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Library Web sites for people with disability: accessibility evaluation of library websites in Pakistan

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Introduction

The Web is the source of information for people who have any kind of disability also known as People With Disability (PWDs). This is a fundamental human right recognized in the UN Convention on the Rights of PWDs, particularly indicate the Internet and other accessible information and communication technologies (ICTs). The UN convention on the rights of PWDs, signed on March 30, 2007 by 132 countries throughout the world clearly states that: "[. . .] PWDs should be able to live independently and participate fully in all aspects of life [. . .] PWDs should have equal access to the physical environment, to transportation, to information and communication technology, and to other facilities and services open or provided to the public" ("Convention on the Rights of Persons with Disabilities", Wikipedia, 2013). It is, therefore, that PWDs shall no more be deprived of benefiting the services, which normally provided through Web sites. Different research studies reveal that, currently, Web sites are three times more accessible by people without any kind of disability than PWDs.

PWDs in Pakistan

Pakistan is a large country with an estimated population of 180.7 million (as of July 2012), making it the sixth most populous country in the world. According to the official document, "Persons with Disabilities (PWDs) Statistics in Pakistan, 2012", the total PWD population constitutes 19.2 per cent of individuals that are crippled, 8.2 per cent blind, 7.5 per cent deaf and 7.6 per cent with intellectual disabilities and multiple disabilities are recorded at 8.3 per cent. Thus, the number of these special populations (964,000) is more than the total population of Bhutan (738,000 in 2011) and the number of blind (412,000) is more than the total population of Maldives (320,000 in 2011). Demographic data show that 34.3 per cent of the total PWDs live in urban areas, while, at national level, 2.54 per cent of the whole population in Pakistan has some kind of disability (Pakistan 2012). There currently is no law to safeguard the basic rights of PWDs in Pakistan[1]. The Web is a progressively more important resource

in government, health care, recreation and education. It is important that Web sites be equally accessible to all people including people with disabilities, that the Web be accessible to provide equal access and equal opportunity to people with disabilities (Paciello, 2000). Thus, breaking the time, space, language and regional barriers, an accessible Web reduces the digital divide and can help PWDs more actively participate in society.

Library Web sites in Pakistan

Library Web sites serve a very specialized group of people in the community of a developing country like Pakistan. In Pakistan, a very small number of library Web sites are developed because of lack of interest, funding problems, financial crunch, lower literacy rates and socio-economic conditions. However, the advancement of ICTs and initiatives taken by the Higher Education Commission (HEC) has made it possible and mandatory for all academic institutes of higher education to take competitive advantage over one another. This initiative resulted to compete and boost their services to attract more students by offering unique and upgraded services, facilities and learning management techniques. A survey conducted in 2009 presented content analysis of 52 library Web sites of Pakistan (Qutab and Mahmood, 2009, pp. 430-445).

The Library Web site, Online Library, Digital Library and Library Automation are the extended library services provided to its patrons at the library doorstep. A university Web site contains information about academics, admissions, administration, programs, research, library etc. The HEC's National Digital Library Service is also provided to all recognized institutes of higher education and universities. A common person can visit the library physically any time and also take advantages of online services through the library Web site. But the question is either university library Web sites in Pakistan providing facilities to persons who have any kind of disability? Studies show that normal persons use Web sites three times more than PWDs for information gathering (Abanumy *et al.*, 2005, pp. 99-106). A Web site is not usable if it is not accessible so we say no usability is achieved if a Web site is not accessible (Henry, 2006, pp. 1-51).

Web user interfaces are developed primarily to provide information and services to the widest range of users, including people with any kind of disabilities (Dix, 2004). To make the Web site accessible globally and especially to deal with special needs of PWDs, Web developers are required to give special attention to the issues of PWDs while designing and implementing Web sites. Jacobs (2006) stated that "if the importance of PWDs were not considered for the accessibility issues then it would be having negative impact on the large segment of society, which consists of people with physical impairment and ultimately leads disable persons to inaccessibility". There are 135 HEC-recognized universities and other academic institutions in Pakistan. HEC has officially announced the ranking of universities according to which the top ten universities of Pakistan are[2]:

(1) Quaid-i-azam University, Islamabad.
(2) Pakistan Institute of Engineering And Applied Sciences, Islamabad.
(3) Aga Khan University, Karachi.
(4) University of Agriculture, Faisalabad.
(5) University of the Punjab, Lahore.
(6) National University of Sciences and Technology (NUST), Islamabad.
(7) PirMehr Ali Shah Arid Agriculture University, Rawalpindi.
(8) University of Health Sciences, Lahore.
(9) COMSATS Institute of Information Technology (CIIT), Islamabad.
(10) Lahore University of Management Sciences, Lahore.

