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Anita Sharma
anita9sharma@gmail.com

Ranjeet Kumar Choudhary Prof.
Mahatma Gandhi Central University, Bihar-845401,India, rkchoudhary@mgcub.ac.in

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Web Accessibility of Indian University Library Website: An Evaluation with WAVE Website Evaluation Tool

Anita Sharma

Ph.D. Research Scholar

Department of Library & Information Science, School of Computational Sciences,
Information and Communication Technology

Mahatma Gandhi Central University, Bihar-845401

E-mail: anita9sharma@gmail.com

Prof. Ranjeet Kumar Choudhary

Professor & Head, Supervisor

Department of Library & Information Science, School of Computational Sciences, Information
and Communication Technology

Mahatma Gandhi Central University, Bihar-845401

Email: rkchoudhary@mgcub.ac.in

Abstract

The advent of new teaching-learning methods has brought a great demand for accessible educational websites. There is much research on the accessibility of websites on educational websites in recent years from different countries. A website serves as a communication channel for publishing information and services in higher education. It is expected that higher education institutions must provide access to their information resources and services to all its user in an equal manner irrespective of their physical disability. Hence, it should be mandatory for higher education institutions to include web accessibility as an essential part of their websites. Libraries are the heart and an integral part of the higher education system. A library website is the main door from where learners are benefited from the information resources and services of an institute. This paper takes the issue of web accessibility of the home page of the library website for the top fifty universities ranked by NIRF (National Institutional Ranking Framework). NIRF is approved by MHRD (Ministry of Human Resource Department), and it ranks institution across the country in India. The home page of the top fifty Universities Library websites has been analyzed for accessibility errors and related issues with the help of WAVE (Web Accessibility Evaluation Tool). Results revealed that maximum universities had accessibility issues on their library home page.

Keywords: Web Accessibility, Library Website, WAVE, Accessibility Error, Aria

1. Introduction

The web is primarily designed with the intention to serve all people. The website has become an important medium of information communication. Everyone should get equal opportunity to get access to the web despite their disability. Web accessibility has become right for everyone. If a website is not following accessibility protocols and standards and is not accessible to disabled users, then it is violating guidelines in WCAG 2.0(Web Content Accessibility Guideline), which gives accessibility standards for the website. So, there is a need to determine whether educational websites, especially library websites, are following accessibility standards or not. In this paper WAVE tool has been selected for determining accessibility errors of the home page of the library website. WAVE tool conforms to guidelines present in WCAG 2.0. For the above reason, the researcher has chosen the top fifty Indian universities ranked by NIRF, which are of national importance in the education field in India. The library website of these universities will be analyzed for accessibility errors. Though there are studies on the evaluation of the accessibility of education websites, especially higher education, there are very few studies available based on educational library websites. So, to fill the gap, this study has been taken up.

2. Objectives

- To locate accessibility errors present in home page of universities library website,
- To identify colour contrast error in home page of universities library website,
- To know how many accessibility features are present on home page of universities library website,
- To access how many structural elements useful for screen reader and assistive technology are available in home page of library website,
- To find number of ARIA (Accessible Rich Internet Application) attributes useful for making website and web content more accessible for people with disability, are present in home page of university library website,
- To see whether there is relation between rank of university and accessibility issues produced by WAVE evaluation tool, and
- To bring in light accessibility and related issues to web developers to improve accessibility issues at the time of design and development of the library websites.

3. WAVE as a Website Evaluation Tool

There is various web accessibility evaluation tool which is online services or software program to find the whether content on the web meets accessibility guidelines. “Apart from specifying the web accessibility criteria, specific tools are needed to objectively evaluate the accessibility of a website.”(Ahmi & Mohamad, 2015)

Some of web accessibility evaluation tools are:Dynomapper.com, A11y Compliance Platform, AATT(Automated accessibility Testing Tool), Accessibility Checker, Accessibility Checklist, Accessibility Management Platform(AMP),A Checker, Fireeyes and WAVE. To check web accessibility of website these tools are very useful.

WAVE

WAVE (Web Accessibility Evaluation Tool) WAVE is an automated web accessibility evaluation tool developed by WebAIM. It detects accessibility errors in a website and also point out possible errors. Developers, designer and users of website can use WAVE for identifying accessibility errors after CSS and Java Script has been applied on website. One can directly put website URL on Web AIM website or add as an extension in their browsers like Chrome and Firefox to use it for finding accessibility errors. WAVE is abide by WCAG 2.0(Web Content Accessibility Guidelines).It should be known that WAVE is not a replacement for fool proof testing of websites. It is helpful is useful in quick, superficial level of checking of website.

Using of WAVE

In <https://wave.webaim.org/> enter webpage address of website which has been chosen for evaluation for accessibility errors. Two extension are also available for evaluating accessibility errors in WAVE tool. Firefox wave extension and chrome wave extension

Sometime due to security reasons CSS and Java script are locked and are not accessible to <https://wave.webim.org>, then one can add wave extension to Firefox or chrome browser. So, wave chrome or Firefox extensions should be used for evaluating complex, scripted content.

The screenshot displays the WAVE accessibility evaluation tool interface. On the left, a sidebar shows the WAVE logo and 'powered by WebAIM'. Below this, there are controls for 'Styles: OFF ON' and a 'Summary' section with tabs for 'Summary', 'Details', 'Reference', 'Structure', and 'Contrast'. The summary statistics are as follows:

Category	Count
Errors	22
Contrast Errors	19
Alerts	21
Features	3
Structural Elements	41
ARIA	50

At the bottom of the sidebar is a 'View details' button. The main content area shows the website being evaluated, 'JRD Tata Memorial LIBRARY Indian Institute of Science'. A top banner indicates 'The following apply to the entire page:' with icons for 'en' and 'ht'. The website navigation menu includes 'Home', 'About', 'Journals', 'E-Books', 'Databases', and 'Services'. Each menu item has a purple WAVE error icon and a tooltip showing an ARIA error message, such as 'aria-controls="sm-1621942033363299-2"'. A 'Code' button is visible at the bottom of the page.

Fig.1 A snapshot view of summary of accessibility errors for Indian Institute of Science, Bengaluru Library home page in WAVE.

4. Literature Review

Camposverde-Molina et al., (2020) came up with systematic literature review on analysing the empirical methods of evaluation accessibility to educational websites. They selected 25 papers ,in which it turned out that 20 papers out of 25 was evaluated with automation tools,2 papers was evaluated by with users of website and rest 3 papers were collectively evaluated by experts, real users and automatic tools. It was also concluded that educational websites do not conform to standard for web accessibility like Web Content Accessibility Guidelines (WACG).This review paper is very useful for researchers who are interested in studies on website accessibility.

