

# Usability of Cloud SaaS based E-Governance for People with Disabilities

B. Gohin  
Research Scholar  
Dept. of Computer Applications  
Dr. M.G.R.  
Educational & Research Institute  
University  
Chennai-95, Tamil Nadu, India

Viji Vinod, PhD.  
Professor & Head  
Dept. of Computer Applications  
Dr. M.G.R.  
Educational & Research Institute  
University  
Chennai-95, Tamil Nadu, India

N.Rajkumar  
Research Scholar  
Dept. of Computer Applications  
Dr. M.G.R.  
Educational & Research Institute  
University  
Chennai-95, Tamil Nadu, India

## ABSTRACT

People with disabilities in society has been rapidly increasing due to the demographic trends long documented by many researchers, now-a-days the governmental leaders have paid little attention to their needs when planning and implementing Cloud SaaS projects. If this ignorance continues in society, people with disabilities will be even more disadvantaged. Since the acquiring knowledge is now much easier for those without any disabilities. This research is intended to provide an in-depth evaluation of the E-Governance sites of India's central government based on the Web Content Accessibility (WCA) Guidelines provided by W3C (World Wide Web Consortium). Based on the WCA Guidelines, we have studied and coded each individual E-Governance site of the central government. The results indicate that the governmental Web sites in general have made many mistakes. In light of these research findings, this paper offers a number of levels to improve the Cloud Based SaaS design practices in India that may also apply to public organizations in general and disability community people can also access the services easily.

## Keywords

Cloud Computing, E-Governance, SaaS, Accessibility, Disabilities, W3C, WCA;

## 1. INTRODUCTION

The Cloud Computing SaaS Architecture has emerged as an integral part of human society [2]. Providing and Getting the electronic information are essential elements of modern life. Accessing the cloud SaaS Services is a large extent, that decides whether or not one can fully participate in the networked Society [1]. So it is important to ensure that people with disabilities, have equal opportunities to benefit from the Cloud Software services, especially from on-line public Cloud services. Many people describes that the Software as a Services is low cost and no need to purchase softwares. But here the problem is the cloud based software services are really not accessible to everyone [8].

People with disabilities in society has been increasing due to the demographic trends long documented by many researchers. The government leaders are giving little attention to the needs of people with disabilities when planning and implementing E-Governance projects development, and hence many critical online public activities and customer

services are not readily available to the disability communities [3]. The critical challenge facing by all governmental agencies is how to make the massive volume of information being published on public sector Websites accessible to every one in the society. The reinventing E-Government movement in the central government of India launched its own largescale administrative reform aimed at modernizing the governmental services and that should be accessible all types of people [11]. This research is intended to provide an accessibility assessment of the E-Governance sites of the central governmental agencies in India, to assure that the Cloud SaaS based public services are implemented in India, based on the w3c guidelines and checklists to support disable people [6].

## 2. RESEARCH CONCEPTUALIZATION

The use of Cloud Computing often has particular potential benefits for many people with disabilities. For example, People who are visually impaired the text-based Cloud Software services opened a world of information that was previously off-limits [4]. Now it is possible for many people with disabilities to get information right from its original source (rather than waiting for Braille translations, etc.). Unfortunately, with their focus on structuring and sharing documents, the originators of the Web ignored the visual logic or graphic design aspects of cloud information delivery that are now stymieing blind users today [12].

Due to the fact that the E-Governance sites continues to increasingly embrace colors, graphics, motion pictures, audio, and the other dynamic elements, the current E-Governance sites design practices have caused more difficulties for disabled individuals trying to benefit equally from this society. A recent study shows that the usability of most current e-government sites is on average three times higher for users without disabilities than for those who are blind or have low vision and other disabilities [11]. Another research project published by Forrester Research found that only one in four ecommerce sites it surveyed met even minimum requirements provided by the Web Accessibility Initiative for disabled Web users, such as providing text descriptions of images for the blind users [10]. Waddell calls the Web "the growing digital divide in access for people with disabilities" [4]. Even in the public sector of the U.S., where Web accessibility is legally mandated, a significant number of

official e-governance sites still contain features that do not provide reasonable access to disabled users.

