Annals of Library and Information Studies
Vol. 70, December 2023, pp. 215-225
DOI: 10.56042/alis.v70i4.2814

Accessibility Evaluation of Selected Library Websites in Delhi-NCR using an Automated Tool

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Received: 17 June 2023; Accepted: 17 July 2023

COVID-19 has bound library users to access content majorly digitally. During the pandemic, various libraries made their resources accessible digitally via remote login. The accessibility evaluation of 15 selected libraries of the Delhi-National Capital Region (NCR) is investigated, focusing on blind and visually impaired (BVI) users. This research aims to investigate and evaluate library accessibility with reference to the Web Content Accessibility Guidelines (WCAG 2.1). WAVE (Web Accessibility Evaluation Tool), a well-known automated accessibility evaluation tool, was used in the study. The WAVE results show that 13 out of 15 library websites contain errors, and 14 out of 15 have alerts based on six components ("Errors, Alerts, Features, Structural elements, ARIA, and Contrast Errors"). The study found that the most common error in websites is Linked image missing alternative text, the second highest error is Empty link, and the third highest error is Empty Button. For these three highest occurring errors, WAVE recommended solutions are also provided for resolving them to improve the accessibility of these websites.

Keywords: Blind and Visually Impaired (BVI), Library Websites,WAVE (Web Accessibility Evaluation Tool),Web Accessibility,Web Content Accessibility Guidelines (WCAG) 2.1

Introduction

Internet usage is increasing every day for various reasons in various domains, and evaluating these domains is critical in computer technology. Usability, a subset of web accessibility, is applied in various industries worldwide. Access to information is vital for the development and upliftment of humankind. Internet technology has brought many opportunities for people because it makes information available without boundaries, making it accessible to all. People who are blind and visually impaired face many challenges while accessing web content compared to people with vision. "The RPwD Act, 2016 categorized visual impairment in two categories: Blindness and Low Vision"[1]. When it comes to using the Internet for services, disabled individuals face numerous obstacles.

Nonetheless, various technologies are available to assist them in accessing the Internet. One of the most crucial concerns in providing universal access is website accessibility. Website accessibility is defined as a website's capacity to assist users with disabilities, particularly blind persons, in gaining access to the Internet. There are several techniques available to assess a website's accessibility. Automated online accessibility testing technologies are so simple to use and understand that even someone who isn't in the IT sector can utilize them. There are various standards for accessibility evaluation of websites that help us make the website accessible to people with vision loss as it is accessible to others. Universities and institutions Library websites have been an excellent platform for digitally disseminating relevant information among their stakeholders. As a result, website accessibility is critical for students to guarantee equitable access to the library's electronic resources and services regardless of their physical disability or other constraints. This study explains the issues with web accessibility, particularly for those with disabilities. Several types of research suggest that some strategies be combined to attain better results.

Review of literature

Panda & Chakravarty[2] conducted a study entitled "Evaluating the Web Accessibility of IIT Libraries: A Study of Web Content Accessibility Guidelines" published in "Performance Measurement and Metrics". The article reports a study to examine and disclose the status of "Web Content Accessibility Guidelines

(WCAG)" "Conformance levels (A, AA, AAA)" and accessibility status of "Indian Institutes of Technology (IIT)" Library websites build on the "Site improve""Software-as-a-Service (SaaS)" platform of "Indian Institutes of Technology (IIT)" Library websites. Results shows that in terms of the three "WCAG 2.1 Conformance Levels A (max IIT Bombay), AA (max IIT Dhanbad (ISM)), and AAA (max IIT Gandhinagar and IIT Varanasi (BHU)), Severity, and Responsibility", the study was able to discover substantial accessibility-related shortcomings of the "IIT library websites". The study's findings show that, while the library websites of India's IITs have a well-designed and easy-to-navigate homepage in terms of VIP accessibility, there are still some concerns to be fixed.

Ismail &Kuppusamy[3] in their study entitled "Web accessibility investigation and identification of major issues of higher education websites with statistical measures: A case study of college websites" published in the "Journal of King Saud University - Computer and Information Sciences"to do a accessibility test of selected college websites. In terms of indicators like the number of difficulties, warnings, and the state of success criterion breaches, the study listed the significant accessibility hurdles disclosed by these sites. In terms of the "TAW tool", there were 2646 faults found, 15995 warnings, and 1356 things that were not evaluated. The overall number of infractions detected with the aXe tool was 1951, with 1733 items requiring examination. The number of Warnings is discovered to be higher than the number of obstacles identified, and this should be reduced by engaging specialists in manual judgment.

