007

In 2004, the four Korean government websites had accessibility error rates for priority 1 and 2 checkpoints of 22.2% and 13.8% respectively. These results were substantially higher than those of the four U.S. government websites, which had corresponding error rates of 1.6% and 1.0%, respectively. Interestingly, the accessibility error rate of the Korean websites' non-text information content with priority 1 checkpoints (22.2%), which deal with the most fundamental issues regarding web accessibility, was higher than their error rate of non-text information content with priority 2 checkpoints (13.8%). This result may indicate severe accessibility problems among the four Korean government websites.

The current 2007 accessibility error rates for priority 1 and 2 checkpoints of the four Korean government websites are 3.2% and 11.5% respectively. These results are still approximately two times higher than the corresponding error rates of the four U.S. government websites, which are 1.6% and 4.7% for the priority 1 and 2 checkpoints respectively.

Additionally, the overall accessibility error rates of the Korean and the U.S. government websites were 36.0% and 2.6% respectively in 2004 and are 14.8% and 6.2% respectively in 2007 (see Table 1 and Table 2).

During 2004 and 2007, the Korean government websites have shown improvement in their accessibility in both the priority 1 checkpoints and the overall accessibility. This improvement may be the result from the fact that, in 2005, Korean government started to evaluate accessibility of its agencies' websites and made the evaluation results publicly available. However, on average the Korean government websites' error rate is still approximately two times higher than that of the U.S. websites. This may suggest the need for legal enforcement or other additional mechanisms (e.g., limiting supports or funding for agencies whose websites demonstrate low accessibility) in Korea to improve web accessibility among Korean government organizations. Moreover, the Korean government websites have a much higher number of non-text information items than the U.S. government websites (1601 vs. 731 in 2004 and 2168 vs. 901 in 2007, see Table 1 and Table 2). This result may indicate dissimilarity in the websites' information provision due to cultural differences between the two countries.

While the four Korean government websites have shown improvement in their accessibility errors during 2004 and 2007, the four U.S. government websites have experienced poorer result in 2007 than that in 2004. On average the accessibility error rate for the four U.S. government websites was 2.6% in 2004 and is 6.2% in 2007. Additionally, the higher accessibility error rates for the four U.S. government websites were found in five of the six non-text information content groups (see Table 1 and Table 2). The poorer accessibility error rates in 2007 for the four U.S. government websites are the result from the new design of one website in the group.

3.2 Accessibility Error in Each Non-Text Information Content Group

This section provides some details about the common errors found in each non-text information content group. Additionally, we compared the accessibility errors identified by the automated software tools in the first evaluation to those found by human judgment in the second evaluation. The comparison shows that, for all eight selected websites evaluated in this study, fewer accessibility errors were identified by human experts than by the automated software tools (see Table 1 and Table 2). Thus, potential errors or redundancies in identifying web accessibility problems using automated software tools are also discussed in this section.

(1) Images

According to a checkpoint in priority 1, a text equivalent is required for every image. This could be done by providing either the "alt" or "longdesc" tag. The "alt" tag would indicate that the non-text information content is an image, while the "longdesc" tag would provide a longer and more detailed description of the image.

In 2004, the four Korean government websites contained 535 images, 339 of which provided neither the "alt" nor the "longdesc" tag, indicating a serious problem with an accessibility error rate of 63.4% (see Table 1). Virtually no image in the four Korean government websites in 2004 used the "longdesc" tag to provide a longer and more detailed description of the image.

Additionally, the Korean government websites failed to provide neither the "alt" nor the "longdesc" tag for most of the button, bullet, and space holder images (i.e., images used for empty or open space). This contributed to the high accessibility error rate in 2004 for the Korean government websites. In contrast, developers of the U.S. government websites added the "alt" tag for every button, bullet, and space holder image. However, in 2007 the four Korean government websites show a substantial improvement in the accessibility error rate related to image. This error rate is reduced to only 5.5% and the "alt" tag is provided for most of the button, bullet, and space holder images.