It is assumed that these Web sites are accessible to common people, but PWDs do not have full access to services and resources available on these Web sites. Moreover, these Web sites were developed with the intent to provide facilities to both types of clients. The purpose of this study is limited to assess the level of accessibility of the Library Web sites of these top ten academic institutions to determine if Web-based services are provided in balanced manner to all their patrons or not, especially to PWDs.

Web accessibility

World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI) has established accessibility standards and guidelines for both the development of new websites and evaluation of already developed Web sites. "These guidelines are named as Web Content Accessibility Guidelines (WCAG), the web developer must follow these guidelines in order to make their sites accessible for all people especially people with any kind of disabilities [. . .] these guidelines are more accurately testable with automated testing tools and human evaluation also" (Hassanzadeh and Navidi, 2010, pp. 789-803). WCAG 1.0 and WCAG 2.0 were published in May 1999 and December 2008, respectively.

Accessibility evaluation is a multi-resource suite which outlines different approaches to evaluate Web sites in terms of accessibility of contents. The purpose of accessibility evaluation is to check the contents either through electronic or manual procedures according to standard criteria as devised by WCAG. The methods and approaches provide general procedures and guidelines for evaluation of both under-developed and existing Web sites. Web contents' accessibility recommendations are categorized into groups (Bakhsh and Mehmood, 2012, pp. 342-347) that are presented in Table I.

Multiple online accessibility checking tools are available to check compliance to the standard of a Web site. Researchers and designers use the output of these tools for improving Web content accessibility. These tools not only determine the level of accessibility they also provide support in maintenance and debugging (repair) of the Web sites (Bakhsh and Mehmood, 2012, pp. 342-347). While determining the level of accessibility and by conforming to international guidelines, these tools consider a set of metrics for evaluation purpose. Tools

Table I.
W3C priority categories

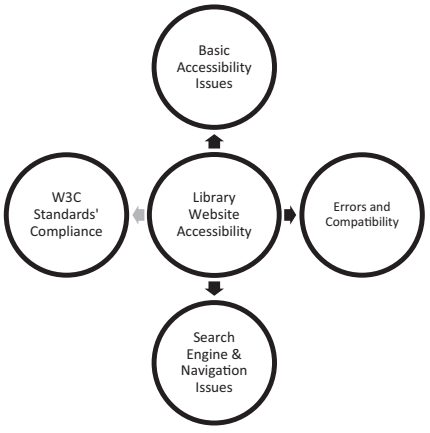
Sr. no.	Description	Symbol
1	Essential guidelines to be followed by the developers in order to make all information accessible for all types of users	A
2	These should be followed by the developers to remove important accessibility issues and barriers that cause inaccessibility of information on a Web site	AA
3	These guidelines are not much important, however, these may be followed in order to make Web site more comfortable for the use of people with any kind of disability	AAA

which have more features and a wide range of metrics are preferred over other automated tools which ultimately reduces time and effort in maintenance of sites.

According to the W3C Web accessibility guidelines, "Web accessibility refers to the access of website content, regardless of the browsing technology and browsed/retrieved information, it must be understandable by the clients fully and user interaction be insured if required" (Jacobs, 2006).

Second, special a Web site requires special consideration. However, while determining its accessibility, core areas like basic accessibility issues, detection of errors and compatibility, search engine best practices and following W3C standards must be considered completely. Caldwell (2006, pp. 1-9), while talking about Web accessibility and academic libraries, explicitly debates: "It is important that universities and their respective libraries understand and attempt to apply these guidelines when offering remote e-learning services and resources". Similarly, the Web Design Framework for Improved Accessibility for People with Disabilities (WDFAD) is a method of presenting Web accessibility guidelines into concise and Web developers' format (Bakhsh and Mehmood, 2012, pp. 342-347). We have developed the basic accessibility evaluation framework (shown in Figure 1) for library Web sites, based on the basic four principles of WCAG 2.0 coupled with the guidelines summarized in different library Web sites accessibility evaluation studies, i.e. (Craven, 2008; Caldwell, 2006, pp. 1-9; Flatley and DeJong, 2005). More or less, this framework supports the extended WDFAD.