## **2.1 Characteristics of Cloud SaaS**

The Cloud based software services can be considered as a multifaceted mass medium that contains many different configurations of communication medium. The software services are device-independent method for exchanging government documents across many different ways, like G2C,G2B,G2G,G2E [2] . The glue that holds the modern cloud computing world together is the software services designed by the programming languages, namely HTML(Hypertext markup Language) , XML(Extensible Markup language), ASP.Net, Python, Java Scripts . 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 informations in on-line [7]. Instead of receiving information sequentially, information recorded with Hypertext is designed in multiple layers of software services. The intertextuality and non-linearity of HTML enable Software service pages to connect various virtual contents with specific "links" which allow on-line users to move among points and "nodes". Therefore, SaaS pages are more than printed pages posted electronically [5]. The cloud offers many new opportunities as well as challenges to modern organizations. First of all the cloud SaaS makes it easy to transmit information in a short period of time [6]. Changes to any e-governance 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 medias. Secondly the e-government web pages can include larger amounts and variety of information without incurring major printing and distribution costs [4]. On the cloud SaaS, 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 cloud SaaS's communication effects.

Cloud SaaS characteristic sets that e-governance site development apart from traditional media design is the lack of control. Software service designer somewhat loses control over how on-line users will browse through the web pages, the display form of the fonts and colors used on a page, and the size, proportions and exact locations of the different Web texts. On the cloud, many users largely determine their own navigation paths, and they are free to "jump" to any location that interests to them. In addition, the designers cannot know the exact computer equipment that the various potential users are having, or what fonts and software have been installed in the user's pc's. The exact way of WWW pages present information would be partly determined by the users' own environment [9].

Therefore, Web content should be ideally designed in a way that the users using different mediums (for example, desktop computers, mobile phones, televisions, PDA, et al.), with different Web browsers (for example, Google Chrome,Firefox, Internet Explorer...), and under different constraints can all access [10]. 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.

## **2.2 Reasons for Providing Web Accessibility**

There are more than 750 million people with disabilities worldwide (70 million in India alone) [13]. 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 cloud software services [2]. It is important to make every possible e-governance site accessible. As the director of the World Wide Web Consortium and inventor of the Web, Tim Berner-lee, stated that the power of the Web is in its universality [5]. 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 [8]. The Americans with Disabilities Act (ADA), Section 508 and similar laws and regulations in other countries 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-governance and e-commerce, the focus of the law have changed to include the cloud computing services [9]. Section 508 of the Rehabilitation Act defines the processes used by the federal government to procure electronic and information technology [12]. One of the most important focus 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 [7].

Although India 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 India 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. According to a report published by Forrester Research , Global 3,500 companies are estimated to spend \$560 million to retrofit their websites to meet W3C Web Accessibility Initiative guidelines. Sixty-eight percent of consumers between 45 and 54 years old are on-line and nearly onefourth have a disability (US Census).

So the government organizations must plan site design projects keeping people with disabilities in mind. Doing so is costeffective -- 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. 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. 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.

### **2.3 Web Accessibility Standards : WCAG**

To promote interest in e-governance site 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 (WCAG 1.0 and WCAG 2.0 ; <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 in WCAG 1.0, 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. For example, BOBBY ([www.cast.org/bobby/](http://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. 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 twenty-five official homepages of India's central governmental web sites, based on the Web Content Accessibility Guidelines published by the W3C. This research uses a form of the case survey method 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 Guidelines**