Interestingly, the number of images in the four U.S. government websites is much less than that in the four Korean government websites. From 2004 and 2007 combined, totally there are only 560 images in the four U.S. government websites. This is less than half of 1249 images in the four Korean government websites. Additionally, the accessibility error rate related to image for the U.S. government websites in both 2004 and 2007 are lower than 5.0%.

In the first evaluation using an automated software tool, we found that, if an image has neither the "alt" nor the "longdesc" tag, the automated software tool counts the image as an error twice. That is, the automated software tool provides redundant counts of web accessibility errors. These redundant counts lead to the high errors found in the first evaluation and the high adjusted accessibility errors related to images (see row B and D in Table 1 and Table 2).

On the other hand, the automated software tool could not determine whether the text included in the "alt" or the "longdesc" tags provides an equivalent and sufficient description of the image. For example, the tag: alt = "mogaha" may not sufficiently explain that the image is the picture of the Ministry of Government Administration and Home Affairs building.

This accessibility error could be detected only by the judgment of human experts.

(2) Flickers

Although a flickering or flashing screen may add attractiveness and draw attention to the webpage, because of the serious risk of seizures that flickers may pose to some users, a checkpoint in priority 1 suggests avoiding causing the screen to flicker. Thus, all flickers detected in both the Korean and the U.S. government websites were considered the accessibility problems and had the accessibility error rate of 100% (see Table 1 and Table 2).

Unfortunately, WCAG provide no clear criteria for determining actual flickers. Under a particular condition (see definition of flicker in Appendix A), a flickering or flashing screen may cause seizures in users with photosensitive epilepsy. Thus, when evaluating web accessibility problems related to flickers, we will require visual confirmation by human experts and some other additional methods (e.g., measuring the flickering rate) to determine whether the non-text information content operates in the particular condition leading to seizures in users with photosensitive epilepsy.

(3) Tables

Because tables are visually formatted in a rectangular grid of cells and headers, websites may include tables to represent logical relationships among data. Thus, checkpoints in priority 1 require every data table to identify its row and column headers and to use markup tags to associate its data cells and header cells. The following example in Figure 1 shows a simple table on a webpage, its HTML code, and how assistive technologies (e.g., speech synthesizers, Braille-based devices) may render this table for users with visual disabilities. Additionally, checkpoints in priority 2 suggest that web developers not use tables for layouts and that, if a table is used for a layout, web developers not use any structural markup for the purposes of visual formatting.

Name	Exam 1	Exam 2	Exam 3
Joe	10	10	10
Jim	7	8	9

```
<TABLE>
<TR>
  <TH id="t1">Name</TH>
  <TH id="t2">Exam 1</TH>
  <TH id="t3">Exam 2</TH>
  <TH id="t4">Exam 3</TH>
<TR>
  <TD headers="t1">Joe</TD>
  <TD headers="t2">10</TD>
  <TD headers="t3">10</TD>
  <TD headers="t4">10</TD>
<TR>
  <TD headers="t1">Jim</TD>
  <TD headers="t2">7</TD>
  <TD headers="t3">8</TD>
  <TD headers="t4">9</TD>
</TABLE>
```

Assistive technologies may render the above table as follows:

Name: Joe, Exam 1: 10, Exam 2: 10, Exam 3: 10

Name: Jim, Exam 1: 7, Exam 2: 8, Exam 3: 9

With tags to associate data cells and header cells, the table and its data can be properly linearized (i.e., contents of a table are converted into text format) by the assistive technologies.

Fig. 1 Rendering Tables on Webpages

The accessibility error rates related to the checkpoints in priority 1 for both the Korean and the U.S. websites are virtually zero. However, the study results in Table 1 and Table 2 show that table is the non-text information content group having the second highest accessibility error rates. These accessibility error rates arise from tables embedded on webpages being used for layout, rather than for data presentation. Some layout tables include structural markup tags to visually format images, text and other information on webpages. Sometimes these markup tags prevent the assistive technologies to render the table correctly.