Gupta & Singh[4] in their study entitled "Web Content Accessibility Evaluation of Universities' Websites - A Case Study for Universities of Punjab State in India". This article investigated the accessibility of 27 University websites in the Indian state of Punjab. TAW and WAVE are two important evaluation methods that are used to examine the website. These tools give us the current status of selected websites "(Web Content Accessibility Guidelines)WCAG 2.1" is a set of guidelines for web accessibility. During the inspection, it was also discovered that there are a few recurring mistakes that may be remedied by simply adding accessibility features. The overall findings of the investigation demanded that these sites' accessibility be improved. Among the findings of this study are a list of errors that, when corrected, will benefit users with various disabilities.

Ismail &Kuppusamy[5]conducted a study entitled "Accessibility analysis of Northeastern India Region websites for persons with disabilities" to examine the current condition of web accessibility for people with disabilities (PwD) on websites in India's Northeastern region. Study analysed 40 websites in India's Northeast region using automated accessibility tools such as "Eval Access" and "WAVE". The findings of the accessibility research of these websites highlight the need to improve their accessibility even more. The study also discovered that some of the most prevalent checkpoint failures exist, which can be reduced by incorporating basic accessibility features. Using two key accessibility evaluation methods, the article offered a report on the web accessibility of 40 "Northeastern Indian" websites. Priority level 1 errors were found to be less common on these sites, according to the study. However, many accessibility violation notifications have been discovered. Even though warnings are less serious than errors, attempts to limit the frequency of warnings would undoubtedly improve the accessibility of these sites.

Agarwal *et al*.[6] in their study entitled "Assessing the usability, accessibility, and mobile readiness of e-government websites: a case study in India" published in the "Universal Access in the Information Society".The study looked at 164 government websites that are used to deliver e-services and are listed by ministries. Website usability was assessed using automated online tools based on a variety of quality characteristics. The online tool TAW was used to assess compliance with the "Web Content Accessibility Guidelines Version 2.0". Findings reveal that many government service websites are difficult to use, that most of them do not meet "WCAG 2.0" accessibility standards, and that none of them are fully functional on mobile devices. The most of websites are not readily accessible to disabled individuals, according to the results of the accessibility study, and they cannot be utilized to navigate through assistive technology like a screen reader.

Kesswani & Kumar[7]conducted a study entitled "Accessibility analysis of websites of educational institutions" published in the "Perspectives in Science"to assess the accessibility of websites from Top Universities and educational institutions. "HERA", "Test de Accesibilidad Web (TAW)", and the "Firefox Accessibility Evaluation Toolbar" were utilised for the manual evaluation using "WCAG 2.0". The results demonstrate that, despite governments' efforts to enforce accessibility regulations on educational

institutions, the majority of nations still have a long way to go before most of them are fully implemented. Less than half of the standards are generally followed by educational institutions. Two key areas that need to be prioritized are ensuring that sites displaying new technology adjust gently and providing device independence. This study will eventually be expanded to incorporate a more thorough analysis of accessibility.

Bakhsh & Mehmood[8] conducted a study entitled "Web Accessibility for Disabled: A Case Study of Government Websites in Pakistan". This article assessed the websites of Pakistan's central government using accessibility evaluation methods based on the "World Wide Web Consortium's (W3C)" web accessibility standards. The tools utilised in the evaluation procedure are the functional accessibility evaluator and the overall validator. The findings demonstrate that the majority of websites are not built to meet accessibility criteria for impaired people. Since the websites are not designed as per the W3C accessibility standards, it is highly challenging for a visually handicapped people in Pakistan to access the digital resources provided on the government website. Information inaccessibility for handicapped people leads to prejudice between disabled and non-disabled people. It's as if the visually impaired are being treated unfairly.

Venter &Lotriet[9] in their study entitled "Accessibility of South African Web sites to visually disabled users" published in the "SA Journal of Information Management" tolook into the accessibility of South African Web sites for disabled users, with a focus on visually impaired people. Blindness or visual impairment has emerged as the most restricting type of handicap when it comes to computer use. "Bobby 3.2", an online accessibility evaluation tool developed by the Centre for Applied Special Technology, was used to assess the accessibility of several"South African" websites. Findings indicate that visually impaired South Africans will have a difficult time conducting business or extracting information from South African websites. This appears to imply that businesses are ignoring the demands of their disabled consumers, perhaps resulting in the loss of these customers and the revenue they may have generated. Inaccessibility of Web sites to visually impaired users may be considered discrimination, which could lead to future pressure on businesses to correct this injustice.

Mccord*et al.*[10] conducted a study entitled "An accessibility assessment of selected Web-based health information resources" published in the "Library Hi Tech". This article reports a studyon accessibility evaluation of eight "Web-based health information resources (PubMed, OVID Medline, MEDLINE plus, CANCERLIT, the Hazardous Substance Data Bank, TOXLINE, and two databases of Material Safety Data Sheets (MSDS))" evaluates how with ease these resources can be used using adaptive technologies, and it also offers suggestions for improvement where necessary. The evaluation criteria were utilised in conjunction with three assistive technology software products: "JAWS for Windows 3.31", "Dragon Naturally Speaking Standard 4.0", and "Bobby 3.2". The results show that none of the databases in this examination were completely accessible to users utilising adaptive software solutions.