Figure 1. *Library website accessibility evaluation framework*



Web site accessibility can better be evaluated when the basics accessibility principles are considered. The framework presents five assessment measures of library website accessibility namely to basic accessibility issues, scripting and styling errors with browser compatibility, search engines' best practice guidelines and navigation issues and compliance to W3C standards. Each assessment measure with benchmarking criteria is mentioned in Table II.

Literature review

WCAG 2.0 standards and guidelines have been devised and made international by the W3C consortium and first published in July 2005 (Abascal *et al.*, 2004, pp. 71-79). Worldwide, there are multiple research studies conducted on evaluating accessibility of websites as per W3C's accessibility guidelines from Section 508 of US Rehabilitation Act 1973. Specifically talking about library Web sites, initial search and review of literature reveals that library Web sites are still lacking for such evaluation. One relevant study was conducted in Australia with a purpose to determine whether public library Web sites in Western Australia comply with WCAG standards to provide services to PWDs.

Conway *et al.* (2012, pp. 170-188) discusses the status of Web site accessibility of the National Library of Australia along with nine State and Territory Libraries. She assessed conformance of these Web sites with the Web Content Accessibility Guideline (WCAG) Version 2.0 and identifies major barriers to accessibility by users with disability. However, the researcher applied two alternate methods, i.e. evaluation with users' participation and evaluation without users' participation for assessing the Web site

Brobst (2009, pp. 88-103) evaluated the home pages of Florida's public libraries for accessibility. This study includes every Florida public library system Web site, examining each home page of the 78 libraries offering Web sites. The study used the WebXact online evaluation service to identify errors using compliance standards of the US Rehabilitation Act of 1973.

Conway (2011, pp. 15-15) presents information on the WCAG formed under the Web Accessibility National Transition Strategy of Australian Government. It is found that most of the public library Web sites do not follow WCAG.

Yi and Kang (2012, pp. 373-374) discuss the accessibility issues of public library Web sites from the perspectives of PWDs. This study evaluates 20 public library Web sites, based on Section 508 of US Rehabilitation Act 1973, that have high percentage of PWDs and senior citizens.

Wijayaratne (2011) conducted a research study on Sri Lankan academic libraries to measure the readiness of their Web site to assist people with any kind of disability. This survey study finds provision of physical access, facilities, services and provision of Web access to people with special needs.

Craven (2000, pp. 25-51), in his article, considers accessibility issues in terms of content provision; analyses current situation in UK academic

Table II.
Assessment measure and benchmarking criteria

Sr. no.	Category	Benchmarks
1	Styling and scripting errors	Here general errors like broken links, server configuration issues, scripting and styling errors are checked
2	Accessibility issues	In this category, issues related to WCAG 2 and Section 508 of Rehabilitation Act 1973 of the United States is checked. WCAG defines
3	Browser compatibility issues	This criterion addresses and identifies issues related to browser-specific behavior of a Web site. Accessibility standards require a Web site to be completely compatible with earlier browsers and the contents are available on mobile devices also
4	Search engine best practice guidelines	The search component of our research instrument detects violation of Search Engine Optimization (SEO) guidelines and identifies those Webpages that do not follow SEO best practices
5	W3C standards	Here a Web site is analyzed for compliance of W3C standards. Cascade Style Sheet (CSS), Hyper Text Markup Language (HTML), and Extensive Hyper Text Markup Language (XHTML) script is validated

libraries regarding provision of accessible library Webpages. This work also discusses the policy, legislation and impact of Web designers regarding accessibility issues.

Look (2009, pp. 156-157) presents a review of the book "Web Accessibility: Practical Advice for the Library and Information Professional" mentioning that this is a good resource for those Library and Information Science professionals who want a better understanding of the subject of Web accessibility for libraries. This book includes different topics like accessibility evaluation and assessment tools; how accessibility affects people; issues for library and information science professionals; and relevant guidelines and evaluation methods.