A study with two web accessibility tool namely TAW and aXe has been carried out by **Smail & Kuppusamy (2019)** on 44 college website affiliated with the University of Kashmir and Cluster University Srinagar. Many accessibility issues and barriers like warning, number of problems, and review were identified. Statistical description were also included in this study and finally a list of suggestion were given for improvement of these websites.

Acosta & Luján Mora(2017) have studied accessibility of the websites of higher education Ecuadorian universities belonging to categories A,B,C. Study focused on determining accessibility errors present on these websites and recommends some suggestions to web developers for adhering to WCAG 2.0 guidelines

Abu Shwar(2015) in his paper performed evaluation of sample website in Jordan in terms of accessibility. Paper compares this accessibility evaluation with Website in England and Arabic region. Result showed that accessibility errors of Jordan and Arab region is greater by UK by 13 and 5 consequently.

Ahmi & Mohamad (2015) in the paper “Web Accessibility of the Malaysian Public University” have evaluated 20 public universities in Malaysia. They used. A- Checker and WAVE evaluation tool for evaluation. Result indicated that there was improvement in web accessibility in public universities when it was compared with previous studied. However, it was stressed that action should be taken to ensure that websites are accessible to all.

Sánchez García et al., (2013) in their paper studied on accessibility of Web pages of 10 Andalusian universities. The paper highlights which universities are complying with the guidelines and regulations recommended by the European Commission and comply by guidelines developed by the World Wide Web Consortium (W3).It indicates particular accessibility issues and their problem for each university. Paper concluded universities need to do a lot to achieve compliance with regulations recommended by the European Commission and comply by guidelines developed by the World Wide Web Consortium (W3)

Al-Khalifa et al. (2011) in the study “A pilot study for evaluating Arabic websites using automated WCAG 2.0 evaluation tools” conducted a pilot study on evaluation of Arabic websites with the use of automated Website Content Accessibility Guideline evaluation tools. It is claimed to be unique study in this area.

5. Methodology

Study on home page of library Website of top 50 Indian University (ranked by NIRF) for accessibility errors and related issues started on 5th April 2020 to May 30th 2020. For this study researcher has chosen WAVE evaluation tool among other existing website evaluation tools. There are two methods for evaluation of website. In the first method, WAVE extension is added in Chrome browser or Firefox browser from <http://wave.webaim.org>. and check accessibility within browser. In the second method, one can directly enter URL of website in <http://wave.webaim.org> to check its accessibility summary report.

When analysis is run in WAVE, it shows summary report on left side of window and embeds icon and indicators in webpage. There are mainly six types of elements present in report with colour code. Red square icon indicates accessibility error, which means one with disability will face problem in accessing this webpage. Red double circle (one hollow and one filled) indicates contrast error. Yellow icon indicates alert or warnings. Green icon shows accessibility features which may or may not be useful for screen reader users. Blue icon shows structural elements that may be useful for users using screen reader or other assistive technology. Purple icon indicates ARIA which is detected by assistive technologies.

Data from top 50 universities library website were taken out between period 5th April 2021 to May 30th 2021. After that all data were tabulated and analysed with the help of Microsoft Excel spreadsheet. Relevant tables, graphs, and charts have been presented in Analysis of result and Discussion section. Results were drawn from table, chart and graph.

In this study evaluation is limited to summary report presented by WAVE tool. However, one can evaluate deeply by clicking on individual elements in report and find specific error in website.

6. Analysis and Discussion of Results

Table 1. Summary Results of WAVE for Library Home Page of University Library Websites

Rank	Name of University	Accessibility Errors	Contrast Errors	Alert	Features	Structural element	Aria
1	Indian Institute of Science, Bengaluru	22	19	21	3	41	50
2	Jawaharlal Lal National University, New Delhi	2	37	29	26	35	7
3	Banaras Hindu university, Varanasi	11	4	9	1	2	0
	Amrita Vishwa Vidyapeetham Coimbatore	5	6	6	13	66	3

5	Jadavpur University Kolkata	8	35	9	9	19	0
6	University of Hyderabad Hyderabad	15	33	22	4	8	0
7	Culcutta University Kolkata	25	21	37	46	57	39
8	Manipal Academy of Higher Education Manipal	10	6	17	11	67	72
9	Savitribai Phule Pune University Pune	0	0	8	2	22	6
10	Jamia Millia Islamia New Delhi	62	80	50	5	7	3
11	University of Delhi	5	4	56	17	1	0
12	Anna University Chennai	16	18	17	7	16	26
13	Bharathiar University Coimbatore Tamil Nadu	6	8	12	1	53	0
14	Homi Bhabha National Institute Mumbai	NA					
15	Birla Institute of Technology & Science Pilani	9	5	69	6	122	2
16	Vellore Institute of Technology Vellore	28	1	267	5	65	5
17	Aligarh Muslim University Aligarh	4	40	126	73	34	20
18	Institute of Chemical Technology Mumbai	12	9	189	10	61	373
19	Andhra University Visakhapatnam Andhra Pradesh	5	9	28	3	57	43
20	Siksha 'o' Anusandhan Bhubaneswar	2	1	24	2	13	26
21	Jamia Hamdard New Delhi	26	80	36	23	32	5

22	University of Madras Chennai	13	28	4	25	12	4
23	Kerala university Thiruvananthapuram	11	49	53	2	5	0
24	Kalinga Institute of Industrial Technology, Bhubaneswar Orissa	8	10	13	5	12	0
25	Shanmugha Arts Science Technology & Research Academy ,Thanjavur	9	0	32	5	42	0
26	Punjab University Chandigarh	1	46	12	1	10	0
27	Mysore University ,Mysuru	18	4	44	1	22	32
28	Sri Ramchandra Institute of Higher Education And Research	24	24	34	33	39	18
29	Osmania University, Hyderabad	2	0	40	2	8	0
30	Mahtma Gandhi University ,Kottayam	1	0	15	10	22	7
31	Thapar Institute of Engineering & Technology Patiala ,Punjab	85	15	90	7	100	59
32	kings George Medical University, Lucknow	13	7	131	1	334	6
33	JSS Academy of Higher Education and research Mysuru Karnataka	9	7	29	26	31	5
34	Tata Institute of Social Science Mumbai	74	45	33	2	648	0
35	S.R.M. Institute of Science and Technology Chennai	25	1	265	7	86	5