Lilly & Van Fleet[11] conducted a study entitled "Measuring the Accessibility of Public Library Home Pages" published in the "Reference & User Services Quarterly". This article assessed the accessibility of Hennen's one hundred finest American public libraries' home sites. "The HAPLR (Hennen's American Public Library Rating)" Index Scores were used to choose the libraries. According to the findings of the study, "The Bobby online evaluation service" classified seventy-four of the one hundred libraries as having maintained web pages, with fourteen of those web sites being designated as being accessible. Web pages were more likely to be accessible in libraries with bigger service populations and lower "HAPLR" scores.

Abuaddous & *et al.*[12]conducted a study entitled "Toward a Combined Method for Evaluation of Web Accessibility". Their article reports a study where automated examination were conducted on the home pages of 20 "Malaysian" public higher educational institutions to examine the current condition of university web site accessibility. In 2012 and 2013, two experiments were conducted to evaluate if the results had changed significantly. Using automated tools such as "Accessibility Check, A Checker, and TAW Online", study conducted two accessibility evaluations for twenty colleges in Malaysia. The findings revealed substantial flaws, with no meaningful improvements to the websites from 2012 to 2013. Unfortunately, according to the tools specified, no websites were completely accessible. Furthermore, the tools produce a wide range of

results. This could be related to the fact that accessibility tools interpret "WCAG 1.0" differently, and depending on the interpretation, accessibility tools may provide users with automated results that require human judgment.

Jati & Dominic[13] conducted a study entitled "Website Accessibility Performance Evaluation in Malaysia" to assess the accessibility of 90 websites in Malaysia using Tawdish, an online accessibility test tool that gives a very comprehensive examination of website accessibility. Most of the "Malaysian" websites did not match the "Web Content Accessibility Guidelines (WCAG") standards, according to the findings of this survey. The accessibility level of "Malaysian" websites is quite low, with error priority 1 appearing on 93 percent, 87 percent, and 87 percent of education, government, and business websites, respectively, while error priority 2 and 3 appear on all the websites assessed in this study.

Alshamari[14] in a study entitled "Accessibility Evaluation of Arabic E-Commerce Web Sites Using Automated Tools" looked at the technologies that disabled people use to access the internet. It also uses five accessibility testing tools to check the accessibility of three popular Arab ecommerce websites: "Achecker, TAW, Eval Access, MAUVE, and FAE". Many accessibility criteria are covered by the "Achecker" tool, according to this research. The most typical accessibility issues discovered while testing the accessibility of the targeted websites are navigation, readability, input assistance, and timing. "HTML" faults are considered accessibility difficulties, which means "HTML" errors might influence accessibility evaluations.

Acosta-Vargas *&et al.*[15] in their study entitled "Toward a Combined Method for Evaluation of Web Accessibility" used a mixed method involving the use of automatic and heuristic technologies to make websites more accessible. The "Web Site Accessibility Assessment Methodology (WCAG-EM)" from the "Web Content Accessibility Guidelines 2.0" in this study "(WCAG 2.0)". Findings reveal that most of the websites evaluated can attain an acceptable level of compliance. However, testing with automated technologies could not guarantee complete online accessibility. Because automated web accessibility programmes aren't always correct, it's best to utilise them during website creation rather than as a trustworthy monitoring system. It's usually a good idea to get a second opinion from a web accessibility expert.

Sodhar & Bhanbhro[16] conducted a study entitled "Evaluation of Web Accessibility of Engineering University". In this article, four websites from renowned engineering universities and higher education institutions in Pakistan were assessed for their accessibility. Success criteria are based on the "WCAG standards," and web accessibility is evaluated using accessibility tools. With the use of two distinct, easily accessible web tools (the Wave tool and the Powermapper tool), the quantity of errors and generally troublesome elements were examined. The outcomes are better on the W4 website. With a measure level of "AAA," the Wave tool W1 website's results are better, while the "Powermapper tool" W4 website's results are superior.

Rysavy & Michalak[17] in their study entitled "Assessing the Accessibility of Library Tools & Services When You Aren't an Accessibility Expert: Part 1" published in the "Journal of Library Administration"to learn more about other schools and institutions' accessible efforts. Study used the "WAVE" online accessibility checker to audit the main library electronic resources: "Gale Power Search, ProQuest, Yewno, EBSCO, LibGuides, SpringShare A–Z Database List, JSTOR, Adam Matthew, SAGE Research Methods, and Encyclopedia Britannica" to determine the accessibility of the library's subscribed tools and services. "WAVE" results show that 9 out of 10 electronic resources assessed had problems, and 10 out of 10 electronic resources audited have alerts.

