Evaluation of Web Accessibility of Engineering University Websites of Pakistan through Online Tools

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Summary
Day-by-day use of internet is increased for different purposes of different domains and the evaluation of these domains plays important role in computer technology. Web accessibility is a field of usability used for worldwide for different domains. Now-a-days researchers are working on the accessibility compliances and accessibility issues. In this research work is done for the evaluation of web accessibility of four websites of highly reputed engineering universities of higher educational institutions of Pakistan. Accessibility tools are used to measure the web accessibility and success criteria measure WCAG standards. Evaluation of web accessibility by using two different online easily available tools (Wave tool and Powermapper tool) and number of errors, alerts, features, structural elements, html5 & ARIA, contrast errors, accessibility, compatibility, search, standards, usability and overall issues features were checked. From the results of Wave tool W1 website has better results and measure level id AAA and from the results of Powermapper tool W4 website has better results.

Key words:
Accessibility; Usability; Experiments; Wave tool; Power mapper tool.

1. Introduction

Due to highly increasing expectations of accessible websites of educational institutions there is an increased research on accessibility. Many researchers are now working on accessibility compliances and accessibility issues. Contributions are made towards the imposing of highly accessible websites. Researchers are paying special focus on assessment of basic attributes such as documentation, content management and interactivity. As far as educational websites are concerned, a little work has done on accessibility analysis of educational institutes around the globe. There are various accessibility standards for websites. According to some standards a website's content should meet minimum success criteria to achieve the desired accessibility [1]. This study depends on analysing the accessibility of educational websites on the basis of accessibility guidelines.

Moreover, usability of a website has a significant role in achieving user satisfaction. It is considered as a substantial aspect for any website to provide effective services to the visitors. Highly accessible and usable websites fulfil the different users' requirements and enable the websites to provide the essential services [2].Many websites are being designed in light of usability standards. Weak website designs have negative usage impact and reduce interaction with the website. Accessibility and usability of websites are believed to be overlapping sets. Usability problems in any website reduce the optimum usage of content services and visitor's interaction with the website. To some extent usability issues remain a subset of accessibility issues [3]. It is observed that educational websites pay less attention on designing websites according to usability and accessibility criteria. Therefore, the purpose of this research is to conduct usability and accessibility evaluation of educational websites using automated tools. The findings are expected to help educational institutes and developers to improve their websites according to user requirements and take notice of underlying issues.

Educational institutes have always worked on improving their reputation and provide quality education around the world. Websites have become an essential source of disseminating information for educational institutions [4-6]. The major obstacles faced by educational websites include achievement of accessibility and usability of website. It will be a difficult situation for the visitors to use all the resources of the websites if the website is not accessible. Efforts must be taken by the educational institutions to impose on building the websites with the guidelines for accessibility to seek the user satisfaction [7, 8].

In recent years websites have appeared to be a strong tool for communication between organizations and the visitors. Accessibility and usability are considered to be success factors and fundamental features for any website [10-14]. The expectations of users of any educational website are to gain information like date sheets, results, class and assignment deadlines, examination time table and other important announcements. The question arises here that

Manuscript received December 5, 2019
Manuscript revised December 20, 2019

whether the visitor getting that information within time or not?

Different tools and techniques can be used for assessing the website evaluation. Those tools can be efficient source of assessing in context of effectiveness, efficiency and satisfaction of website. There are two major attributes of website evaluation such as internal attributes and external attributes. Internal attributes tell about website development and design that as measure the time to load a page of website, performance, images, html files, number of links and compatibility with internet browser. External attributes are responsible for usage of website that may include readability and contents of website [8]. The accessibility of website can be analysed with many tools such as: A Checker, WAVE and aXe [4].

This research work based on the four experiments by using accessibility tools, one is Wave tool, 2nd tool is Powermapper, and 3rd tool is web accessibility checker and fourth is TAW. This study was done by applying Web Content Accessibility Guidelines (WCAG).WCAG provide technical standards and 12-13 guidelines for testing success criteria of each guideline have three levels: A, AA, and AAA. A shows the (lowest), AA, and AAA (highest) result.

Thirteen guidelines and testing success criteria categorize into four principles, those principles which are POURC [1, 9]. Whereas, P- Perceivable: Contains text alternative, time based media, Adaptable, Distinguishable. O-Operable: Contains keyboard accessible, enough time, Seizures and physical reactions and navigable, input modalities. U-Understandable: Contains readable, predictable, input assistance. wR-Robust: Contains compatible (parsing, Name, role, value). C-Conformance: Contains interpreting normative requirements, conformance requirements, conformance claims as shown in Figure 1.