36	Alagappa University Karaikudi,Tamil Nadu	12	40	8	2	30	4
37	Amity University Noida Gautam Buddha Nagar, Uttar Pradesh	42	29	95	20	122	0
38	Sri Venkateshwara Univer sity Thirupati ,Andhra Pradesh	3	13	35	3	12	0
39	Sathyabama Institute of Science and Technology, Chennai	39	32	1198	595	58	19
40	Tezpur University.Tezpur Assam	103	2	281	18	37	26
41	Koneru Lakshmaiah Education Foundation University, Vaddeswaram	9	2	8	0	18	0
42	Saveetha Institiute of Medical and Technical Sciences, Chen nai	1	22	7	3	43	0
43	Symbiosis International Pune	13	50	18	0	16	0
44	Gujrat University,Ahemd abad,Gujrat	17	76	14	16	88	113
45	Delhi Technological University New Delhi	51	23	89	0	3	0
46	Dr. D.Y. Patil Vidyapeeth Pune, Maharashtra	22	0	44	5	26	16
47	Gauhati University Guwahati ,Assam	19	58	9	5	55	27
48	University of Kashmir, Srinagar Jammu &Kashmir	8	5	287	3	64	0

49	North Eastern Hill University Shillong , Meghalaya	11	6	46	40	3	0
50	Visva Bharati Santiniketan, West Bengal	20	14	28	48	29	8

N.B. Out of 50 University only one university has no library home page

Table.1 Lists top 50 Indian Universities ranked by NRIF. In this table summary results of WAVE for Library Home Page of University Library Websites has been displayed. For analysis purpose data in summary report has been categorised in groups, which are discussed below separately with table, charts and graphs.

6.1. Analysis and Result of Accessibility Errors

Table2. Summary of Accessibility Errors for Library Home Page	
Accessibility Errors	No. of Library Home Page
0 Errors	1
1-10 Errors	20
11-20 Errors	14
21-30 Errors	7
31-40 Errors	1
More than 40	6
Total	49

