# Usability of E-Government Web-Sites for People with Disabilities

Chaomeng James Huang
*Shih-Hsin University*
*chuang@cc.shu.edu.tw*

## Abstract

*While the proportion of people with disabilities in society has been rapidly increasing due to the demographic trends long documented by many researchers, governmental leaders have paid little attention to their needs when planning and implementing Web projects. If this ignorance continues, people with disabilities will be even more disadvantaged since acquiring knowledge is now much easier for those without disabilities. This study is intended to provide an in-depth evaluation of the Web sites of Taiwan's central government based on the Web Content Accessibility (WCA) Guidelines provided by W3C. Based on the WCA Guidelines, the authors carefully studied and coded each individual Web site of the central governmental agencies. The coding results indicate that the governmental Web sites in general have made many of the mistakes warned against. In light of these research findings, this paper offers a number of strategies to improve the Web design practices in Taiwan that may also apply to public organizations in general.*

## 1. Introduction

The Internet has emerged as an integral part of human society. The gathering and sharing of electronic information are becoming essential elements of modern life. Access to the Internet, to a large extent, decides whether or not one can fully participate in the increasingly turbulent and networked world. Therefore, it is important to ensure that people, especially those with disabilities, have equal opportunities to benefit from the Web, especially from on-line public services.

While many people describe the Web as a low cost, all encompassing, and far-reaching medium (Parker, 1997), it is really not accessible to everyone. The proportion of people with disabilities in society has been increasing due to the demographic trends long documented by many researchers (e.g. U.S. Office of Personnel Management, 1988; Barth et al., 1993; West, 1998). Nevertheless, government leaders have paid little attention to the needs of people with disabilities when planning and implementing Web projects, and hence many critical on-line public activities and customer services are not readily available to the disabled. In short, a critical challenge facing all governmental agencies is how to make the massive volume of information being published on public sector Websites accessible to every citizen they serve.

Following the reinventing government movement in the U.S. (Gore, 1994; Osborne & Gaebler, 1992), the central government of Taiwan launched its own large-scale administrative reform aimed at modernizing the governmental services soon after the reelection of the President Lee Teng-Hui in 1996. A major theme of the reform effort has been to establish an "electronic government," and the first step was to help the government agencies go on-line (Wei, 1999). By the time this study was conducted, this reform had been underway for about five years. All of the central agencies have established their own Web sites for at least four years, but there has been virtually no systematic evaluation to justify these efforts to go on-line.

To be sure, the increasing transparency of the Internet has certainly led to questions concerning its impact on the administrative ethics of public employees (Menzel, 1998) as well as on the personal and organizational behavior of citizens (e.g. Hsian, 1999). However, there is a lack of evaluation of the contents of governmental Web sites. This research is intended to provide an accessibility assessment of the Web sites of the central governmental agencies in Taiwan, to ensure that the web-based public services in Taiwan are implemented in an equitable manner, and to provide policy recommendations for e-government managers in general.

## 2. Research conceptualization

The use of Web technology often has particular potential benefits for many people with disabilities. For example, for people who are visually impaired, the earlier text-based Internet sites opened a world of information that was previously off-limits. "For the first time in history, it is now possible for many people with disabilities to get information right from its original source (rather than waiting for Braille translations, etc.)" (Christensen, 2001:

30) Unfortunately, with their focus on structuring and sharing documents, the originators of the Web ignored the visual logic or graphic design aspects of Web information delivery that are now stymieing blind users today. Due to the fact that the Web continues to increasingly embrace colors, graphics, motion pictures, audio, and the other dynamic elements, the current Web design practices have caused more difficulties for disabled individuals trying to benefit equally from society. A recent study shows that the usability of most current Web sites is on average three times higher for users without disabilities than for those who are blind or have low vision (Nielsen, 2001). Another research project published by Forrester Research (Souza & Manning, 2000) found that only one in four e-commerce sites it surveyed met even minimum requirements provided by the Web Accessibility Initiative (www.w3.org/WAI/) for disabled Web users, such as providing text descriptions of images for the blind. Waddell (1998) calls the Web "the growing digital divide in access for people with disabilities." Even in the public sector of the U.S., where Web accessibility is legally mandated, a significant number of official Web sites still contain features that do not provide reasonable access to disabled users (Gant and Gant, 2002).