Data was collected from the defined sources of engineering universities websites of Pakistan. Evaluation of the collected data was evaluated on the tools (wave tool and PowerMapper). After the evaluation of the websites results are generated and this result described in Evaluation and Results and Discussion section as shown in Figure 2.

Huge number of data is available online on different domain for testing the web accessibility. In this research work is done on the websites of highly reputed institution of higher education engineering universities of Pakistan for the evaluation of web accessibility on different tools. Following Table 1 shows that the websites of highly reputed engineering universities.

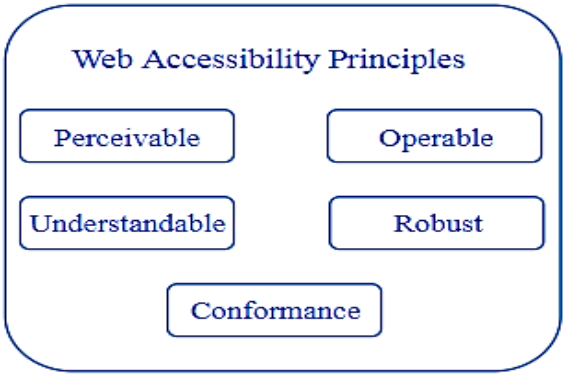

Fig. 1 Web Accessibility Principles (POURC)

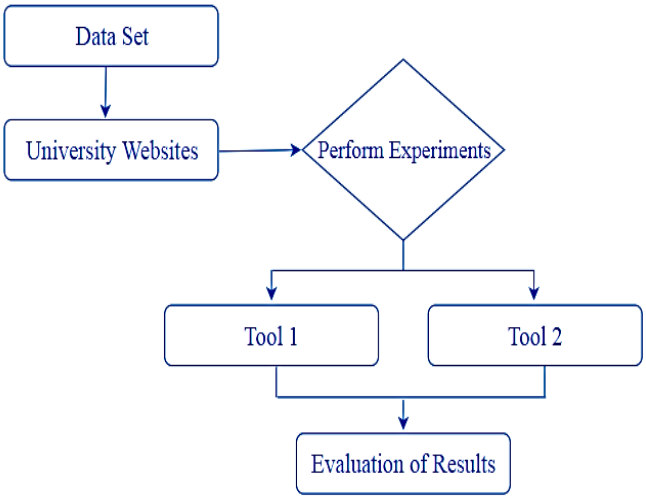

Fig. 2 Methodology of Research

Table 1: Engineering Websites of Pakistan used for Testing Accessibility

S. No.	Assigned name of website (W)	Name Of Higher Educational University Websites of Pakistan	Official Links
1	W1	Quaid-e-Awam University of Engineering, Science and Technology, Nawabshah	https://www.quest.edu.pk
2	W2	National University of Science and Technology, Islamabad	http://www.nust.edu.pk
3	W3	Pakistan Institute of Engineering and Applied Sciences, Islamabad	http://www.pieas.edu.pk
4	W4	University of Engineering and Technology, Lahore	http://www.uet.edu.pk

2. Evaluation of Web Accessibility through Tools

2.1 Web Accessibility on WAVE Tool

Wave tool is easily available online tool used for measuring of the accessibility of sites and also find out the error occurs in website, sorting out easily without consuming time and efforts of the websites. This tool is effortless, usable and understandable easily. In online Wave tool worked on the five features (Errors, Alerts, Structural elements, Html5 & ARIA and Contrast Errors). Figure 3 shows the interface of wave tool after the evaluation of the website W1.

Table 2 shows the results of Public sector engineering universities websites on Wave tool, these results based on six components with results. Four websites (W1, W2, W3 and W4) were used for the measuring of accessibility. After the evaluation of websites through online tool, maximum 48 errors came in W3 website and minimum 23 errors came in W1. Maximum 103 alerts came in W3 site and minimum 3 features came in W4 site. Overall results of engineering Websites which are: W1 contains Errors 23, Alerts 54, Features 5, Structural elements 33, Html 5 & ARIA 0, Contrast Errors 6. W2 contains Errors 41, Alerts 66, Features 10, Structural elements 110, Html 5 & ARIA 3, Contrast Errors 72. W2 contains Errors 48, Alerts 103, Features 10, Structural elements 101, Html 5 & ARIA 31, Contrast Errors 32. W4 contains Errors 33, Alerts 57, Features 3, Structural elements 39, Html 5 & ARIA 44, Contrast Errors 37.