Ahmi and Mohamad[18]conducted a studyentitled "Evaluating Accessibility of Malaysian Public Universities Websites Using Achecker and Wave" that was published in the "Journal of Information and Communication Technology". The results indicate a low degree of compliance with the "WCAG 2.0" &"Section 508 standards". Challenges like "availability of text substitutes for any non-text elements, keyboard accessibility, and colour contrast" require instantaneous awareness. There are several problems that can be solved, including "navigation," "adaptability," "input assistance," "compatibility," "empty link," and "empty heading." Many websites have implemented some of the "Section 508" accessibility components in significant ways, despite their lack of compliance.

Objectives

The study aims to check or assess the accessibility of "BVI" library websites in India's "Delhi-NCR Region" (Academic and Public Libraries) in relation to accessibility for people with visual disability. The following are the key goals of this paper:

- To assess the"Delhi-NCR Library's websites" accessibility in terms of the "WCAG criteria".
- To propose alternative solutions and suggestions for website difficulties with a focus on meeting the "WCAG 2.1 criteria of accessibility".
- To identify web page accessibility concerns in terms of "WCAG criteria".
- To identify the majorly occurring errors in the websites.

Scope

I selected 15 "BVI libraries" at random in the "Delhi-NCR region" of India to evaluate for accessibility criteria. From a prior study, fifteen URLs of "Delhi-NCR India websites" were gathered for the evaluation process.

Methodology

The study assesses the accessibility and "WCAG compliance" of the "Delhi-NCR library websites". The "WAVE tool" was used to analyse these websites. The "WAVE"programme was used to test the "Delhi-NCR Libraries" library websites for compliance with the "W3C's WCAG 2.1 guidelines".

Automated Evaluation Tool

An automatic assessment tool aids developers in evaluating websites for accessibility and determining if they comply with accessibility rules. There are a plethora of automated evaluation tools available nowadays for web accessibility tests. The WAVE Tool, an online evaluation tool, was utilized to evaluate the accessibility of homepage websites using the WCAG 2.1 criteria for this study.

"Web Content Accessibility Guidelines (WCAG) 2.1"

Several recommendations are provided by the Web Content Accessibility Guidelines (WCAG) 2.1 to enhance the accessibility of Web content. These recommendations will help make information more accessible to a larger range of disabled individuals. The accessibility of web content on desktops, laptops, tablets, and mobile devices is covered by these regulations. The usability of web content for all users will typically increase by adhering to these criteria. Guidelines are established by the Web Content Accessibility Guidelines (WCAG) 2.1 to provide

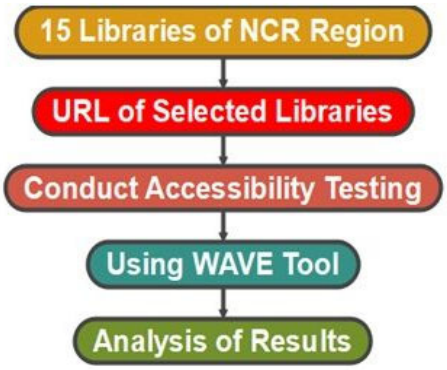

Fig. 1 — Methodology used for Evaluation of Web Accessibility[35]

Table 1 — BVI Libraries Websites of Delhi-NCR Region used for Accessibility Testing

S. No.	Name of The Library of Delhi-NCR Region	Website Link
1	Braille Library,(Digital Information Resource Center for V.I.)University of Delhi[19]	https://bl.du.ac.in/bl/web/
2	SOL Library, University of Delhi[20]	http://web.sol.du.ac.in/library/index.php/page/7
3	Helen Keller Unit (HKU), Jawaharlal Nehru University[21]	http://lib.jnu.ac.in/Assistive_Technolog_%20Area
4	Learning Centre for Differently Abled (LCDA), Dr Zakir Husain Library(Central Library), Jamia Millia Islamia[22]	https://www.jmi.ac.in/studyatjamia/library/zhl/lcda
5	Amba Dalmia Digital Resource Centre for Visually Challenged (ADDRC), Miranda House[23]	https://www.mirandahouse.ac.in/academics/centres/addrc.php
6	Indraprastha College for Women Library[24]	https://sites.google.com/ip.du.ac.in/libraryipcw/service-for-vh-students?authuser=0
7	Daulat Ram College Library, University of Delhi[25]	https://www.dr.du.ac.in/library-and-reading-room.php
8	Ram Lal Anand College Library, University of Delhi[26]	https://rlacollege.edu.in/Our_facilities.php
9	Dr. B. R. Ambedkar University Delhi[27]	https://aud.ac.in/services-1/library/library-home
10	Braille Library, Delhi Public Library[28]	https://dpl.gov.in/index.php/braille-library-service
11	National Association for the Blind Delhi[29]	https://www.nabdelhi.in/
12	All India Confederation Of The Blind, New Delhi[30]	https://www.aicb.org.in/
13	Durgabai Deshmukh College of Special Education (Visual Impairment), The Blind Relief Association[31]	http://www.durgabaideshmukhcollege.org/
14	Saksham Digital Library[32]	https://saksham.org/saksham-digital-library/
15	St Stephen's College Library[33]	https://www.ststephens.edu/library/