## 2.1 Characteristics of the Web

The Web can be considered as a multifaceted mass medium that contains many different configurations of communication (Morris & Ogan, 1996). As Lynch and Horton (1999) pointed out, the originators of the Web intended the Web to be a device-independent method for exchanging documents across many different platforms. The glue that holds the modern Internet world together is the Web programming language, namely HTML (Hypertext Markup Language). The term "Hypertext" was first coined by Theodor Holme Nelson, a recognized ideologist of Hypertext, in reference to a radically new way of storing and viewing information. Instead of gathering or retrieving information sequentially, information recorded with Hypertext is fashioned in multiple layers. An automated index is built into the Web document. The intertextuality and non-linearity of HTML enable Web pages to connect various virtual contents with specific "links" which allow on-line users to move among points and "nodes" (Howell, 1992).

Therefore, Web pages are more than printed pages posted electronically. The Web offers many new opportunities as well as challenges to modern organizations (Parker, 1997; Mitra & Cohen, 1999). First of all, the Web makes it easy to transmit information in a timely fashion. Changes to a Web site can be published in a relatively short time when compared to the lengthy processes of redesigning, production and distribution processes that are necessary for most printed media. Secondly, Web pages can include larger amounts and a greater variety of information without incurring major printing and distribution costs. On the Web, costs do not necessarily increase as the amount of information being communicated increases. Furthermore, multimedia objects, including drawing, photographs, animation, sound, video, and computer applications, can be incorporated into Web pages at a low cost to enhance the Web's communication effects.

One Web characteristic that sets Web development apart from traditional media design is the lack of control. Unlike designers of printed media, a Web designer somewhat loses control over how on-line users will browse through the pages, the appearance of the fonts and colors used on a page, and the size, proportions and exact locations of the different Web texts. On the Web, users largely determine their own navigation paths, and they are free to "jump" to any location that interests them. In addition, designers cannot know the exact computer equipment that the various potential users have, or what fonts and software have been installed in the users' computers. The exact way WWW pages present information would be partly determined by the users' own environment.

Therefore, Web content should ideally be designed in a way that the users using different agents (for example, desktop computers, mobile phones, televisions, PDA, et al.), with different Web browsers (for example, Lynx, Netscape Navigator, Internet Explorer…), and under different constraints can all access. In short, Web accessibility is not only concerned with disabilities, but also with the ideal that anyone using any kind of Web browsing technology can access and get full and complete information within it (Letourneau, 2000).

## 2.2 Reasons for providing Web accessibility

There are more than 750 million people with disabilities worldwide (at least 6 million in the United States alone). As noted earlier, at a time when the number of people with disabilities is increasing as the population ages, our society has become one that depends more and more on computers and digital technology for work, education and entertainment. Participating in the digital economy by definition requires the ability to access and use the Web. It is hence important to make every possible Web site accessible. As the director of World Wide Web Consortium and inventor of the Web, Tim Berner-lee (http://www.w3.org/WAI/), stated, "the power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect".

In addition to common human decency, the most obvious reason to make governmental Web sites accessible to the disabled is to comply with the law. The Americans with Disabilities Act (ADA), Section 508 and similar laws and regulations in other countries (Paciello, 2000: 39-44) often mandate the establishment of means to allow the disabled access to the same information and use of the same tools as anyone else on the Web. For example, the ADA requires "reasonable accommodations" and "effective communication" in areas of employment, public services, and telecommunication services. With the popularity of e-government and e-commerce, the foci of the law have changed to include the Internet (Sager, 2000). Section 508 of the Rehabilitation Act defines the processes used by the federal government to procure electronic and information technology. One of the most important foci of the law is to ensure access to electronic and information technology made available to people with disabilities who are federal employees or members of the general public. In Canada, the Equity and Diversity Directorate of the Public Service Commission was the first national institution to publish Web accessibility guidelines to ensure that all governmental Web pages and associated electronic data was accessible to every Web user.