For example, Figure 2 shows a nested table used for layout. This table includes a sub-table used to present data and thus provides markup tags to associate data cells and header cells. In this example the automated software tool would report the “Table (layout) may not linearize properly” accessibility error. In this case, the human experts would

check this reported error by reviewing the table's HTML code and manually testing the table's linearization using the assistive technology (i.e., IBM Home Page Reader). We often found that the HTML code properly provided markup tags to associate data cells and header cells and the assistive technology could render the table correctly. Thus, we eliminated some accessibility errors reported by the automated software tool. This leads to the result that the number of adjusted accessibility errors for table is higher than 70% (see the results in Table 1 and Table 2).

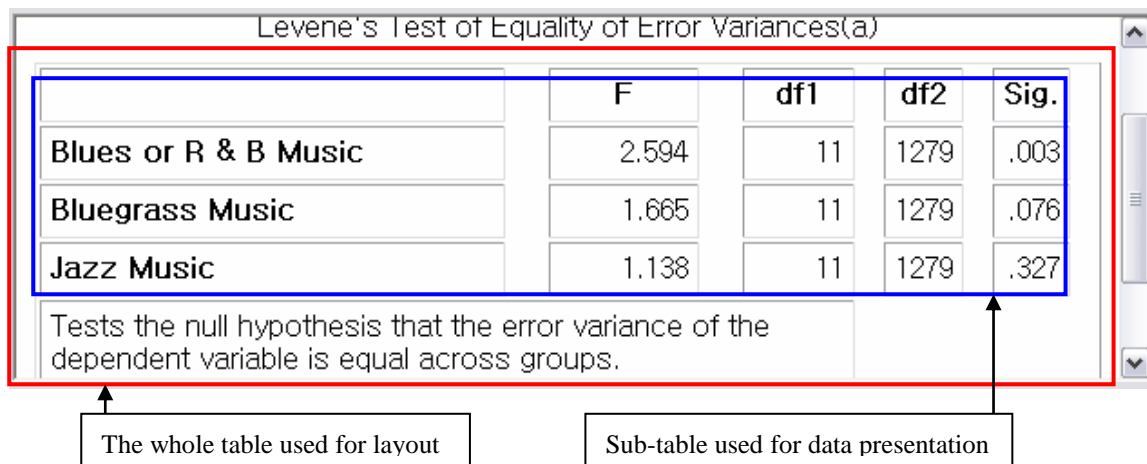


Fig.2 Table used for layout

(4) Applets / Scripts

A checkpoint in priority 1 requires webpages to be usable when applets / scripts are turned off or not supported and, if this is not possible, to provide equivalent information on an alternative accessible page. In addition, a checkpoint in priority 2 requires that the event handlers for applets / scripts be input device-independent. Accordingly, the common errors found for applets / scripts are related to “alternative text to script not available” and “script not keyboard accessible” issues.

In some websites, the applets / scripts are defined at the top of the HTML code and, when needed, they can be called many times by the functions / events in the main body of the HTML code. To check the accessibility errors related to applets / scripts, both the automated software tool and the human experts examined the functions / events that call the applets / scripts, rather than the applets / scripts themselves. Thus, this could result in higher number of errors related to applets / scripts than the actual number of applets / scripts.

In the first evaluation conducted with the automated software tool, the majority of applets /scripts accessibility errors identified by the automated tool were “script not keyboard accessible.” That is, the automated software tool detected that the functions / events may use device-dependent event handlers (e.g., OnMouseOver, OnMouseUp) instead of device-independent event handlers (e.g., OnFocus). However, in the second evaluation conducted by human experts, after reviewing and manually testing the HTML code of the problematic functions / events, the human experts were able to execute more than half of these problematic functions / events with a keyboard.

Interestingly, the number of applets / scripts used in the Korean government websites is much higher than that in the U.S. government websites (358 vs. 19 in 2004 and 243 vs. 17 in 2007, see Table 1 and Table 2). This may provide another evidence indicating dissimilarity in the websites' information provision and expression due to cultural differences between the two countries.