Fig. 3 Interface of Wave Tool after testing

Table 2: Evaluation results of websites Accessibility through Wave tool

S. No.	Website	Errors	Alerts	Features	Structural Elements	Html5 & ARIA	Contrast Errors
1	W1	23	54	5	33	0	6
2	W2	41	66	10	110	3	72
3	W3	48	103	11	101	31	32
4	W4	33	57	3	39	44	37

2.2 Web Accessibility on PowerMapper Tool

PowerMapper is easily available online tool for the measuring of web accessibility of websites. To test web accessibility of websites only ten pages and given detail of error issues in websites. The major components of power mapper to measure web accessibility which are Overall quality, Errors, Accessibility, Compatibility, Search, Standards, Usability, Overall issues and measure the results of overall websites in those components.

Table 3 shows the results of Public sector universities websites in engineering domain on PowerMapper tool, these results based on seven components with results as shown in Figure 4. Four websites (W1, W2, W3 and W4) are used to measure the accessibility of those websites. All components show the values but W1 shows zero percentage value in first component (Error). Overall results of Websites which are: W1 Error percentage 0, Accessibility percentage is 100, Compatibility percentage 11, Search percentage 100, Standards Percentage 100, Usability percentage 100, Overall issues percentage of W1 is 90. W2 Error percentage 11, Accessibility percentage is 51, Compatibility percentage 51, Search percentage 51, Standards Percentage 51, Usability percentage 51, Overall issues percentage of W1 is 45. W3 Error percentage 31, Accessibility percentage is 51, Compatibility percentage 21, Search percentage 51, Standards Percentage 51, Usability percentage 51, Overall issues percentage of W3 is 75. W4 Error percentage 11, Accessibility percentage is 11, Compatibility percentage 11, Search percentage 11, Standards Percentage 11, Usability percentage 11, Overall issues percentage of W4 is 9.

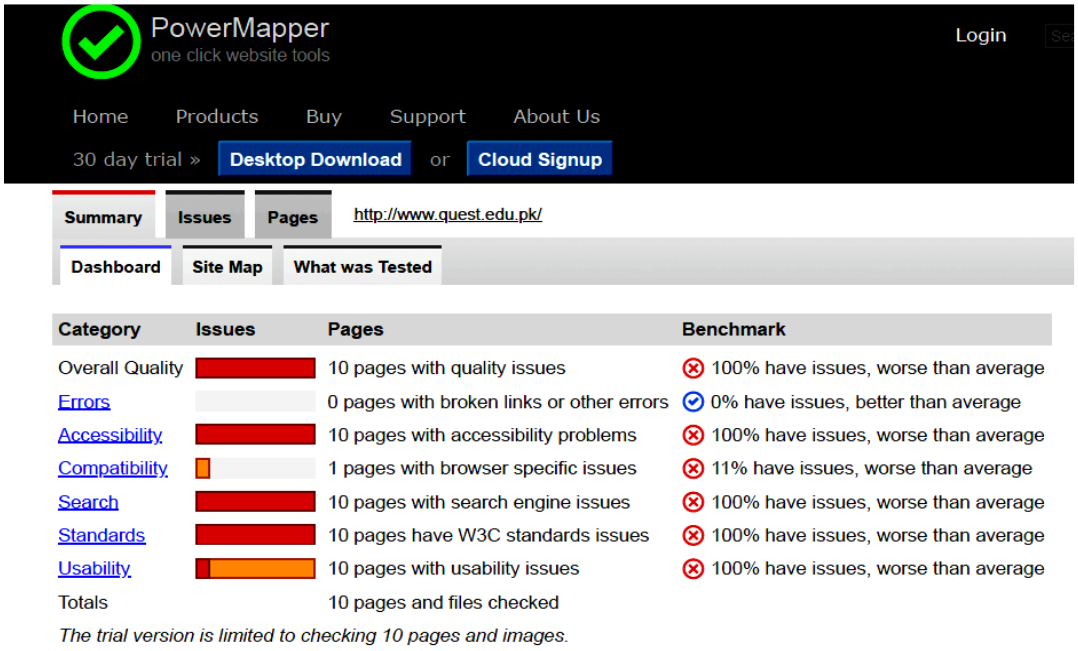

Fig. 4 Interface of PowerMapper Tool after testing

Table 3: Evaluation results of websites Accessibility through Power Mapper

S. No.	Website	Errors	Accessibility	Compatibility	Search	Standards	Usability	Overall Issues
1	W1	0	100	11	100	100	100	90
2	**W2**	**11**	**51**	**51**	**51**	**51**	**51**	**45**
3	W3	31	51	21	51	51	51	75
4	**W4**	**11**	**11**	**11**	**11**	**11**	**11**	**9**