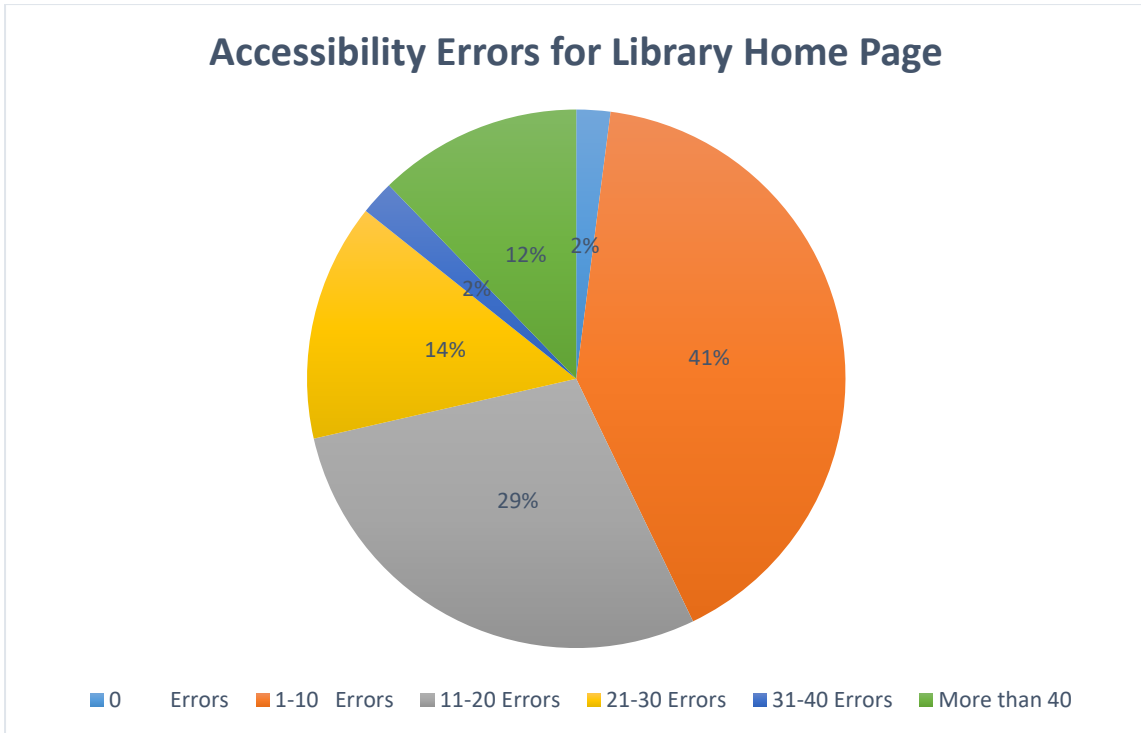


Fig.2 Accessibility Errors for Library Home Page Percentage wise

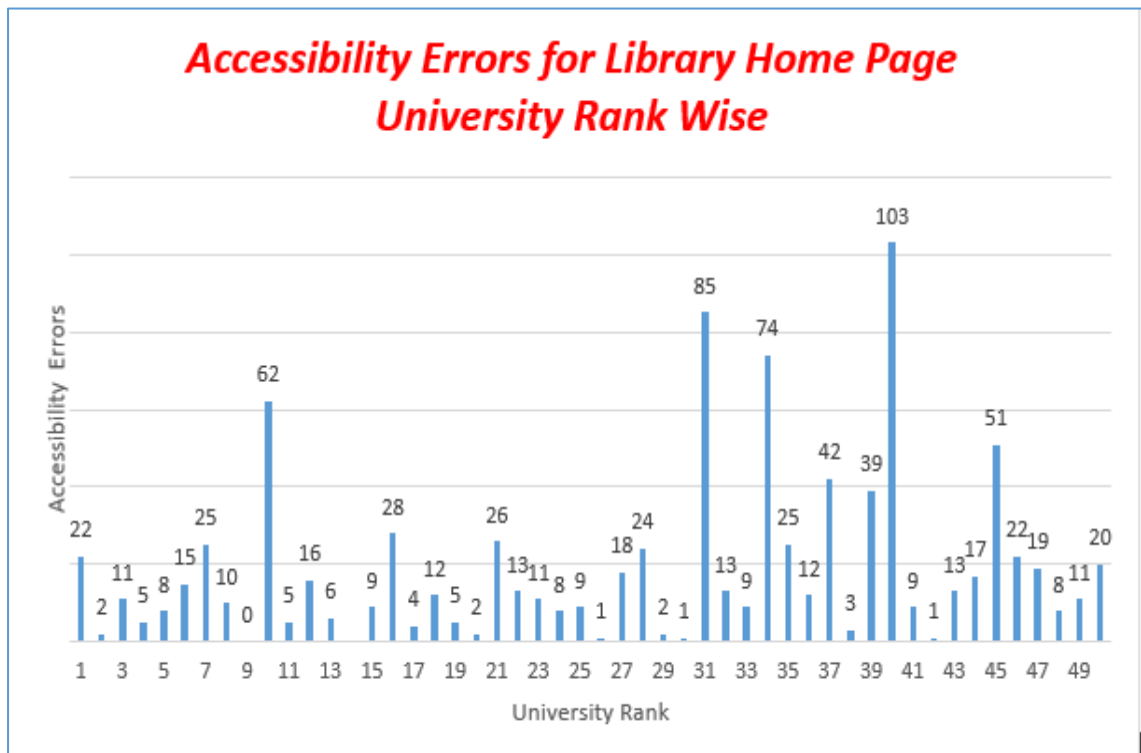


Fig3. Accessibility Errors according to university rank wise

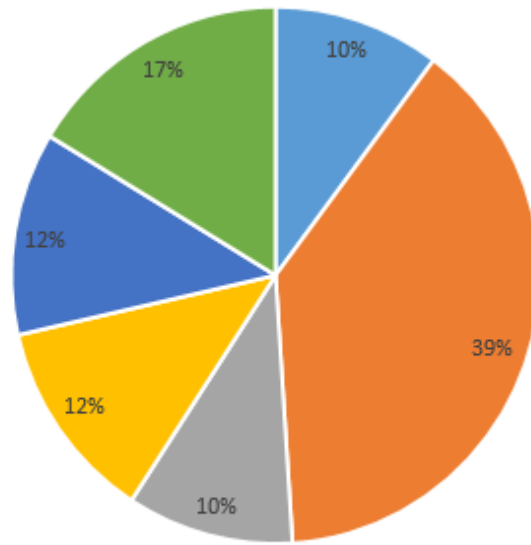
Analysis for Accessibility Errors in library home page.

Accessibility error represents errors like empty link, missing link image, missing alternative link, form label missing, heading error and document language error in a web page. Minimum value of accessibility errors in wave for library home page of universities is zero and maximum value is 103. So, there is enough difference in minimum and maximum accessibility errors presented by WAVE evaluation tool. Only 2% out of 49 universities library home page are having Zero errors. Maximum library home page fall under range of 1-10 errors. In the fig.3 it is found that University ranked at 1st and 9th have zero accessibility errors, while maximum no of errors are detected at university at rank 40 followed by university at 31st rank. It can be deduced that there is no correlation between ranking and numbers of accessibility errors detected with WAVE tool.

6.2. Analysis and Result of Contrast Errors

Contrast Errors	No. of Library Home Page
0 Contrast Errors	5
1-10 Contrast Errors	19
11-20 Contrast Errors	5
21-30 Contrast Errors	6
31-40 Contrast Errors	6
More than 40	8
Total	49

Table 3. Summary of Contrast Errors for Library Home Page



■ 0 Contrast Errors ■ 1-10 Contrast Errors ■ 11-20 Contrast Errors
 ■ 21-30 Contrast Errors ■ 31-40 Contrast Errors ■ More than 40

Fig.4 Contrast Errors for Library Home Page Percentage wise

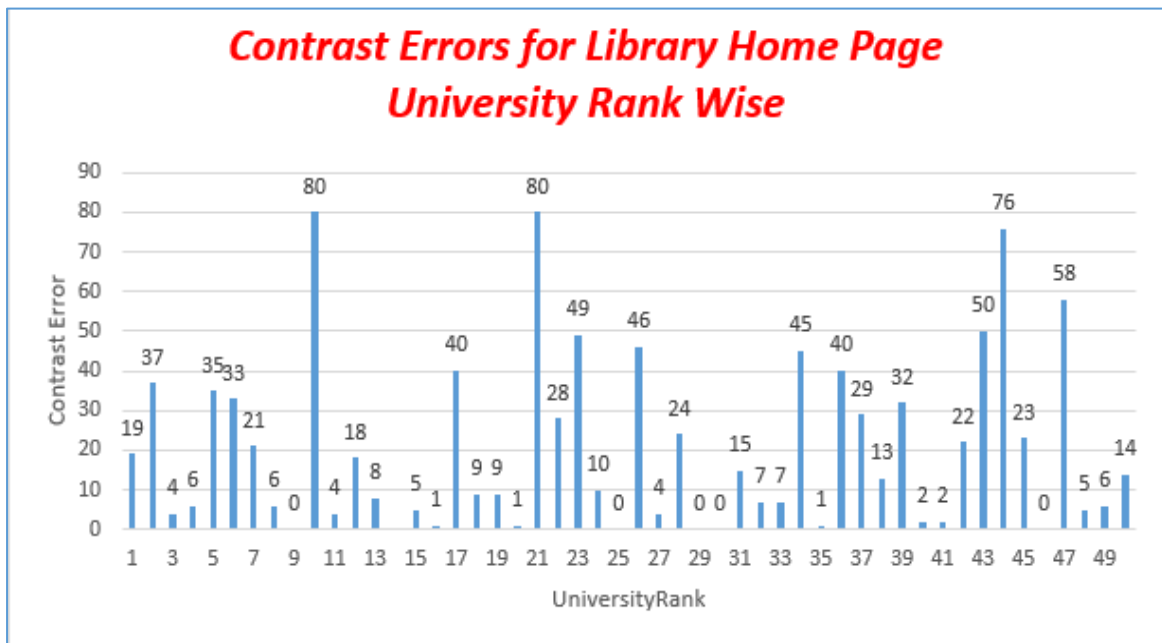


Fig5. Contrast Errors according to university rank wise

Analysis for Contrast Errors in library home page

Contrast is very necessary for a web page to be clearly visible. From table 3 it is seen that 5 library home page has zero contrast error. Minimum value of contrast errors in wave is 5 and maximum is 19. In fig 4 maximum percentage of contrast error is 39 which falls in group 1-

10.Fig. reveals that university library home page at rank 10th and 21st are having maximum contrast errors followed by university at 44th rank. It again shows that there is no dependency of contrast errors detected on WAVE tool with ranking of university.