Providenti and Zai (2007, pp. 494-508) discusses the guidelines, standards, legislation and mechanism concerning Web accessibility for academic library Web sites in the USA. Major findings are that public and private academic colleges and universities libraries must provide accessible Web sites.

Mukherjee (2011, pp. 5-5) assesses the usability and accessibility of popular commercial Indian Web sites using different Web analyzer tools. Three popular Indian commercial Web sites, i.e. indiatimes.com, sify.com and rediff.com, were analyzed through Yahoo Site Explorer, Google Trends, Alexa and Smart viper. Findings were that rediff.com is more used among the three. The study finds that there are differences between Web site designers' assumption about popularity of a page and audiences' actual interests. The study concludes that it may be meaningful to confirm audience interest during creation of Webpages.

Poll (2007, pp. 1-9) categorizes the methods of Web site evaluation by grouping into two, i.e. with and without users' participation. This study identifies diverse scope of library website quality criteria which includes both the Contents and Accessibility.

Sohaib *et al.* (2012) examines the relationship between Web usability and Web accessibility guidelines and presents the difference between both of them.

Methodology

The evaluation is made on the basis of WCAG provided by W3C using free online web accessibility analysis tool. We used SortSite® (commercial standards-based web testing tool from PowerMapper.com, 2010) to check the subject Web sites for accessibility issues. This analysis tool determines the level of conformance of a Web site to WCAG 2.0 as defined by W3C accessibility guidelines. SortSite® is capable of checking multiple accessibility issues, i.e. broken links, browser specific codes, scripting and image formats, checking compliance of search engine good practices and guidelines, validating web standards like HTML, XHTML and CSS. The tool also considers the usability.gov guidelines and examines the given website for usability issues. SortSite® is used by different accessibility evaluators and its results are also crossed-checked (Conway *et al.*, 2012, pp. 170-188).

Results and discussion

Results of this study were analyzed on the basis of accessibility framework devised for library Web sites (Figure 1). The SortSite® Professional Web accessibility checker tool was used for evaluation of subject Web sites entirely and to generate results assessing the issues of Web sites for compatibility, Search Engine Optimization (SEO) issues and conformance to required standards. The evaluation version of SortSite® is limited to checking first 100 pages of Web site; therefore, the required results are generated on percentage of Web pages identified with issues concerning each criteria and is discussed in details here under:

WCAG defines three priority levels A, AA and AAA, where priority A describes that PWDs would find it impossible to use Web site contents. Therefore, a Web site must follow priority A level guidelines to make the Web contents accessible to all kind of people including PWDs.

Compliance to priority level AA helps removing the accessibility barriers and makes the Web contents more accessible to users. Similarly, conformance to priority level AAA refers to make the Web site more comfortable and easy to use by PWDs.

Each Web site was evaluated for general errors and issues concerning Accessibility issues, Browser-specific compatibility issues, Search Engine guidelines violation and optimization best practices and Compliance to W3C standards. Commonly identified

Priority A level Accessibility issues in the subject Web site are mentioned in Table III.

Accessibility

Ascertaining the contents of subject Web sites through SortSite, it was found that 50 per cent of the Web sites have multiple Priority A level Accessibility issues. The rest of 50 per cent Web sites were in much better condition; however, there were Priority AA and AAA level issues in all studied Web sites. Multiple errors like broken links, scripting errors, server configuration, spelling mistakes and dead links on the Webpage of the understudy websites were identified by the tool. Overall, 70 per cent of the studied Web sites were identified with broken or dead links and spelling mistakes on their Webpages. However, we have attempted to verify the results manually and found that spelling mistakes (as identified by the SortSite) are either library jargons or proper nouns. While checking the compatibility of subject Web sites, it was found that only 10 per cent of them have browser-specific compatibility issues. Collectively 13 pages out of 1,000 were identified with missing contents or functionality issues for some browsers, whereas 43 pages were identified with major compatibility problems.

Search engine optimization

The notable result of this study is that 70 per cent of the studied Web sites are better than average and no issues were identified regarding violation of SEO guidelines. However, our research tool has detected violation of SEO's best practice guidelines on the library Web sites of LUMS, COMSATS and Quaid-i-Azam University.

