

# Accessibility Analysis of Multilingual Websites for Persons with Visual Impairments

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## ABSTRACT

The World Wide Web (WWW) is expanding exponentially. It has evolved into a standard resource to access the required information by people with diverse capabilities, information requirements and language abilities. In the present form, WWW incorporates a large number of human languages. Multilingual Information access involves websites offering content in more than one language. Web accessibility issues are gradually increasing in multilingual domain. Persons with Disabilities (PWD) are still facing accessibility problems while browsing the multilingual websites. Specifically persons experiencing visual impairments face many barriers while navigating and interacting with multilingual content. Our research work concentrates on Websites in which multi-language support has provided. This paper provides insights into the major accessibility challenges faced by visually impaired users while browsing the multilingual web. We have conducted a preliminary study with persons with visual impairments with respect to the problems that they encounter while browsing multilingual web pages. An online questionnaire with 22 questions placed and posted in AccessIndia online forum for persons with visual impairment. Based on respondent’s responses, it has inferred that visually impaired users are facing multiple difficulties such as interaction barriers, navigational barriers while browsing the web. To improve the browsing experience of these users we have put forward some suggestions, which can employed to increase the accessibility level of multilingual websites.

**Keywords :** Multilingual Web, Web Accessibility, AccessIndia, Persons with Visual Impairments.

## I. INTRODUCTION

The Internet is no more monolingual[1]. WWW is evolving progressively. In the past decade, multilingual websites are predominantly growing and so is the content. Popular newspapers, Government websites, On-line e-commerce websites are rapidly moving towards multilingual platform. According to the statistics of Wikimedia, more than 230 languages are available in Wikipedia[2]. It means that users are expecting the multilingual contents from the web. Person with disabilities are also an integral part of our society, they have equal rights to access the information through World Wide Web without any barrier. According to World Health Organization[3], more than 285 million people worldwide are visually impaired, 39 million people are blind According to Census of India 2011 data on disabilities, it can be observed that 21 million people in India are suffering from some kind of

disabilities[4]. Table 1 represents the total disabilities population of India according to 2011 census report.

TABLE I  
DISABILITIES TOTAL POPULATION IN INDIA 2011 CENSUS

Residence	Person	Male	Female
Total	2.21 %	2.41%	2.01%
Rural	2.24%	2.43%	2.03%
Urban	2.17%	2.34%	1.98%

The language of the content should not restrict access to the web. Content translation mechanisms should put in place. Some of the famous web services like Google Inc. [5] and Yahoo translator[6] are providing options to translate the text chunks. For example, “Translate this page” link has provided at the top of the websites to perform the translation.

W3C -World Wide Web consortium has released Web Content Accessibility Guidelines[7] which provides checkpoints for web accessibility. Authoring Tools Accessibility Guidelines[8] provide guidelines for designing web content authoring tools for persons with disabilities. WCAG 1.0[9] was published in the year 1999 with 14 guidelines and updated version of WCAG1.0 released in 2003. WCAG 2.0[10] has given four principles Perceivable, Operable, Understandable and Robust (POUR) which include 12 different guidelines with 61 success criteria with 3 conformance levels A, AA, AAA. Department of Information Technology (DIT), Ministry of Communications and Information Technology, Government of India has proposed Guidelines for Indian Government Websites[11]. GIGW guidelines ensure accessibility and user friendliness. Under various specifications 115 guidelines were developed. These guidelines provide Website Quality Certification[12] or Standardization Testing Quality Certification. GIGW Guideline checklist range 5.7 (5.7.1, 5.7.2, and 5.7.3)[11] has proposed accessibility rules about multilingual web development.

Our preliminary works concentrate on accessibility barriers in multilingual web access and measures the user's browsing behaviour, navigation difficulties, and error handling while interacting with multilingual websites. We have also tried to understand how PWDs (persons with disabilities) perform when they are exposed to multilingual websites. Our findings reveal that multilingual web sites need to be made more accessible to PWDs and content developers should follow WCAG guidelines while creating the content.

## II. RESEARCH OBJECTIVES

Accessibility barrier while interacting with multilingual Websites, The overall research objectives are as listed below:

- To find the difficulties of persons with visual impairments while browsing the multilingual websites.
- To measure the current accessibility level of multilingual websites.
- To provide potential suggestions to resolve the accessibility issues in multilingual information access according to WCAG and GIGW Guidelines.

The remainder of this paper is organized as follows. In section 2 research objectives are highlighted. Section 3 explains the research motivations and related works. Section 4 explains the advantages of the multilingual

web. Section 5 puts light on accessibility barriers in the multilingual web. Section 7 explains our methodologies. Section 8 explains our experimental analysis results. In section 9 some suggestions for better accessibility of multilingual content has explained. Finally, we conclude and put forward some future research directions.