6.3. Analysis and Result of Accessibility Alerts

Table4. Summary of Alert for Library Home Page	
Alert	No.of Library Home Page
0 Alert	0
1-10 Alert	9
11-20 Alert	8
21-30 Alert	7
31-40 Alert	7
More than 40	18
Total	49

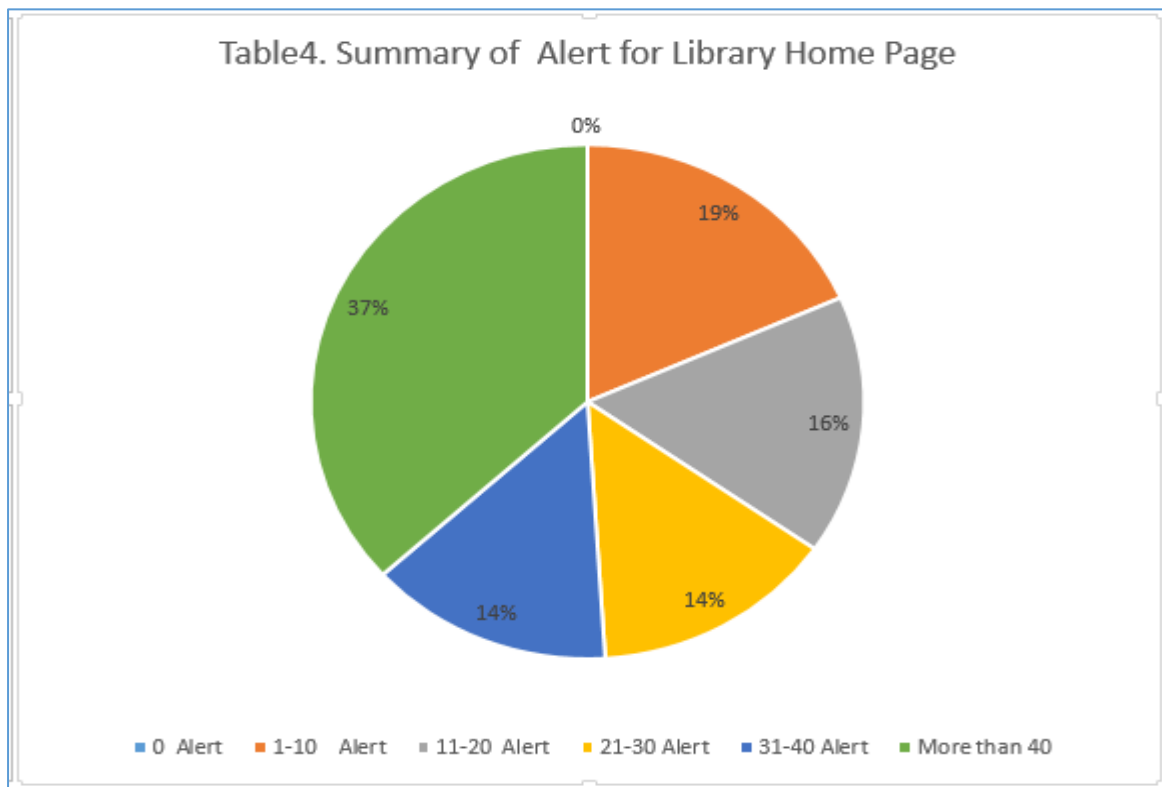


Fig.6 Alert Errors for Library Home Page Percentage wise

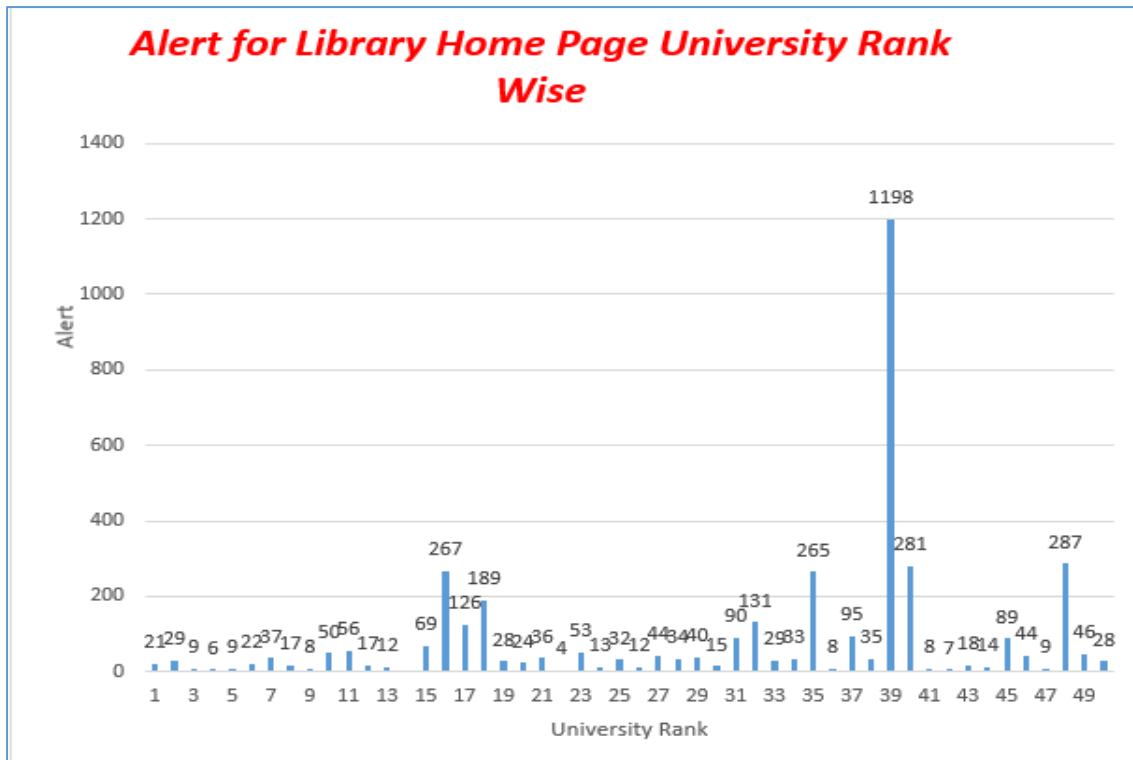


Fig7. Alerts according to university rank wise

Analysis for alerts in library home page

Table 4 indicate that there is no library home page which has zero alerts. There are 9 library home page for which alerts are between the range 1-10 and 18 library home page have more than 40 alerts. Fig.6 shows maximum 37 percent of library home page have more than 40 alerts. Surprisingly, in Fig.7 University library home page at rank 39 is having 1198 alerts. 41 libraries home page have alerts below 100. Only 8 libraries are having alerts above 100. There is no relation between alerts and rank of university.