seamless access of digital content to people with disabilities. Disorders of the visual, auditory, physical, oral, cognitive, linguistic, learning, and neurological types are all included in the category of accessibility. These criteria include a wide range of subjects; however, they are inadequate to satisfy the needs of individuals with a variety of disabilities, degrees, and combinations of disabilities. These standards also promote the usability of Web content for older users whose abilities are changing due to ageing, as well as for all users.To create a global standard for Web content accessibility that meets the needs of individuals, organisations, and governments, the World Wide Web Consortium (W3C) worked with people and organisations from all around the world to establish WCAG 2.1[34].

WAVE Tool

In this study to assess the accessibility of BVI libraries of Delhi-NCR region, we used "WAVE (Web Accessibility Evaluation Tool)". WAVE is a collection of tools that digital content producers can utilize to increase the accessibility of their content for people with impairments. WAVE aids in the evaluation of human material in addition to identifying several accessibilities and WCAG (Web Content Accessibility Guidelines) concerns. It focuses on issues that concern users to facilitate human evaluation and spread awareness of web accessibility[35].It was used to assess web pages for mistakes, alerts, features, structural aspects, ARIA, and contrast issues. It depicts the accessibility difficulties in accordance with the WCAG criteria. In terms of accessibility criteria, Table 2 shows the results of 15

Table 2 — Automated Evaluation Tools used in related studies

S. No.	Related Studies		Automated Tool
	Paper Title	Authors	
1	"Web Content Accessibility Evaluation of Universities' Websites—A Case Study for Universities of Punjab State in India"[4].	Gupta, V., & Singh, H.	TAW and WAVE
2	"Assessing the usability, accessibility, and mobile readiness of e-government websites: A case study in India"[6].	Agrawal, G., Kumar, D., & Singh, M.	TAW
3	"Evaluating the web accessibility of IIT libraries: A study of Web Content Accessibility Guidelines"[2].	Panda, S., & Chakravarty, R.	Siteimprove
4	"Assessing the Accessibility of Library Tools & Services When You Aren't an Accessibility Expert"[17].	Rysavy, M. D. T., & Michalak, R.	WAVE
5	*"Evaluation of Web Accessibility of Engineering University"*[16].	Sodhar IH, Bhanbhro H, & Hassan Amur Z	WAVE and Powermapper
6	"Web accessibility investigation and identification of major issues of higher education websites with statistical measures: A case study of college websites"[3].	Ismail, A., & Kuppusamy, K.	TAW and aXe
7	"Toward a Combined Method for Evaluation of Web Accessibility"[15].	Acosta-Vargas, P., Luján-Mora, S., Acosta, T., & Salvador-Ullauri, L.	WAVE and Koally
8	*"Accessibility analysis of North Eastern India Region websites for persons with disabilities"*[5].	Ismail, A., &Kuppusamy, K. S.	Eval Access and WAVE
9	"Accessibility analysis of websites of educational institutions"[7].	Kesswani, N., & Kumar, S.	HERA, TAW and the Firefox Accessibility Evaluation Toolbar
10	"Accessibility Evaluation of Arabic E-Commerce Web Sites Using Automated Tools"[14].	Alshamari, M.	Achecker, TAW, Eval Access, MAUVE, and FAE
11	"Evaluating Accessibility of Malaysian Public Universities Websites using Achecker and Wave"[18].	Ahmi, A., & Mohamad, R.	AChecker and WAVE
12	"Study of the accessibility diagnosis on the public higher institutions website in Malaysia"[12].	Abuaddous, H. Y., Jali, M. Z., & Basir, N.	Accessibility Check, A-Checker, and TAW Online
13	"Web Accessibility for Disabled: A Case Study of Government Websites in Pakistan"[8].	Bakhsh, M., & Mehmood, A.	Functional accessibility evaluator and the Overall Validator
14	"Accessibility of South African Web sites to visually disabled users"[9].	Venter, S., &Lotriet, H.	Bobby 3.2
15	*"An accessibility assessment of selected Web-based health information resources"*[10].	Mccord, S., Frederiksen, L., & Campbell, N.	Bobby 3.2
16	"Measuring the Accessibility of Public Library Home Pages"[11].	Lilly, E. B., & Van Fleet, C.	Bobby
17	"Website accessibility performance evaluation in Malaysia"[13].	Jati, H., & Dominic, D. D.	Tawdish

websites in the Delhi-NCR India Region that were tested using the WAVE tool of WCAG 2.1.