(5) Frames

A checkpoint in priority 1 requires a frame title to facilitate frame identification and navigation; additionally, a checkpoint in priority 2 requires a description of the frame's purpose and how frames relate to each other if it is not obvious from the frames' titles alone.

In 2004 (see Table 1), the four Korean government websites used eight frames, compared to only three frames found in the four U.S. government websites. This finding suggests that the Korean websites tended to use multiple frames on

each webpage, while the U.S. websites used only a single frame on each webpage. When a webpage includes multiple frames for page layout, it should be possible for users to move from one frame to another by using keyboard (i.e., tab key). Thus, the common frame accessibility problem found among the four Korean websites was that access to frame contents through the use of a screen reader or keyboard did not work properly between frames. We found this problem in more than half of the frames used in the four Korean websites (62.5% error rate). In contrast, the four U.S. websites did not exhibit this “moving between frames” accessibility error (0% error rate) because the U.S. websites used only a single frame on each webpage.

Thus, the recommendation is to use a single frame to prevent the “moving between frames” accessibility error. This could be seen in the result found from the current 2007 accessibility error rate that both the Korean and the U.S. government websites do not have any accessibility error related to frame (see Table 2).

(6) Navigation

A navigation mechanism is any means by which a user can navigate the website. The checkpoints in WCAG focus mainly on providing clear navigation mechanisms, including a clear identity of the target of each link, a precise description of items in the website, a textual site map or table of contents to present the website’s general layout, and a consistent style of navigation mechanism on each webpage.

In the first evaluation conducted by the automated software tool, the software tool reported two common accessibility errors related to navigation – the errors from lack of clear link identification and from opening new browser window. However, from the second evaluation manually conducted by human experts, the results in row D in Table 1 and Table 2 indicate that the adjusted accessibility error rates related to navigation are somewhat high, especially for the U.S. government websites (97.6% and 76.3% in 2004 and 2007 respectively).

The high adjusted error rates arise because the automated software tool does not have human intuition to judge whether the navigation provides clear link identification. For example, the automated software tool would originally report the “link should indicate significance” error for Search by Top 20 Requested Items and Search by Forms links. However, a user browsing the web would know which website he is at and would understand its context. Human intuition would enable this user to predict the link’s target by reading or hearing the link’s descriptions: Search by Top 20 Requested Items or Search by Forms. In this case, the message “link should indicate significance” provided by the automated software tool does not really indicate an accessibility error. This message is nevertheless helpful and serves as a warning message alerting us to verify whether the link’s description is meaningful; that is, to ask ourselves, “Can we predict the link’s target by reading the link’s description?”

On the other hand, opening new browser window may be convenient for normal users who can easily see the new browser window, close this new browser window, and come back to the original browser window to continue reading the content on the main webpage. However, this is not a case for especially users with visual impairs. Thus, for any navigation link opening a new browser window, a warning message or notification mechanism must be provided to inform the visually impaired users. When this warning message or notification mechanism is missing, it is an accessibility error. This error type constitutes the most number of errors for the navigation non-text information content group.

4. Conclusion

In this study we evaluated four Korean government and four U.S. government websites in 2004 and 2007. The evaluation was based on priorities 1 and 2 of the WCAG. The non-text information content in the websites was categorized into six content groups: images, flickers, tables, applets / scripts, frames, and navigation. The initial evaluation conducted by using the automated software tool was followed by a manual evaluation by human experts. The manual evaluation was conducted by reviewing the HTML code and testing the websites with the assistive technology.

Accessibility errors were found in virtually all six non-text information content groups, especially among the four Korean government websites in 2004. The errors in web accessibility could be improved if web developers were more aware of the limitations of the elderly and the disabled. Web developers need to make stronger efforts to develop accessible websites for everyone. Overall accessibility errors in 2007 found from the four Korean government websites were still approximately two times higher than those from the four U.S. government websites. This may

suggest the need for legal enforcement or other additional mechanisms in Korea to improve web accessibility among Korean organizations.