W3C standards

Thirty per cent of library Web sites were found violating the W3C guidelines and are identified in the worse than average category. Multiple issues were also detected regarding W3C standards on the Webpages of remaining 70 per cent Web sites, but they are found to have passed CSS and HTML validation which is the basic requirement for assessing W3C standards. Figure 2 shows the number of pages (in percentage) identified with Accessibility issues. The figure shows that there are less number of pages identified in the library Web site of Agriculture University Faisalabad (AUF), while the library Web sites of Agha Khan University and University of Health Sciences have about 80 per cent pages with accessibility issues.

Collective analysis of subject Web sites was performed to judge the overall status regarding accessibility issues of library Web sites in Pakistan. Based on the devised framework, results of the analysis were summarized to explore how many Web sites are in *Better* and/or *Worse* condition. Figure 3 shows the collective analysis of all Web sites in percentage, based on the examined accessibility components. Analysis shows that major issue in the subject Web site is scripting and coding errors. The second one is the non-conformance to WCAG 2.0 guideline.

Overall quality of a Web site was judged by calculating the number of pages with quality issues divided by

Table III.
Commonly identified Priority A level accessibility issues in Pakistani university library Web site

W3C compliance code	Heading	Description of the failure
F7	Blinking content without a mechanism to pause	No provision to pause the blinking contents. The user may not have sufficient time to read the content between blinks or it may be so distracting that the user will not be able to read other content on the page
F77	Duplicate values of type ID	Duplicate values of type ID which makes user unable to programmatically determine which headers are associated with the data cell or which control is associated with which label or name
F91	Incorrect marking-up table headers	Navigating cell by cell, screen readers will often fail to read the header cells associated with content
F73	Links that are not visually evident without color vision	Non-color visual distinction is required for links because people who cannot perceive color differences cannot identify links
F65	No alternate attribute for image	In this case assistive technologies are not able to identify the image or to convey its purpose to the user
F89	No alternate for pointing device input method	Users with special needs, such as using alternate keyboards or input devices that works as keyboard emulators for the people with disability, will not be able to access the function of the content
F68	No alternate text for images	Describes a failure condition where links contains only non-text content, for example an image, and/or the these non-text contents are implemented in a way that it can be ignored by assistive technology
F54	Using only pointing-device-specific event handlers (including gesture) for a function	Pointing device is the only mechanism available to invoke a function of the content. In this case the users with no vision or user who want to use keyboards or input devices will be unable to access the function of the content
F25	Webpage without title or meaningful title	Describes a malfunction situation where Webpage contains a title, but the given title does not identify the appropriate contents and/or purpose of the Webpage

Figure 2. *Number of pages of individual websites*

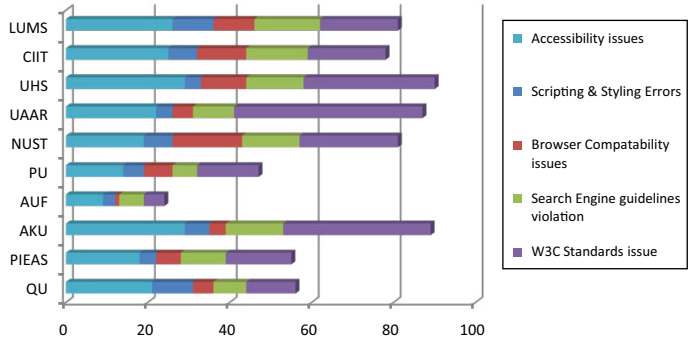


Figure 3. *Component-wise accessibility status of library websites in Pakistan*

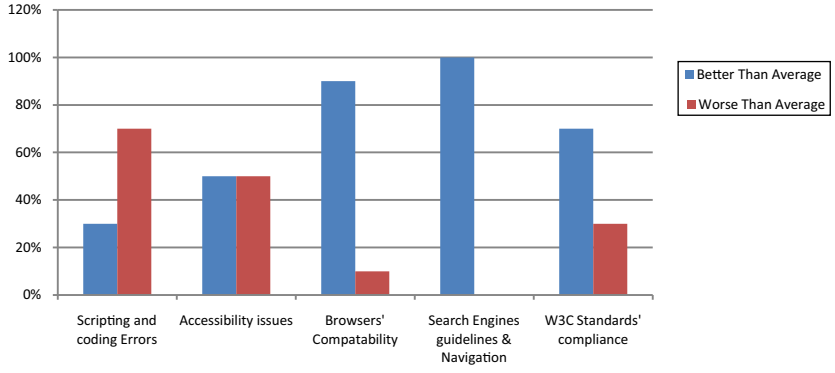


Figure 4. *Percentage of quality issues in university library websites of Pakistan*