Evaluation of Web Accessibility using WAVE Tool

The Wave tool is a simple online tool for measuring how accessible websites are. It can also be used to identify errors in websites and quickly fix them without taking much time or effort from the websites themselves. This tool is simple to use, comprehend, and apply. The six key components are represented in the figure below and were worked on with the online Wave tool. The interface of wave tool after the evaluation of the website of Delhi Public Library, Old Delhi is shown in figure. 2. Table 3 shows the results of BVI libraries of Delhi-NCR region on Wave tool, these outcomes based on six components of accessibility.

Web Accessibility Errors

Except for the All India Confederation of the Blind in New Delhi and Indraprastha College for Women Library, University of Delhi practically every website reported at least one error. Ten websites reported between one to ten mistakes, two websites reported between eleven to twenty errors and one website reported between fifty-one to sixty errors. Summary of the selected websites' issues is shown is Table 4.

Table 5 shows the details of the WAVE issues that demand quick action from the web administrator. A "Linked image missing alternative text" in which an image without alternative text results in an empty link was the most discovered fault among the websites. To resolve this issue, "add appropriate alternative text that presents the content of the image and/or the function of the link."The second most occurred error is "Empty Link", in which a link contains no text. To fix this error "remove the empty link or provide text within the link that describes the functionality and/or target of that link." The third most common mistake is "Empty Button," in which a button is empty or has no value text. To resolve this problem "Place text content within the <button> element or give the <input> element a value attribute."Table 5 lists all the WAVE errors found in the above listed websites, along with an explanation of their purpose and significance.

Findings

In this study, accessibility evaluation was conducted on 15Library websites of Delhi-NCR region. Those websites are developed for special