3. Results and Discussions

In this research work four websites of Pakistan were used for the evaluation of websites Accessibility. Those websites are in engineering domain and public sector websites. Four websites were used for the measuring the accessibility of websites (W1, W2, W3 and W4) on Two online tools. First tool is used Wave and the results based on six Components that are: Error, Alerts, Features, Structural elements, Html 5 & ARIA and Contrast Error. From the given results of Wave tool W1 website have almost best results than the other websites as shown in Figure 5. Same way of evaluation were used for all the websites but website W2 having bad results with comparison to W1 website and other websites (W3 and W4) having average results. In another procedure of evaluation is used on the online tool PowerMapper. W1 and W3 having almost better results than the W3 and W4 as shown in Figure 6. But website W4 has not good results than the W1 and W3.

Table 4 shows the accessibility levels of websites by using Wave tool that website W1 have best results than the W2 and W3 websites, but website W4 has satisfactory results. Same way accessibility level is designed for results of PowerMapper tool as described in Table 5. Results of the PowerMapper tool shows that W1 has not good results as compared to the W2, W3 and W4. W4 has better results and W2 and W3 have results are moderate than the W4.

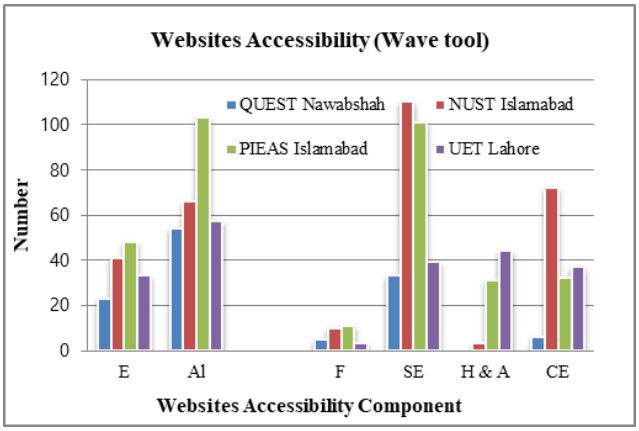

Fig. 5 Websites Accessibility through Wave tool

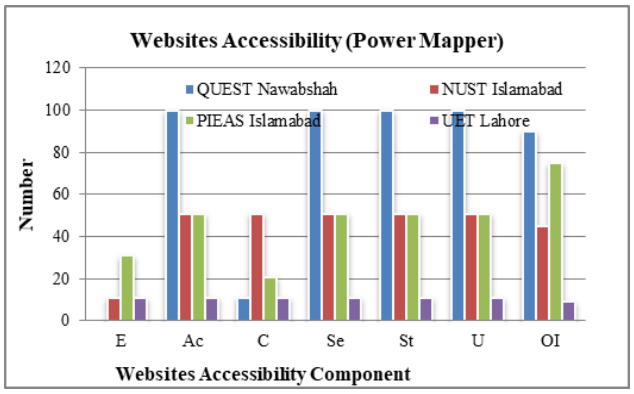

Fig. 6 Websites Accessibility through PowerMapper tool

Table 4: Measure of Accessibility levels by using Wave tool

Websites	Accessibility of Websites
W1	AAA
W2	A
W3	A
W4	AA

Table 5: Measure of Accessibility levels by using Power mapper tool

Websites	Accessibility of Websites
W1	A
W2	AA
W3	AA
W4	AAA

4. Conclusion and Future Work

The main purpose of this research work is to evaluate the accessibility of engineering universities of websites of Pakistan by using Websites Accessibility online available tools (Wave and PowerMapper). These tools are based on the components, Wave tool have six components and Power mapper have seven components. The results of these websites are also based on those components of both tools. W1 website has almost good results in Wave tool and gave results of minimum error, features, alerts, structural element Html5 & ARIA and contrast error. But same W1 has not good results in PowerMapper tool. In PowerMapper tool W4 has better of minimum error, accessibility, usability, search, standards and overall issues. Same way of evaluation of other website W2 and W3 have good results than the W1. The future work of the research work is check other online tools of accessibility and usability would use for the better solution of improving the issues came in educational websites also use different domains for other types of testing/evaluation of accessibility as well as usability. This study is also very helpful for the further research in field of usability.

Abbreviations

S. No.	Components	Abbreviation
1	Errors	= E
2	Alerts	= Al
3	Features	= F
4	Structural Elements	= SE
5	Html5 & ARIA	= H & A
6	Contrast Errors	= CE
7	Accessibility	= Ac
8	Compatibility	= C
9	Search	= Se
10	Standards	= St
11	Usability	= U
12	Overall Issues	= OI

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