Additionally, the study shows a disappointing result that the four U.S. government websites have poorer accessibility error rates in 2007 than that in 2004 because of the new design of one website in the group. This result suggests that accessibility of the website be regularly evaluated, especially every time after the website is updated or changed.

Results of the manual evaluation reported fewer accessibility errors than those reported in the first evaluation conducted by the automated software tool. This study discussed the sources of redundancies in accessibility errors identified by the automated software tool. The automated software tool is useful for determining potential accessibility errors. However, judgment from human experts and results from manual testing are necessary to correctly identify accessibility errors.

It is expected that the results of this study can help to expedite efforts to implement policies that bridge the information gap and provide equal Internet opportunities for the elderly and the disabled. Additionally, the potential problems or redundant accessibility errors identified by the automated software tools discussed in this study shall encourage research activities to improve these software tools. Furthermore, weighted values may be given according to the importance of each type of information content to develop an accessibility index based on factors such as culture, website characteristics and types of organizations.

Similar to any other empirical study, this study has certain limitations. First, the websites evaluated in this study were from only two countries. Second, the study evaluated only four government websites from each country, resulting in only eight websites being evaluated. Third, in the first evaluation, only one automated software tool was used to identify accessibility errors in the websites. Similarly, in the second evaluation, only one assistive technology was used to manually test the websites' accessibility errors. Finally, this study was conducted only in 2004 and 2007. It may not be sufficient to be considered a longitudinal study. Websites can be frequently redesigned, and their accessibility may change. Therefore, generalization of this study's findings may be inappropriate, and researchers should exercise their judgment in extrapolating the results of this study.

Table 1 The 2004 Accessibility Error Rate

	Six non-text information contents	Image	Flicker	Table	Applet/ Script	Frame	Navigation	Total
	Four Korean government websites	A. Number of non-text information items	535 (33.4%) ^a	15 (0.9%) ^a	149 (9.3%) ^a	358 (22.4%) ^a	8 (0.5%) ^a	536 (33.5%) ^a
B. Number of non-text information items with accessibility problems – result found from the first evaluation		821	15	141	210	6	140	1333
C. Number of non-text information items with accessibility problems – result found from the second evaluation		339 (58.8%) ^a	15 (2.6%) ^a	54 (9.4%) ^a	59 (10.2%) ^a	5 (0.9%) ^a	105 (18.2%) ^a	577 (100.0%) ^a
D. Number of adjusted accessibility errors		482 (58.7%) ^b	0 (0.0%) ^b	87 (61.7%) ^b	151 (71.9%) ^b	1 (16.7%) ^b	35 (25.0%) ^b	756 (56.7%) ^b
E. Accessibility error rate (C/A)		63.4%	100.0%	36.2%	16.5%	62.5%	19.6%	36.0%
Six non-text information contents		Image	Flicker	Table	Applet/ Script	Frame	Navigation	Total
Four U.S. government websites	A. Number of non-text information items	298 (40.8%) ^a	0 (0.0%) ^a	89 (12.2%) ^a	19 (2.6%) ^a	3 (0.4%) ^a	322 (44.0%) ^a	731 (100.0%) ^a
	B. Number of non-text information items with accessibility problems – result found from the first evaluation	298	0	89	12	0	42	441
	C. Number of non-text information items with accessibility problems – result found from the second evaluation	4 (21.1%) ^a	0 (0.0%) ^a	14 (73.7%) ^a	0 (0.0%) ^a	0 (0.0%) ^a	1 (5.3%) ^a	19 (100.0%) ^a
	D. Number of adjusted accessibility errors	294 (98.7%) ^b	0 (0.0%) ^b	75 (84.3%) ^b	12 (100.0%) ^b	0 (0.0%) ^b	41 (97.6%) ^b	422 (95.7%) ^b
	E. Accessibility error rate (C/A)	1.3%	0.0%	15.7%	0.0%	0.0%	0.3%	2.6%

^a Percentage of the row's total

^b Percentage of row B: number of non-text information contents with accessibility problems – result found in the first evaluation