6.4. Analysis and Result of Accessibility Features

Features	No.of Library Home Page
0 Features	3
1-10 Features	30
11-20 Features	6
21-30 Features	4
31-40 Features	2
More than 40	4
Total	49

Table6. Summary of Features for Library Home

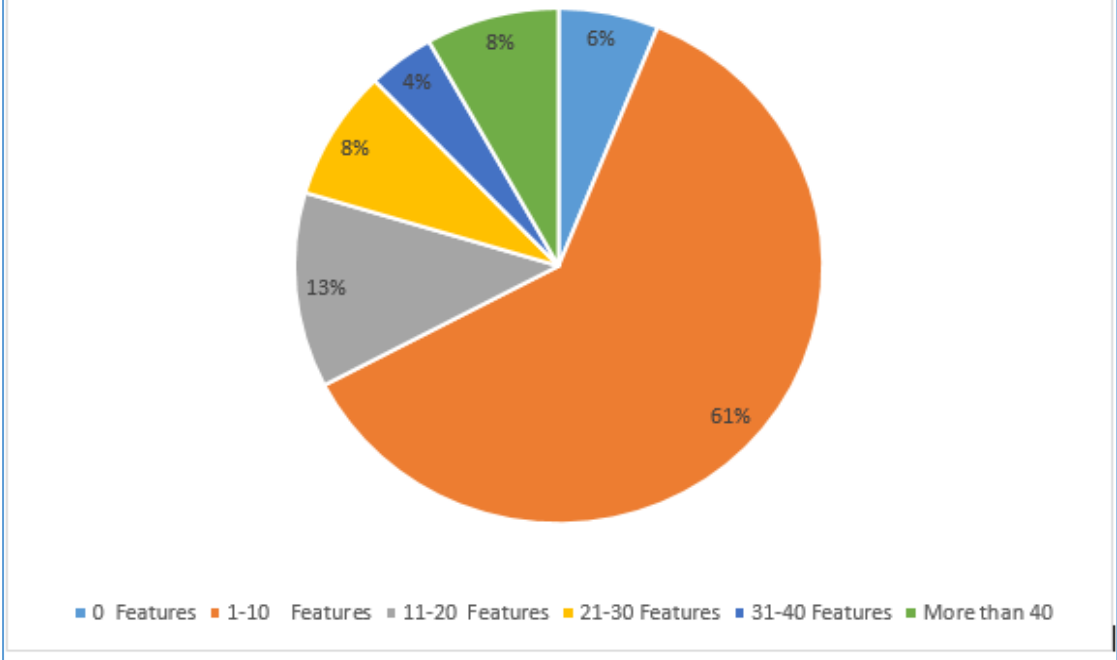


Fig.8 Features for Library Home Page Percentage wise

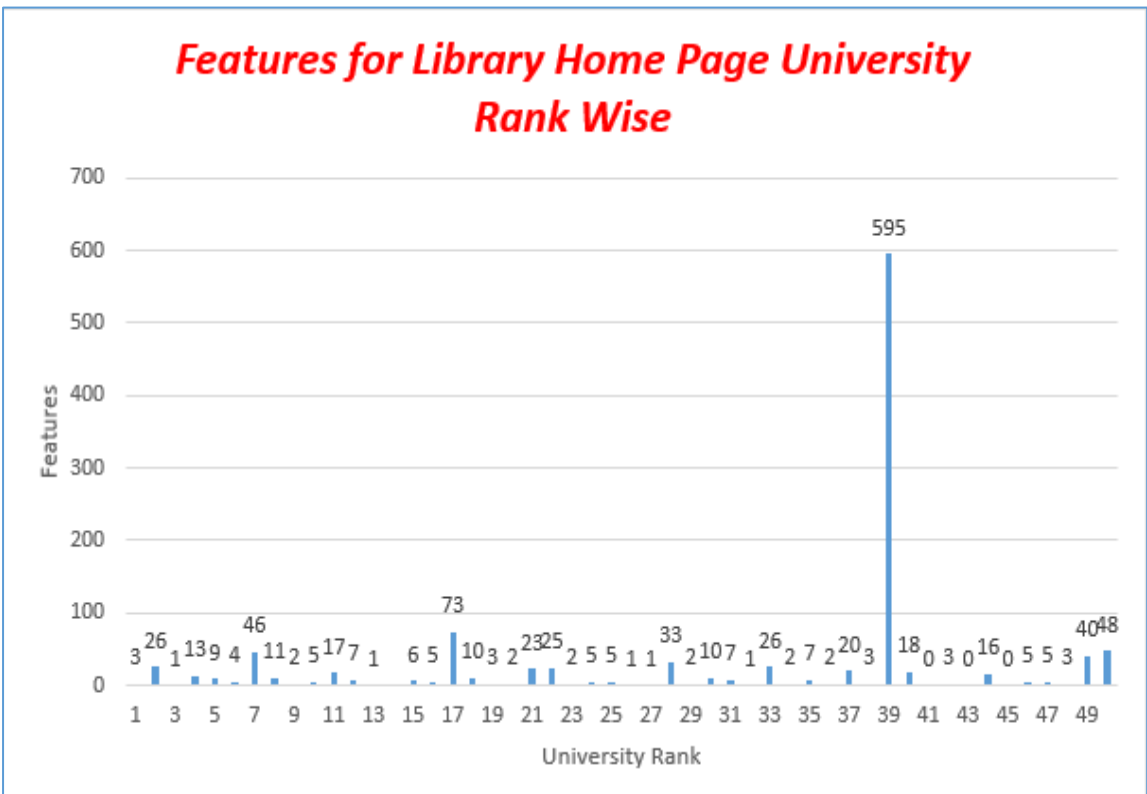


Fig9.Features according to university rank wise

Analysis for features in library home page

WAVE also detects Accessibility features which may or may not be useful for screen reader users. In table.6 it was found that 3 library home page have zero accessibility features. While 30 libraries home page out of 49 libraries have less than or equal to 10 accessibility features and only 4 libraries have more than 40 accessibility features. Fig.8 shows that 61% of libraries home page have accessibility features between 1 and 10. Accessibility feature for library home page at rank 39 has 595 which is above average and all 48 libraries home page have less than 100 accessibility features.