## III. RESEARCH MOTIVATION AND RELATED WORKS

Although assistive technologies like screen readers has changed the way the web is accessed by PWD but it has been seen that assistive technologies and accessibility evaluation tools are not fully effective[13] in multilingual information access. [14] Rodriguez V´azquez, conducted an experiment to analyse the major challenges faced by visually impaired users, while accessing the multilingual web. According to Large and Moukdad [15] non- English speakers are accessing the web faster than English speaking users. In the aforementioned work, they automatically selected page's language based on the language setting of a web browser. In other method, language is automatically selected using geographical location of user IP Address.

Balaji and Kuppusamy[16] analysed the accessibility level of twenty Indian government railway websites. In his work, he incorporated on three different tools to evaluate websites 1. AChecker[17] 2.WAVE[18] 3.EvalAccess [19] Findings present the errors of these important web resources and accessibility suggestions are given to resolve the accessibility issues in websites.

Gade[20] proposed an approach to evaluate the user behaviour in digital libraries. This analysis gathered information of log file analysis, clickstream logger. Outcomes of the analysis conclude the description of user requirements in multilingual information systems. Hutchison, David[21] Conducted a search analysis to find different linguistic and cultural background of users, in his study associated with Log Analysis for Digital Societies (LADS) which is a part CLEF(Cross Language Evaluation Forum). Braschler[22] investigate the merging approach of multiple translations of source data. His research work concentrates on improving the retrieval effectiveness and improves the lexical coverage in multi-language web.

W3C (World Wide Web Consortium) has organized a workshop in Madrid on October 2010, entitled “The Multilingual Web: Where Are We”. Purpose of the workshop is to introduce best practices and W3C standards procedures aimed at helping multilingual content creators, localizers, tools developers. The major findings of workshop are shown English web pages decreases and that of other languages web pages is gradually increasing in web space[23].

#### **IV. Advantage of Multilingual Web**

The primary purpose of developing a website is to communicate and share information among all sections of society without any barriers. Multilingual website covers variety of customers around the world[24], since larger number of users like to work with their preferred regional language. We have mentioned few benefits of developing the multilingual web. According to the survey conducted by w3techs[25], 52.5 % people are using English as their primary language, it means they browse and search contents in English. There are about one billion people who is use some other language as their primary language and these Internet users prefer to browse in their native language than English language. The population of these users is growing rapidly which forces us to think for multilingual web.

Multilingual websites serve the user needs better, it make users feel comfortable and satisfied with the website, it can make huge differences in browsing Internet[26], so they can bring new users to the particular website.

Multilingual is a cost effective platform, which is affordable to all[27]. Translating the language is not an easy task says Brelsta and Chessa[28] but nowadays advanced technologies and tools like Google Translation are available to change the web Contents between languages without spending high cost. There are many websites that are not having multilingual features[29]. It creates a quite negative impression for non-English stakeholders.

They cannot reach directly to target websites or contents. Multilingual websites are having a great advantage that will make barrier-free information access to non-English speaking users. Users[30] If a user fires a query in a language other than English, if its available in the multilingual content, a search engine can easily fetch and place result in a top rank[31].

#### **V. Accessibility barriers in multilingual websites**

The Multilingual websites offer content in more than one language. However, screen reader users are facing accessibility barriers in multilingual browsing.

In our preliminary user study, persons experiencing Visual impairments shared their views about the issues and difficulties that they are facing while browsing multilingual websites. These barriers are mention in following subsections.

##### **A. Language selection bar**

Screen reader users find it difficult to select their preferred language in a multilingual website. Screen Reader users are facing certain difficulties while choosing their preferred language as they have to navigate many steps forward to find the position of multilingual option provided by the web page designer. This option is mostly provided as a language bar acting as a drop down menu with language options (e.g. “English”, “Hindi”, “Tamil”, “Malayalam” etc.). In our study with persons experiencing visual impairments, many of them mentioned that they are facing difficulties in locating the language selector.

##### **B. Un-Translated Content**

Visually impaired users are facing challenges in multi-language content translation. Perfection in modern translation method is not yet fully achieved. Screen reader users access only text contents and remaining is the non-text contents which could not be easily accessed by these users. Purely graphical and highly visual media contents such as video, pictures, charts, maps, posters etc.

##### **C. Pronunciation problem**

Screen readers are a modern technological gift for visually impaired users. This Software is integrated with speech synthesizers (TTS) to speak multiple languages. Even though screen reader speaks multiple languages, the quality of speech output is not so natural. Screen reader perfection and pronunciation issues arise while delivering the content in Indian regional languages. Even in the English language the same words can mean different meanings. One word can get

different reaction and meaning the word reaction depends on which region in the country you are in, same can apply for regional languages also.

#### **D. Alternate Text Issue**

Multilingual websites offers content in more than one language. If a user likes to switch from one language to another contents might change or translate according to user's preferred language, but the Alt text for images, objects are not translated automatically according to user preferred language which may make them inaccessible to screen reader users. Screen reader users are highly suffered while browsing in this scenario. To create a solution for this issue, content creators should develop multilingual versions of source templates with proper language support.