Although Taiwan has not yet developed specific laws or regulations regarding Web accessibility, it has enacted several legislations and governmental regulations similar to the ADA. Until recently these laws and regulations were mainly concerned with the topics of employment, transportation and public facilities. However, it is only a matter of time before the governmental Web sites in Taiwan come under political and legal challenges for not being accessible to the disabled. It seems likely that in time the Web-based services will be held to the same standards as the services or facility architecture of the physical world in the courts.

Moreover, making a Web site so accessible could be a competitive advantage economically. Many companies have found that creating accessibility on their Web sites is cost-effective and generally good business practice (Solomon, 2000). According to a report published by Forrester Research (Souza, Manning, and Dorsey, 2001), Global 3,500 companies are estimated to spend $560 million to retrofit their web sites to meet W3C Web Accessibility Initiative guidelines. E-commerce companies, such as Amazon.com, are making their web sites accessible so as to gain a share of the $175 billion in discretionary income controlled by consumers with disabilities (Amazon.com's press release December 6, 2001; Prager, 1999). Sixty-eight percent of consumers between 45 and 54 years old are on-line and nearly one-fourth have a disability (US Census). The authors conclude: "Companies must plan site design projects keeping people with disabilities in mind. Doing so is cost-effective -- especially if accessibility is part of the planning, development, and maintenance process."

Indeed, disabled Web users often become very loyal customers once they find a Web site that accommodates their special needs (Rogers and Rajkumar, 1999; Nielsen, 2000). Accessible Web design also enables low technology to access high technology. More specifically, accessible Web design features enable video and audio elements on the Web to be archived with word search capabilities, and text to be converted into speech by screen readers, and hence senior citizens, people in underdeveloped countries, and even those who are illiterate are also likely to benefit from accessible Web design, since the Web text can be simultaneously presented auditorily through a voice synthesizer. On the other hand, organizations that do not make their Web sites accessible to people with disabilities are not only missing out on marketing opportunities but also facing further financial pitfalls from civil rights organizations pursuing litigation (Kautzman, 1998).

Once the large commercial Web sites in the private sector are accessible, people with disabilities will come to expect the same on-line relationship with government agencies as that they have with businesses. For agencies at all levels of government, the Internet provides an ideal medium to the citizens who used to be relatively alienated from many public services. However, the current government Web site planners and production staff are often not aware of the critical importance of this issue and hence erect various barriers between their on-line services and the disabled constituents (Gant & Gant, 2002; Office of Government Services, Andersen, 2002).

## 2.3 Web accessibility standards: Web content accessibility guidelines

To promote interest in Web accessibility, several hardware and operating system developers, non-profit assistive technology developers, and application software manufacturers have worked to make equal access to the Web possible. The World Wide Consortium (W3C) launched the Web Accessibility Initiative (WAI) in April 1997. Under the direction of The WAI International Program Office director, the WAI team has developed an in-depth and detailed set of Web Content Accessibility Guidelines (WCA Guidelines 1.0; http://web1.w3.org/TR/ WAI-WEBCONTENT/). , and associated checklists.

The WCA Guidelines address two general themes: ensuring graceful transformation to accessible designs, and making content understandable and navigable. They are composed of fourteen specific guidelines, with each including the rationale behind the guideline and a list of

checkpoint definitions. Each checkpoint is assigned a priority level by the WAI Team based on the checkpoint's impact on accessibility. Specifically, Web pages must meet the requirements of priority 1 guidelines. Otherwise, one or more groups of users will find it impossible to access the information in the Web page. Priority 2 indicates that Web content developer should satisfy this checkpoint or one or more groups will find it difficult to access information in the document. Finally, Priority 3 means that a Web content developer may address this checkpoint to improve access to Web documents.

The WCA guidelines are recognized as the authority for designing and creating accessible Web sites, and have been used by several software developers to develop accessibility authoring and checking tools (Tillett, 2001). For example, BOBBY (www.cast.org/bobby/), whose design is based on the W3C Accessibility Guidelines for Page Authoring, is provided as a free on-line service to analyze single Web pages for their accessibility to people with disabilities. Macromedia also joins the effort by providing an on-line checking tool to help Web producers create accessible Web sites.

Overall, making a Web site accessible does not mean minimal Web page design. "The focus is to promote the design of Web sites that are highly usable for the greatest number of surfers" (Paciello, 2000: 50). A Web site designed for accessibility usually enhances its usability for all people, regardless of ability.