Table 2 The Current 2007 Accessibility Error Rate

	Six non-text information contents	Image	Flicker	Table	Applet/ Script	Frame	Navigation	Total
	Four Korean government websites	A. Number of non-text information items	714 (32.9%) ^a	31 (1.4%) ^a	184 (8.5%) ^a	243 (11.2%) ^a	4 (0.2%) ^a	992 (45.8%) ^a
B. Number of non-text information items with accessibility problems – result found from the first evaluation		696	31	177	89	0	245	1238
C. Number of non-text information items with accessibility problems – result found from the second evaluation		39 (12.2%) ^a	31 (9.7%) ^a	49 (15.3%) ^a	50 (15.6%) ^a	0 (0.0%) ^a	151 (47.2%) ^a	320 (100.0%) ^a
D. Number of adjusted accessibility errors		657 (94.4%) ^b	0 (0.0%) ^b	128 (72.3%) ^b	39 (43.8%) ^b	0 (0.0%) ^b	94 (38.4%) ^b	918 (74.2%) ^b
E. Accessibility error rate (C/A)		5.5%	100.0%	26.6%	20.6%	0.0%	15.2%	14.8%
	Six non-text information contents	Image	Flicker	Table	Applet/ Script	Frame	Navigation	Total
	Four U.S. government websites	A. Number of non-text information items	262 (29.1%) ^a	3 (0.3%) ^a	110 (12.2%) ^a	17 (1.9%) ^a	4 (0.4%) ^a	505 (56.0%) ^a
B. Number of non-text information items with accessibility problems – result found from the first evaluation		259	3	112	31*	0	93	498
C. Number of non-text information items with accessibility problems – result found from the second evaluation		11 (19.6%) ^a	3 (5.4%) ^a	19 (33.9%) ^a	1 (1.8%) ^a	0 (0.0%) ^a	22 (39.3%) ^a	56 (100.0%) ^a
D. Number of adjusted accessibility errors		248 (95.8%) ^b	0 (0.0%) ^b	93 (83.0%) ^b	30 (96.8%) ^b	0 (0.0%) ^b	71 (76.3%) ^b	442 (88.8%) ^b
E. Accessibility error rate (C/A)		4.2%	100.0%	17.3%	5.9%	0.0%	4.4%	6.2%

* Some applets / scripts can be called many times. Accessibility errors for applets / scripts are based on the functions / events that call the applets / scripts, rather than the actual number of applets / scripts.

^a Percentage of the row's total

^b Percentage of row B: number of non-text information contents with accessibility problems – result found in the first evaluation

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Appendix A: Non-Text Information Contents

Image

A graphical presentation.

Flicker

A flickering or flashing screen may cause seizures in users with photosensitive epilepsy. Seizures can be triggered by flickering or flashing in the 4 to 59 flashes per second (Hertz) range with a peak sensitivity at 20 flashes per second as well as quick changes from dark to light (like strobe lights).

Table

When tables are used to represent logical relationships among data – text, numbers, images, etc., that information is called “tabular information” and the tables are called “data tables.” Authors may specify these relationships among data by the visual formatting of a table as a rectangular grid of cells and headers. Rows and columns of cells may be organized into row groups and column groups. Rows, columns, row groups, row columns, and cells may have borders drawn around them. Authors may align data vertically or horizontally within a cell and align data in all cells of a row or column.

Applets / Scripts

A program inserted into a Web page. This program will be automatically downloaded and run on the user’s machine.

Frame

Frames allow authors to present documents in multiple views, which may be independent windows or subwindows. Multiple views offer designers a way to keep certain information visible, while other views are scrolled or replaced. For example, within the same window, one frame might display a static banner, a second a navigation menu, and a third the main document that can be scrolled through or replaced by navigating in the second frame.

Navigation

Navigation mechanism is any means by which a user can navigate a page or site. Some typical navigation mechanisms include:

navigation bars : A navigation bar is a collection of links to the most important parts of a document or site.

site maps : A site map provides a global view of the organization of a page or site.

tables of contents : A table of contents generally lists (and links to) the most important sections of a document.