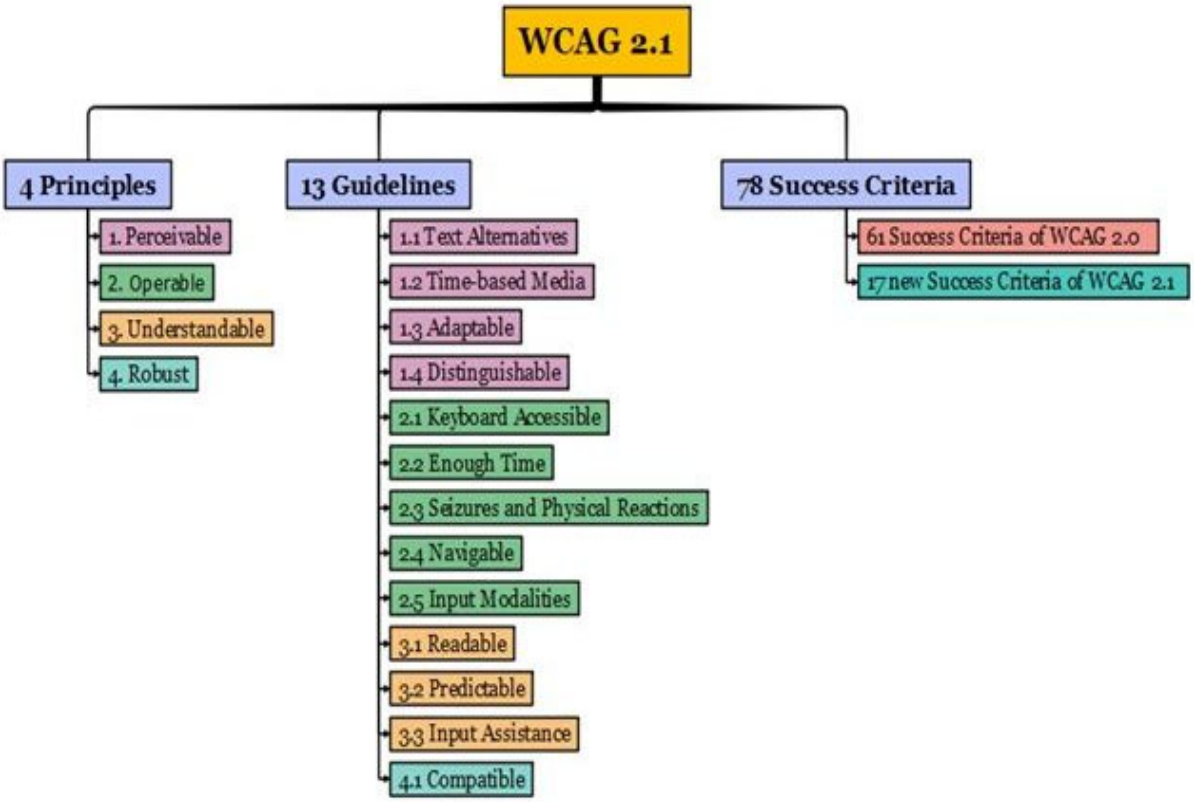

Fig. 2 — WCAG 2.1 Layers of Guidance

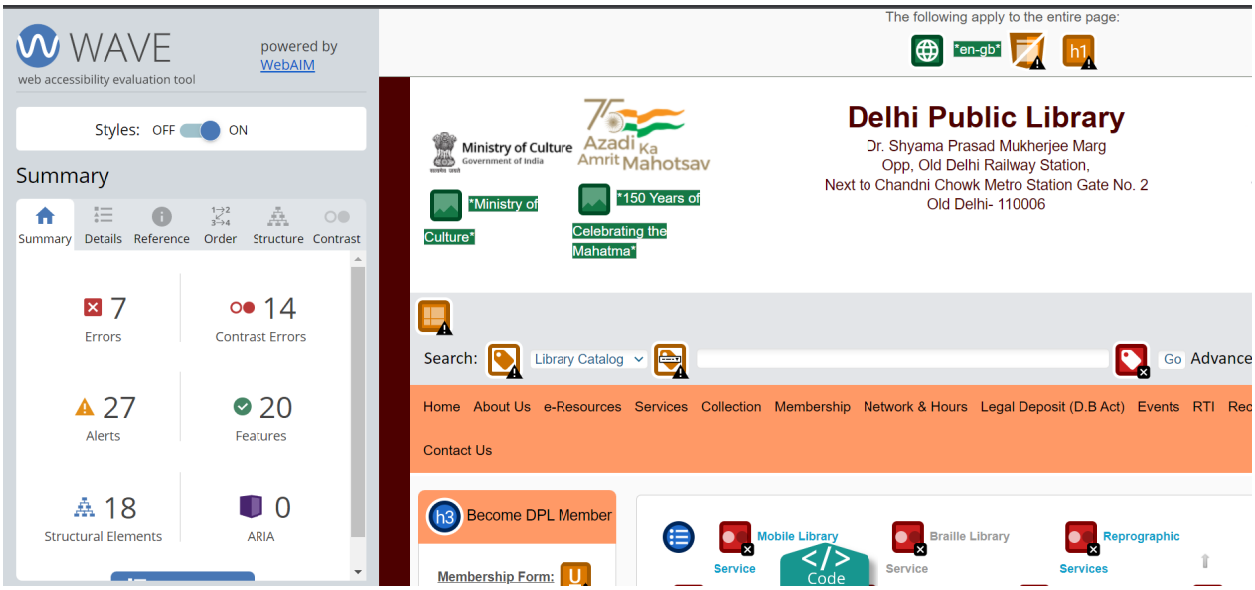

Fig. 3 — Interface of WAVE tool after testingwebsite of Delhi Public Library, Old Delhi

Table 3 — Evaluation Results of Websites Accessibility using WAVE Tool(as on 12-02-2023)

S. No.	Website Link	Errors	Alerts	Features	Structural Elements	ARIA	Contrast Errors
1	https://bl.du.ac.in/bl/web/	1	0	1	6	13	5
2	http://web.sol.du.ac.in/library/index.php/page/7	6	7	5	16	10	7
3	http://lib.jnu.ac.in/Assistive_Technolog_%20Area	3	37	3	46	2	1
4	https://www.jmi.ac.in/studyatjamia/library/zhl/lcda	58	37	2	7	0	49
5	https://www.mirandahouse.ac.in/academics/centres/addrc.php	9	19	1	41	0	61
6	https://sites.google.com/ip.du.ac.in/libraryipcw/service-for-vh-students?authuser=0	0	7	1	12	116	3
7	https://www.dr.du.ac.in/library-and-reading-room.php	6	56	3	52	1	30
8	https://rlacollege.edu.in/Our_facilities.php	3	136	57	26	4	14
9	https://aud.ac.in/services-1/library/library-home	9	9	11	14	8	68
10	https://dpl.gov.in/index.php/braille-library-service	7	27	20	18	0	14
11	https://www.nabdelhi.in/	20	24	33	38	37	5
12	https://www.aicb.org.in/	0	18	16	23	0	0
13	http://www.durgabaideshmukhcollege.org/	3	2	1	1	0	7
14	https://saksham.org/saksham-digital-library/	8	29	15	39	178	9
15	https://www.ststephens.edu/library/	11	12	5	19	0	2

assistance of blind and visually impaired users. All 15 websites were used for measuring their accessibility using automated tool WAVE (Web Accessibility Evaluation Tool) in conformance with the WCAG 2.1 standard. WAVE provides accessibility results for each website based on six components as shown in Table 3. Summary of WAVE errors shows that all websites have at least one error except two websites as shown in Table 4. A detailed error shown by WAVE is given in Table 5 for all 15 websites. It was

Table 4 —WAVE's Reported Web Accessibility Errors

Errors	Number of Webs	Percentage
0 errors	2	13.33%
1-10 errors	10	66.66%
11-20 errors	2	13.33%
21-30 errors	0	0%
31-40 errors	0	0%
41-50 errors	0	0%
51-60 errors	1	6.66%
Total	15	100% (Approx.)