## 3. Research Methods

This study is intended to provide an accessibility evaluation of the thirty-five official homepages of Taiwan's central governmental agencies based on the Web Content Accessibility Guidelines published by the W3C. This research uses a form of the case survey method advocated by Yin and Heald (1975) to assess the degree to which each of the homepages committed Web design mistakes. Web improvement recommendations are then made based on the collection and analysis of the identified design problems.

To establish the framework for analyzing the Web sites of the public agencies, fourteen Web accessibility indicators were extracted from the priority 1 checkpoints of the WCA guidelines (Table 1). It should be noted that while all of the checkpoints are applicable to evaluating various Web sites, only the indicators whose relevant dimensions could be objectively captured on-line were selected for this study. For example, while failing to "use the clearest and simplest language appropriate for a site's content" (checkpoint 14.1) could be a major mistake of Web sites, this standard was not included since it was difficult for the coders to objectively decide if some text is "clear and simple."

**Table 1—Accessibility Indicators**

**Guideline 1. Provide equivalent alternatives to auditory and visual content**
1. Provide a text equivalent for every non-text element
2. Provide redundant text links for each active region of a server-side image map
3. Provide an auditory description of the important information of the visual track of a multimedia presentation
4. For time-based multimedia presentation, synchronize equivalent alternatives with the presentation

**Guideline 2. Don't rely on color alone.**
1. Ensure that all information conveyed with color is also available without color

**Guideline 5. Create tables that transform gracefully**
1. For data tables identify row and column headers
2. For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.

**Guideline 6. Ensure that pages featuring new technologies transform gracefully**
1. Organize documents so they may be read without style sheets
2. Ensure that equivalents for dynamic content are updated when the dynamic content changes
3. Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page

**Guideline 7. Ensure user control of time-sensitive content changes**
1. Provide alternative equivalent design to time-sensitive content
2. Provide user control of time-sensitive content

**Guideline 11. Use W3C technologies and guidelines**
1. Provide a link to an alternative page that uses W3C technologies, that is accessible, and has *equivalent* information (or functionality) to files of non-W3C formats (e.g., PDF, Shockwave, etc.)

**Guideline 12. Provide context and orientation information**
1. Title each frame to facilitate frame identification and navigation

The author organized a panel of coders composed of six public administration graduate students enrolled in an information management program. These students conducted structured content evaluation on each of the existing thirty-five Web sites of the national level executive agencies. Each individual homepage was

carefully studied and coded on the fourteen indicators between September 23, 2001 and October 3, 2001. The coders were asked to rate the assigned homepages on each of the selected dimensions using a yes-no scale, with 0 being "no problem on this dimension", and 1 being "problem identified." In other words, a perfect Web site would be scored as 0 and the most problematic would be scored as a 14. To enhance the validity of the study, all of the homepages were examined by two groups of coders using both GUI (Microsoft Internet Explorer 5.0) and text (Lynx) browsers. Whenever an unmatched result was found, the author would ask the coders to re-examine the homepage, and then make a collective decision on the rating.

## 4. Findings

No homepage received a perfect score of 0 (scored as 0— "no problem"— on all of the 14 indicators). The number of accessibility mistakes which appeared on each of the agency homepages is between two and seven (see Table 2). The best score of 2 was achieved by six agencies including the the Ministry of Interior, the Ministry of Foreign Affairs, the Coast Guard Administration, the Veterans Affairs Commission, the Central Election Commission, and the Aviation Safety Council. On the other hand, the homepages of the The Ministry of Finance and the Consumer Protection Commission contain the most mistakes identified in this study. As Table 2 shows, the most common problems on the homepages of the central governmental agencies were failing to "provide a text equivalent for every non-text element", "organize documents so they may be read without style sheets," "identify row and column headers for data tables," and "provide user control of time-sensitive content.".

Specifically, the first four items are extracted from WCA Guideline 1. This guideline emphasizes the importance of providing text equivalents of non-text content such as images and pre-recorded audio. In practice, Web designers should at least use "alt" for the IMG, INPUT, APPLET elements, and image map areas, and for complex content, provide an additional description using, for example, a description link. As Table 2 shows, the item that received the worst socre in the table is failing to "provide a text equivalent for every non-text element." Among the thirty-five agencies, twenty-five homepages were found to have problems on this indicator.