6.5. Analysis and Result of Structural Element

Table7. Summary of Structural element for Library Home Page	
Structural element	No.of Library Home Page
0 Structural element	0
1-10 Structural element	9
11-20 Structural element	8
21-30 Structural element	6
31-40 Structural element	6
More than 40	20
Total	49

Table7. Summary of Structural element for Library Home Page

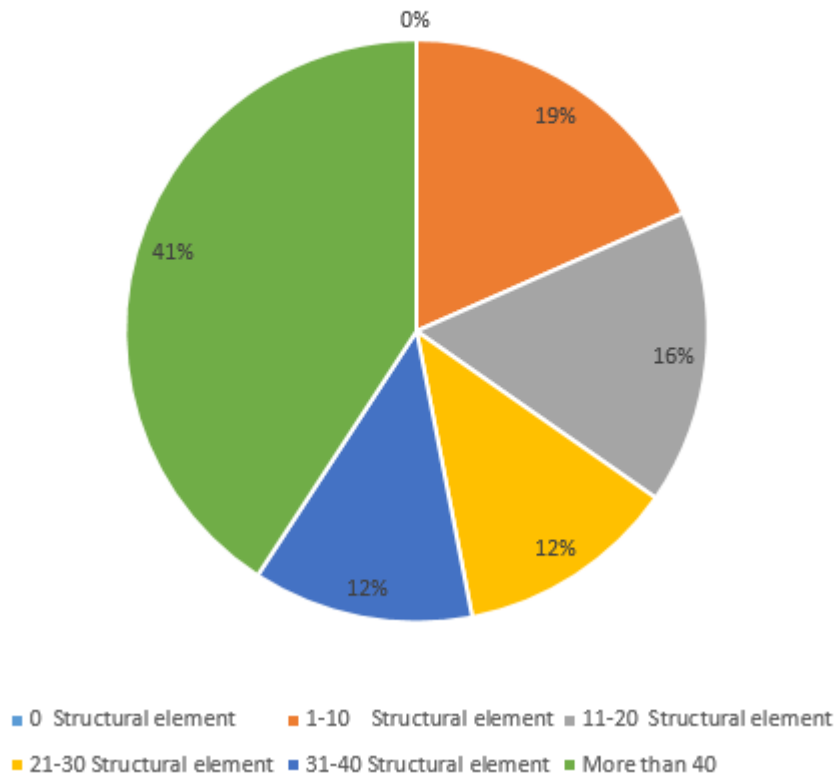


Fig.10 Structural Element for Library Home Page Percentage wise

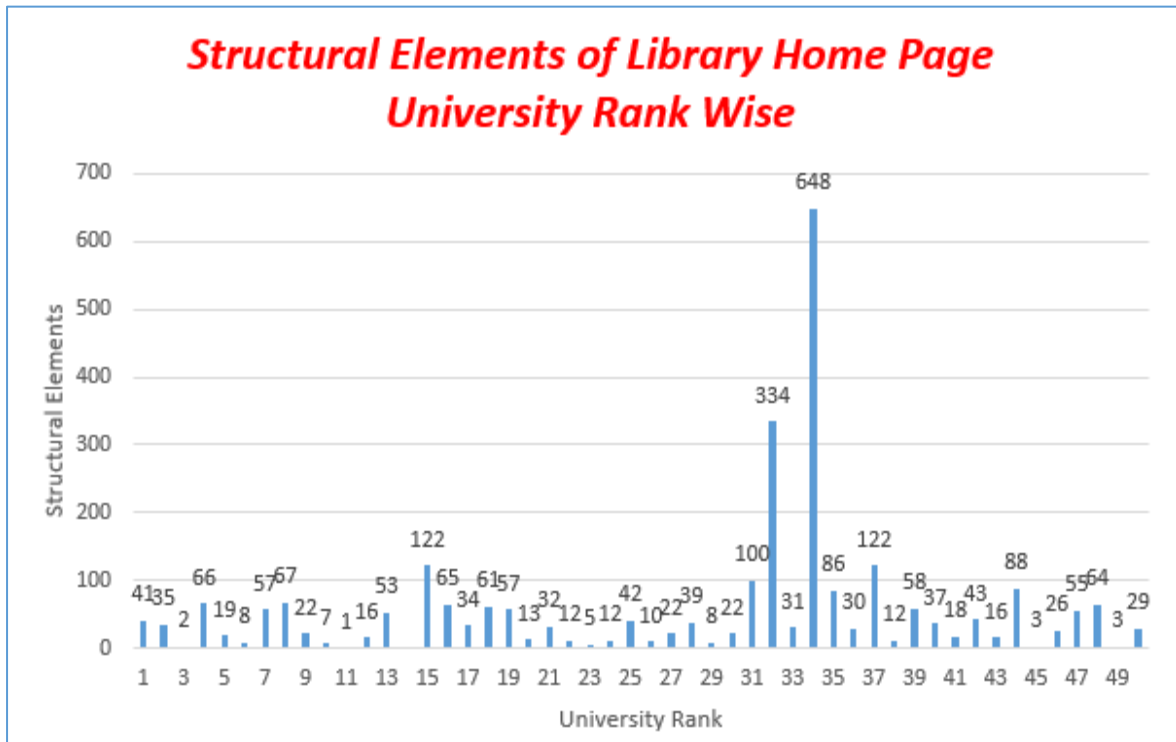


Fig.11 Structural Elements according to university rank wise

Analysis for structural element in library home page

Structural elements may be useful for users using screen reader or other assistive technology. It also plays an important role in deciding whether library home page is accessible for special users or not. Table.7 shows all library home page have issue of structural element in their web page. 20 libraries are having more than 40 structural element, which accounts for 41% (fig.10). Fig.11 shows a disparity in structural element issues between library home page, university at rank has 648, followed by 334 and least value is for university at rank 12.