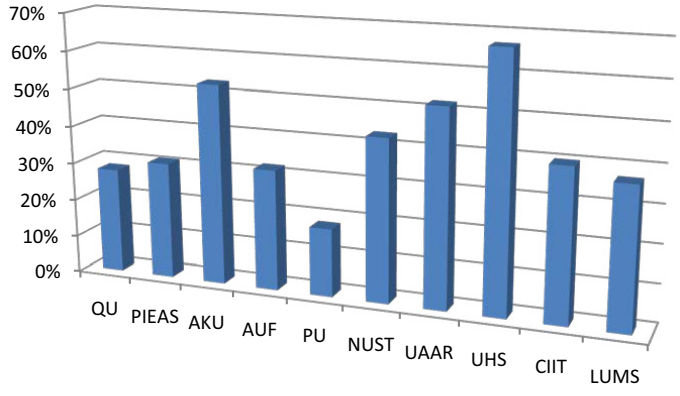
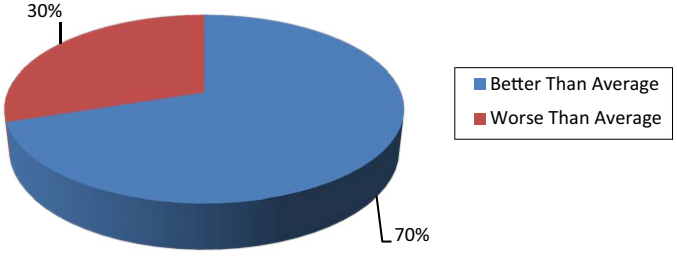


Figure 5. *Overall quality assessment of library websites regarding accessibility issues*



total number of pages of a Web site checked by the evaluation tool as shown in Figure 4. The library Web site of the University of the Punjab (PU) is found to have minimum accessibility issues, whereas that of The University of Health Sciences (UHS) is found to have maximum number of accessibility issues. SortSite identifies the number of Webpages with overall quality issues after checking the entire Web site for over 450 quality issues.

Conclusion

Library Web sites are the gateway to knowledge repositories that provide access to scholarly material without differences (Keisham, 2006, pp. 161-165). University libraries are the major academic libraries in Pakistan which provides Web services to its users through their Web sites. It is, therefore, considered to be widely accessed by all types of users including PWDs. Conformance to WCAG – an international standard emphasizing the right of equal access to information for all citizens – plays a key role in improving the accessibility of Web contents.

We choose SortSite – an online accessibility checker tool – to check the accessibility issues in university library Web sites. SortSite's reliability regarding coverage, completeness and correctness is well established by different research studies.

Web accessibility is a relatively new concept, especially for a country like Pakistan; therefore, it is imperative to say the library Web sites require more attention to make their contents available to all types of people. Based on cumulative research findings and considering Priority A-level accessibility issues, the overall quality of Pakistani university library Web sites was also determined. SortSite categorizes the overall quality of a Web site using two major groups, i.e. Worse than Average (WTA) and Better than Average (BTA). Figure 5 shows that the overall quality of university library Web sites in Pakistan is much better in terms of accessibility issues. Overall quality of subject library Web sites is shown in Figure 5.

However, two factors in determining the overall quality of a Web site are number of Webpages and multiple types

of accessible contents and files. The Web sites which got less error percentage are generally those which comprised few Webpages and less contents as compared to other Web sites.

NOTES

1. http://tribune.com.pk/story/474258/persons-with-disabilities-without-access-quotas-are-meaningless/
2. www.hec.gov.pk/InsideHEC/Divisions/QALI/Others/RankingofUniversities/Pages/TopTenUniversities.aspx

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