On the other hand, providing non-text equivalents (e.g., pre-recorded audio) of text could also be beneficial to nonreaders or people who have difficulty reading. Three homepages lacked an "auditory description of the important information of the visual track of a multimedia presentation." Moreover, none of the three agencies synchronized any equivalent alternatives with the presentation.

The fifth indicator was extracted from Guideline 2. Since people who are color blind or using a text browser (such as Lynx) cannot perceive color differences, this guideline requires Web producers to ensure that all information conveyed with color is also available without color. While no agency in this study was found to have this problem, Web managers should still keep this principle in mind and always test all graphic elements on a color monitor and on a black and white monitor, or seek regular feedback from color blind users.

WCA Guideline 5 is mainly concerned with the usage of tables. Web pages with tables are another classic accessibility barrier. Many visual designers use tables as the only way to place objects or text on specific positions of a page. However, while some user agents allow users to navigate among table cells and access table cell information, most screen readers cannot distinguish or interpret a Web page designed with tables, especially when the page is embedded with multiple tables. Therefore, it is advised that table design should be reserved for true data tables. In addition, tables used to organize information on Web pages should have a simple structure and a logical tab order that is consistent throughout the site (Williams, 2001).

Two indicators come under this guideline. One of them is "for data tables identify row and column headers." Among the Web sites surveyed, nine agencies (26%) did not use TD to identify data cells and TH to identify headers of the tables presented in their homepages.

In addition, screen readers can only read lines of information from left to right, and top to bottom. Therefore, a table must be set up in a logical way to facilitate the correct reading sequence. The other indicator under Guideline 5 was used to examine whether the agencies use appropriate markups (e.g. THEAD, TFOOT, and TBODY can be used to group rows. COL and COLGROUP can be used to group columns) to associate data cells and header cells for data tables that have two or more logical levels of row or column headers. Nearly half of the homepages surveyed showed some tables without appropriate markups of the logical levels of their rows and columns.

Any Web site that features the latest technology often requires the users to install new hardware and/or software, and hence presents enormous barriers to the disabled that may not have a user agent capable of deciphering the Web content. Therefore, ensuring that pages are accessible even when newer technologies are not supported or are turned off is important to Web accessibility.

The next three indicators comprise this dimension. First of all, Web content should be organized in such a way that they may be read without style sheets. A style sheet is a set of statements that specify the presentation of

a document. According to the survey results, most (63%) homepages of the agencies are difficult to read without the support of style sheets due to the specifications of document structures within their respective style sheets.

Similarly, Web pages should be usable when scripts, applets, or other programmatic objects are turned off or not supported since most screen readers do not support these new design tools. However, fourteen (40%) agencies were found to have this problem. Even so, none of these agencies provided equivalent information on an alternative accessible page.

Guideline 7 stresses the importance of providing user control of time-sensitive content changes including moving and regularly updating objects in a Web page. Moving images have an overpowering effect on the human peripheral vision. It is very difficult for the user to concentrate on reading text in the middle of a Web page if there is a running animation hanging up in the corner (Huang, 2001).

Among the thirty-five agencies surveyed in this study, twelve agencies (34%) did not provide alternative equivalent designs to time-sensitive content even though they contained relatively large animations. Furthermore, fifteen homepages (43%) failed to provide users with control of the time-sensitive content, such as allowing users to change presentation at a regular rate, or to turn on and off the animation.

Guideline 11 advises Web designers to use W3C technologies and follow accessibility guidelines. Many non-W3C format documents require viewing with either plug-ins or stand-alone applications. Often, these formats cannot be viewed or navigated with standard browsers, especially those of assistive technologies. Therefore, Web designers should avoid using non-W3C features to make Web pages more accessible to more people using a wider variety of hardware and software. Among the agency Web sites, six (17%) contain PDF files, Quicktime movies, Shockwave objects, or Microsoft Office documents.