Table 5 — Description of WAVE Errors

Description of the Error	What does it mean?	Why does it matter?	Frequency	Percentage
Missing form label	There is no label associated with a form control.	The function or purpose of a form control may not be displayed to screen reader users if the control does not have a correctly associated text label. Form labels give not just larger clickable targets for form controls, but also visible descriptions.	5	3.47%
Empty link	A link contains no text.	The function or goal of a link will not be provided to the user if it has no text. Users of keyboards and screen readers may become confused as a result of this.	36	25%
Linked image missing alternative text	An image without alternative text results in an empty link.	Alternative text for images that are the sole thing in a link must be descriptive. A screen reader has no content to offer to the user regarding the operation of a link if the image is within a link that has no text and the image does not supply alternative text.	57	39.58%
Empty button	A button is empty or has no value text.	When navigating to a button, screen reader users must be given informative language that explains what the button does.	14	9.72%
Missing alternative text	Image alternative text is not present.	An alt attribute is required for each image. The content of a photograph will be unavailable to screen reader users or when the image is unavailable if no substitute text is provided.	13	9.02%
Broken ARIA menu	There are no compulsory menu items in an ARIA menu.	ARIA menus are application menus (similar to software menus) that include specialised keyboard interactions. They must have at least one menuitem, menu item checkbox, or menuitemradio element and are NOT for navigation links on a website.	7	4.86%
Language missing or invalid	The document's language is unknown, or the lang property value is incorrect.	Screen readers can read text in the correct language by recognising the language of the page or page sections. It also allows for text translation to be done automatically.	3	2.08%
Marquee	A <marquee> element is present.	A marquee element displays scrolling text that cannot be stopped by the user. Users, especially those with certain cognitive difficulties, may find scrolling animated information annoying and confusing.	4	2.77%
Empty heading	A heading contains no content.	Some people prefer to navigate by heading elements, especially those who use a keypad or a screen reader. An empty heading will not convey any information and may cause confusion.	1	0.69%
Broken ARIA reference	There is an aria-labelled by or aria-described by reference, but there is no target for the reference.	ARIA labels and descriptions will not be displayed if the element being referred does not exist on the page.	0	0%
Spacer image missing alternative text	There is no alt attribute for a layout spacer image, which should have no alternative text at all.	Layout is maintained via the usage of spacer images. They should have empty alternative text (alt="") since they lack content and should not be displayed to visitors.	4	2.77%
Total			144	100% (Approx.)

found that the most commonly occurring error in the websites is “Linked image missing alternative text", second highest error is “Empty Link” and third highest error is “Empty Button”. Looking into the Alerts on the websites, Ram Lal Anand College Library, University of Delhi shows highest number of alerts at 136 and the website which shows zero alerts is Braille Library, (Digital Information Resource Center for V.I.), University of Delhi.

Conclusion

Using the Websites Accessibility online tool, the article has produced an evaluation report of web accessibility of 15 blind and visually impaired libraries' websites in the Delhi-NCR region (Wave). Errors, alarms, features, structural element, ARIA, and contrast are all components of the WAVE tool, and their accessibility results are likewise based on them. Summary of WAVE errors shows that all

websites have at least one error except two websites. It was found that the most commonly occurring error in the websites is Linked image missing alternative text, second highest error is Empty link, and third highest error is Empty Button. For the given errors, WAVE suggested resolution have been provided. Ram Lal Anand College Library, University of Delhi shows the highest number of alerts at 136and the websites which shows zero alert is Braille Library, University of Delhi. This study is conducted using only one automated tool for checking web accessibility i.e., WAVE tool. Further research in the field of web accessibility can be conducted using more than one tool to know that errors a library website has which can create hindrance for blind and visually Impaired (BVI) users in accessing website just like sighted user. Using the web accessibility test results, we can see whether our website meets the various WCAG standards of accessibility. These findings will also aid in the adaptation of Universal Design while creating websites to make it equally accessible for all. Having an accessible website will help in providing inclusive education for all. This accessibility evaluation can be done in different domains for different forms of accessibility testing and evaluation. To improve the web accessibility of a library's website, website designers and developers should bear in mind the suggestions and perspective of BVI users. Web accessibility awareness programmes should be conducted in this regard at every institution/ University. With the support of such an initiative, BVI learners will be able to access the digital resources seamlessly.

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