6.6 Analysis and Result of Aria

Table8. Summary of Aria for Library Home Page	
Aria	No.of Library Home Page
0 Aria	19
1-10 Aria	14
11-20 Aria	4
21-30 Aria	4
31-40 Aria	2
More than 40	6
Total	49

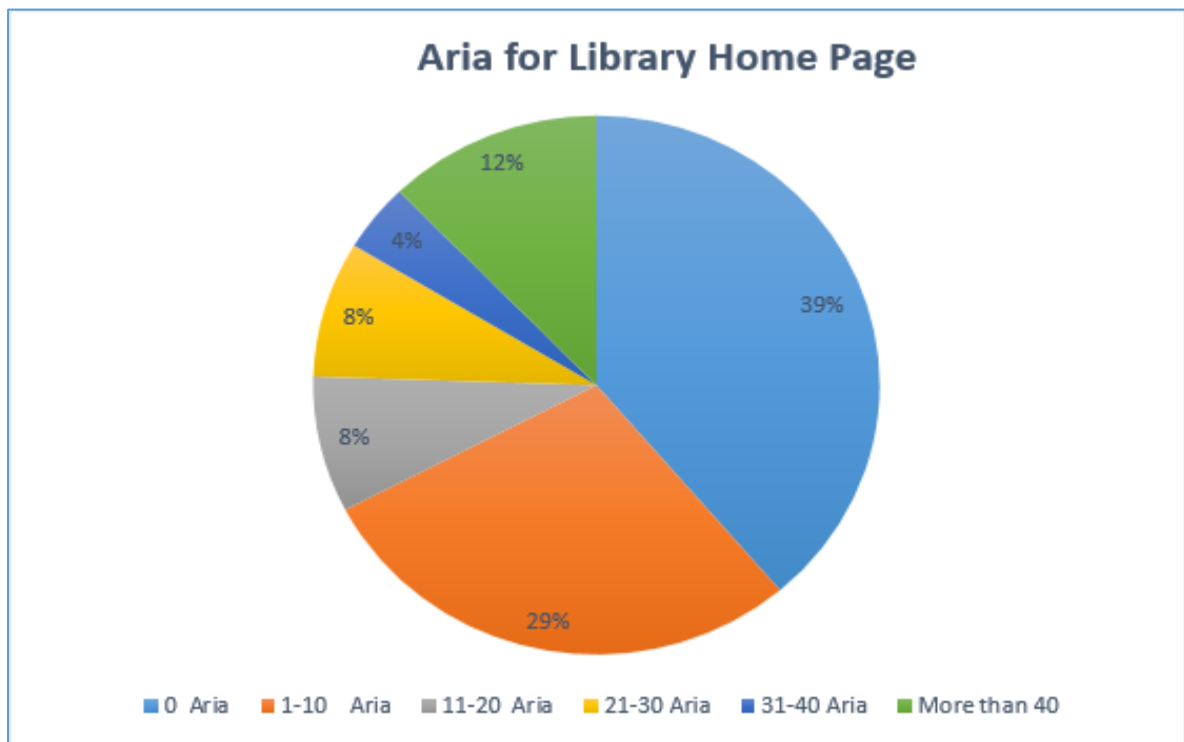


Fig.12 Aria for Library Home Page Percentage wise

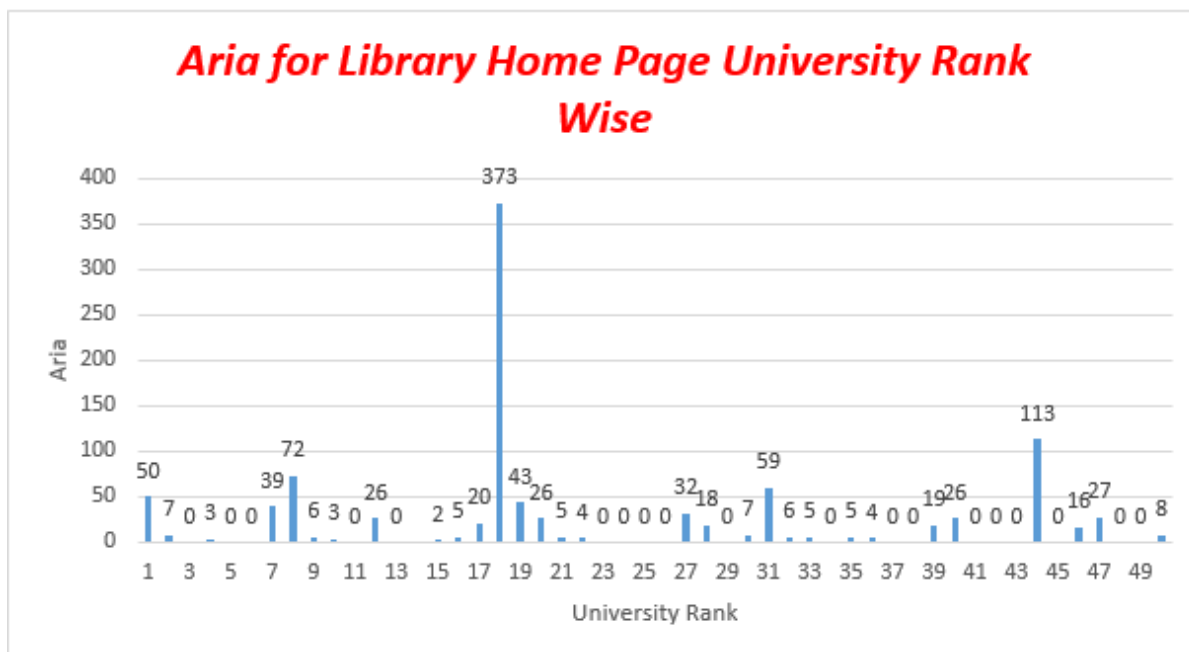


Fig. 13 Aria according to university rank wise

Analysis for Aria in library home page: ARIA is detected by assistive technologies and very useful for making a website accessible. It is detected from table 8 that 19 libraries out of 49 have no ARIA issues in their website. While 14 libraries have ARIA issues between 1 and 10. Only 6 libraries home page have more than 40 ARIA issues. Fig.12 shows 39% have ARIA zero ARIA issues. Only two university at rank 18(373 ARIA) and rank 13(113 ARIA) have more than 100 ARIA issues.

7. Conclusion

Result analysed from WAVE evaluation tool indicated various accessibility issues and related accessibility features which are very useful for making a website accessible to people having some kind of disability. It was concluded that accessibility errors and related issues are present in most of the library home page chosen for study. If these issues are addressed at website design and development time, then website will serve as a useful platform for all users including people with some kind of disability. It is suggested, early the better, website developers should adhere to WCAG guidelines in the beginning of website development helping to result in less accessibility errors. This study will be beneficial to universities which are adhering accessibility norms and standard given by WCAG 2.0 guidelines. They can easily spot accessibility errors in their library website and take necessary steps at an early stage. Results of this paper can be used by website designer and developers to improve website accessibility.

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