<p><b>Guideline 1. Provide equivalent alternatives to auditory and visual content</b></p> <ol style="list-style-type: none"> <li>1. Provide a text equivalent for every non-text element</li> <li>2. Provide redundant text links for each active region of a server-side image map</li> <li>3. Provide an auditory description of the important information of the visual track of a multimedia presentation</li> <li>4. For time-based multimedia presentation, synchronize equivalent alternatives with the presentation</li> </ol> <p><b>Guideline 2. Don't rely on color alone.</b></p> <ol style="list-style-type: none"> <li>1. Ensure that all information conveyed with color is also available without color</li> </ol> <p><b>Guideline 5. Create tables that transform gracefully</b></p> <ol style="list-style-type: none"> <li>1. For data tables identify row and column headers</li> <li>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.</li> </ol> <p><b>Guideline 6. Ensure that pages featuring new technologies transform gracefully</b></p> <ol style="list-style-type: none"> <li>1. Organize documents so they may be read without style sheets</li> <li>2. Ensure that equivalents for dynamic content are updated when the</li> </ol>
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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
<b>Guideline 7. Ensure user control of time-sensitive content changes</b>
1. Provide alternative equivalent design to time-sensitive content
2. Provide user control of time-sensitive content
<b>Guideline 11. Use W3C technologies and guidelines</b>
1. Provide a link to an alternative page that uses W3C technologies, that is accessible, and has <i>equivalent</i> information (or functionality) to files of non-W3C formats (e.g., PDF, Shockwave, etc.)
<b>Guideline 12. Provide context and orientation information</b>
1. Title each frame to facilitate frame identification and navigation

Based on these guidelines we have conducted structured content evaluation on each of the existing thirty-five e-governance sites of the national level executive agencies. Each individual homepage was carefully tested with Bobby tool on the fourteen indicators between August 23, 2012 and September 3, 2012. Then the rate has been 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 another tool TAW, using both GUI (Microsoft Internet Explorer 7.0) and text (Lynx) browsers

#### 4. RESULTS

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 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 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 timesensitive content."

Table 2 – Accessibility Analysis Results of the E-Governance Agencies

Guidelines 1-14 (G.1 to G.14) →

E-Governance Agencies ↑

	G.1	G.2	G.3	G.4	G.5	G.6	G.7	G.8	G.9	G.10	G.11	G.12	G.13	G.14	Total
Ministry of the Interior	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2
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
Ministry of National Defense	1	1	0	0	0	1	0	0	0	0	0	0	0	0	3
Ministry of Education	1	1	1	0	0	0	0	0	0	0	0	0	0	0	3
Ministry of Economic Affairs	0	1	1	0	0	0	1	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	0	0	1	0	0	1	0	0	0	0	0	0	3
Central Bank of India	1	1	0	0	0	0	1	0	0	0	0	0	0	0	3
Fair Trade Commission	1	0	0	1	1	0	0	1	0	0	0	0	0	0	4
Ministry of Transportation and Communications	1	1	0	0	0	1	0	1	0	0	0	0	0	0	4
Government Information Office	1	1	0	0	1	0	0	1	0	0	0	0	0	0	4
Environmental Protection Administration	1	0	1	0	0	1	0	1	0	0	1	0	0	0	5
Council of Labor Affairs	1	1	0	0	1	0	0	1	0	1	0	0	0	0	5

Public Construction Commission	1	0	1	0	0	1	0	0	1	0	1	0	0	0	5
Atomic Energy Council	1	1	0	0	1	1	0	0	0	0	1	0	0	0	5
The Ministry of Justice	1	0	1	1	0	1	0	1	0	0	0	1	0	0	6
Overseas Indians Affairs Commission	1	1	0	0	1	0	1	0	1	0	1	0	0	0	6
Department of Health	1	1	1	0	0	0	1	1	1	0	0	0	0	0	6
National Youth Commission	1	1	1	1	1	0	1	0	1	0	0	0	0	0	7
The Ministry of Finance	1	1	1	0	1	0	1	0	1	1	0	0	0	0	7

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 score in the table is failing to “provide a text equivalent for every non-text element.” Among the twenty-five agencies, fifteen 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. 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.

Among the twenty-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, 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. Complex relationships between parts of a page are especially difficult for people with visual disabilities to interpret.

The most important problem on many current e-governance 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. Therefore, failing to title each frame to facilitate frame identification and navigation could cause significant difficulties for all SaaS 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. CONCLUSION

The results indicate that the most of the e-governance sites in general underserve users with disabilities. While an integrated measure of accessibility for each of the governmental Web sites may be calculated, 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 based on the findings of this research. One could also extract more design implications from the items listed in the research findings.

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