It is noted by the W3C (http://www.w3.org/ TR/WCAG10/#screen-reader) that while converting the above files to HTML files is technically feasible, the conversion does not always create an accessible document. Therefore, Web designers should validate each page for accessibility and usability after the conversion process.

Guideline 12 is concerned about the navigation support provided in a Web page. The success of any Web site mainly depends on the information architecture presented in the Web page (Rosenfeld and Morville, 1998). Complex relationships between parts of a page are especially difficult for people with visual disabilities to interpret.

The most prevalent problem on many current Web sites is the use of frames. Splitting a Web page into frames is very confusing even for users with perfect eyesight because frames break the unified model of the

Web and introduce a new way of looking at data that has not been well integrated into the other aspects of the Web (Nielsen, 2000). Therefore, failing to title each frame to facilitate frame identification and navigation could cause significant difficulties for all Web users.

This problem is found on thirteen (37%) of the agency homepages analyzed in this study. While several of them did use the "title" attribute on their FRAME elements, none of the titles provided meaningful navigation support. For example, one of the agencies titled the frames of its homepage as "upper frame", "middle frame", and "bottom frame"

## 5. Web design recommendations

The coding results indicate that most of the Web sites in general underserve users with disabilities. While an integrated measure of accessibility for each of the governmental Web sites may be calculated (see Table 2), the Web accessibility indicators presented in this paper are best seen as elements of a multi-dimensional analysis framework. The purpose of this research is to develop a set of observations about the individual homepages that can be used as bases for future improvement.

A few design recommendations that are most important for those seeking to improve the accessibility of governmental Web sites are proposed below based on the findings of this research. One could also extract more design implications from the items listed in the research findings.

### 5.1 Establish a Web strategic planning team

As Solomon (2000) reports, while creating Web accessibility from the ground up would not incur much extra cost, retrofitting an existing site can prove to be much more costly. For example, it was estimated that it cost the Sydney Organizing Committee for the Olympic Games over two million dollars to make Olymics.com accessible due to the legal challenges of several disability advocacy groups (Souza & Manning, 2000).

The most cost-efficient way to make a Web site accessible is to build it in accordance with the WCA guidelines from the beginning. Many of the common mistakes identified on the agency homepages are interrelated and symbolize the failures of coordination between the different phases of the Web site development. To ameliorate these problems, a formal strategic planning system should be adopted by the agencies. Strategic planning has been shown to lead to better development of e-commerce models as well as Web sites (Harmon et al., 2001; Davenport & Prusak, 1997; Goodstein et al., 1993). Successful development of large Web sites usually requires a cross-functional and interdisciplinary team

approach. A formal strategic planning of the Web development process can be used to align the positions of the many stakeholders and to improve the coordination between the Web site producers and the line management functions of the agencies.

## 5.2 Use "alt" Attributes

Failing to provide a text equivalent for every non-text element is the most serious problem identified in this study. The power of text equivalents lies in their capacity to be rendered in ways that are accessible to people from various disability groups using a variety of technologies. Text can be readily connected to speech synthesizers and braille displays, and can be presented visually on computer screens and in print. Currently, the main solution to the text equivalent problem is to include an "alt" attribute in every non-text Web page element. With "alt"s, users who are unable to see an image will see (or hear) the associated alternative text. Therefore, it should be mandated that all of the graphical elements on the governmental Web pages should have alternative text descriptions that make sense and can be interpreted by screen readers.

## 5.3 Provide simple and clear navigation interface

Nielsen (2001) argues that Web sites tend to be produced by young designers, who often assume that all users have perfect vision and motor control, and know everything about the Web. This observation also seems to be a fair way of describing the central governmental agencies' Web sites, to judge from the results of this study.

The designers' assumptions rarely hold, even for users who are not disabled. For blind users and senior citizens whose eyesight and memory are affected, using the Web is mostly an exercise in memory. It is important to keep the overall structure of any Web site as simple as possible, and to minimize the need for the users having to remember or guess the relationships between the different items on a Web page or the information range that they should input.

## 5.4 Be careful about incorporating new technologies

The results of this study show that about 40% of the agencies' homepages are not usable when scripts, applets, or other programmatic objects are turned off or not supported, and most (63%) homepages do not present well without the support of style sheets.

Although multimedia has its role on the Web, many of the latest technologies (such as Flash) tend to considerably decrease Web accessibility. Public managers must acknowledge the limitations of the newest Web technologies, and ensure that people with disabilities can properly interpret the Web pages produced by the government through their user agents. Many advocacy groups have established a variety of resources to help Web producers adapt their sites to accessibility principles. For example, the Trace Research and Development Center at the University of Wisconsin provides a program, MAGpie (http://main.wgbh.org/wgbh /pages/ncam/webaccess/_magpie/), to help add captions to three multimedia formats: Apple's QuickTime, the W3C's synchronized Multimedia Integration Language (SMIL), and Microsoft's Synchronized Accessible Media (SAMI).

## 5.5 Establish Formal Accessibility Rules and Regulations

Several countries including the U.S., Australia and Canada have passed specific legislation to enforce or help promote Web accessibility. Formal legislation enables people with disabilities to exercise their rights and helps public agencies to establish related policies to ensure the access of the disabled to public information and services made available through the Internet. For example, the State of Connecticut has designated a committed chaired by Kathleen Anderson to keep pop-up ads from the state's official Web sites (Olsen, 2001).

This research is not only intended to provide a systematic evaluation of the existing governmental Web sites in Taiwan, but also, hopefully, to offer a useful guide for public managers who are interested in Web accessibility in general to learn how to develop highly usable Web sites for their citizens with disabilities.

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## Table 2 — Accessibility Analysis Results of the Governmental Agencies

| | Provide a text equivalent for every non-text element | Organize documents so they may be read without style sheets | For data tables identify row and column headers | provide user control of time-sensitive content | Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page | Title each frame to facilitate frame identification and navigation | Provide alternative equivalent design to time-sensitive content | For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells. | Provide a link to an alternative page that uses W3C technologies, that is accessible, and has equivalent information to files of non-W3C formats | Provide an auditory description of the important information of the visual track of a multimedia presentation | For time-based multimedia presentation, synchronize equivalent alternatives with the presentation | Provide redundant text links for each active region of a server-side image map | Ensure that equivalents for dynamic content are updated when the dynamic content changes | Ensure that all information conveyed with color is also available without color | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The Ministry of the Interior | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| The Ministry of Foreign Affairs | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Coast Guard Administration | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Veterans Affairs Commission | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Central Election Commission | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Aviation Safety Council | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| The Ministry of National Defense | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| The Ministry of Education | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| The Ministry of Economic Affairs | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| National Science Council | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Council of Agriculture | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| Central Personnel Administration | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Central Bank of China | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Fair Trade Commission | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| The Ministry of Transportation and Communications | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Mongolian & Tibetan Affairs Commission | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Directorate General of Accounting and Statistics | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Government Information Office | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Environmental Protection Administration | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| National Palace Museum | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Council of Labor Affairs | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Public Construction Commission | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Atomic Energy Council | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| The Ministry of Justice | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Overseas Chinese Affairs Commission | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5 |

| | Provide a text equivalent for every non-text element | Organize documents so they may be read without style sheets | For data tables identify row and column headers | provide user control of time-sensitive content | Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page | Title each frame to facilitate frame identification and navigation | Provide alternative equivalent design to time-sensitive content | For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells. | Provide a link to an alternative page that uses W3C technologies, that is accessible, and has equivalent information to files of non-W3C formats | Provide an auditory description of the important information of the visual track of a multimedia presentation | For time-based multimedia presentation, synchronize equivalent alternatives with the presentation | Provide redundant text links for each active region of a server-side image map | Ensure that equivalents for dynamic content are updated when the dynamic content changes | Ensure that all information conveyed with color is also available without color | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Department of Health | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| National Youth Commission | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Research, Development, and Evaluation Commission | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 5 |
| Council for Culture Affairs | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| National Council on Physical Fitness and Sports | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Mainland Affairs Council | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Council for Economic Planning and Development | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Council of Indigenous Peoples | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| The Ministry of Finance | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 7 |
| Consumer Protection Commission | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 7 |
| Dept frequency | 25 | 22 | 17 | 15 | 14 | 13 | 12 | 9 | 6 | 3 | 3 | 0 | 0 | 0 | |