#### **E. Advertisement Issue**

Online advertisements are one of the major barriers for persons with visual impairments. Many of the advertisements are not having valid alt text, and are violating web guidelines. Unwanted multilingual advertisement distracts online users from their tasks. Because of this, user performance degrades. Sometimes screen reader users are unable to close the advertisements due to the lack of accessibility options.

#### **F. Psychological affect**

Visually impaired users are not able to perceive the web content in an easy way compared with their sighted counterparts. Sighted users spend less time for glancing, but visually impaired users have to spend more cognitive energy as well as time [32]. For them, the visual information shall be represented aurally. If they continuously get frustrated while navigating and accessing the information then it may result in confusion and mental depression.

## **VI. METHODOLOGIES**

A user study was conducted from September 2016 to March 2017. In our analysis, we have chosen the multilingual domains. Preliminary study focuses on accessibility barriers of screen reader users while browsing the multilingual websites. We prepared a set of questions and posted them into a public group for person with visual impairments in India.

#### **A. Data collection and participant profile**

AccessIndia[33] is an active online forum for persons with visual impairments in India for discussing innovative ideas and issues about accessibility platform. A criterion to take part in our research questionnaire was that the respondent should be a person experiencing visual impairments (Blindness, Low vision, colour blindness). Questionnaire prepared with 22 questions were served through an interface framed with the help of Google form[34]. Some questions cover basic details of participants like name, age, email, type of disabilities and gender, etc. are shown in Table 2. We have posted our questions into AccessIndia[33] forum. 20 visually impaired users responded to our questions were 77.3% of respondents are having complete blindness, 22.7% respondents were having low vision problems. 10% users were female, remaining 90% person's users are male. 60% users were aged between 21 to 35, 35% users were aged between 36 to 55, 5% respondents are aged less than 20 years.

Majority of the respondents were familiar with JAWS and NVDA screen readers with most of the respondents spending more than 6 hours daily on browsing Internet. Today most of the screen readers support multiple languages, for example Freedom Scientific JAWS (commercial)[35], NVDA (Non Visual Desktop Access)[36] is an open source screen reader equipped with a speech synthesizer.

#### **B. Questionnaire**

We avoided traditional questionnaire method like paper and pencil. Instead of the traditional method, we choose online survey and requested to the respondents to fill the survey via online. It is a suitable way to provide accessibility for the person with visual impairments. We prepared questions to find multilingual issues and to analyse the issues faced by visually impaired users, while accessing the multilingual websites. Prepared questions mentioned in Table 3.

Table III: Questionnaire summary

Questions	Options	Question type
How many hours did you spending with Computer / smartphone per day?	Less than an hour, 1 to 2 hours, 2 to 4 hours, 4 to 6 hours, more than 6 hours.	Multiple choice with Radio buttons.
What is your level of usage in Internet?	Expert, Advanced user, Average user, Below average, Beginner.	Multiple choice with Radio buttons.
What kind of website do you visit daily?	Educational, Newspaper, Social Networks, Email and business, Banking, E-commerce, Others.	Multiple choice with Radio buttons.
Which screen reader that you use mostly?	NVDA, JAWS, ORCA, E-speak, Windows Eye, Browser add-ons, Voice over, Others.	Multiple choice with Radio buttons.
What is your default browsing language?	English, Hindi, Tamil, Telugu, Malayalam, Kannada, Bengali, Others.	Multiple choice with Radio buttons.
Have you used websites which provides language changing options ?	Yes, No.	Multiple choice with Radio buttons.
Which language do you prefer for browse internet for its content ?	English, Hindi, Tamil, Telugu, Kannada, Malayalam, Marathi, Sanskrit, Konkani Nepali, Maithili, Bengali, Assamese, Manipuri, Gujarati, Odia, Punjabi, Urdu, Santhali, Kashmiri, Dogri, Bodo, Sindhi.	Multiple choice with Radio buttons
Have you searched using regional languages in search engines such as Google , Bing, etc.	Yes, No.	Multiple choice with Radio buttons
Did your screen reader reads non-English Languages properly?	Yes, No.	Multiple choice with Radio buttons
If you have selected No for the previous question, indicate the language that your Screen reader does not ready properly?	Short Answer	Paragraph
While browsing multilingual website, is the language changing option easily accessible ?	Yes, No	Multiple choice with Radio buttons
What is your accessibility rating regarding web pages that have more than one language	1(Low) to 5(High)	Linear scale
While browsing non-English website, what is your rating on image alt descriptions	1(Low) to 5(High)	Linear scale
What is accessibility rating in about regional language advertisement in webpages	1(Low) to 5(High)	Linear Scale
Any specific difficulties you are facing while using multi language websites. If you are not browsing any multi language, kindly provide what is the accessibility barrier, if any:	Long answer	Paragraph
User Suggestion and feedback about this above Questionnaire	Long answer	Paragraph

## VII. RESULTS

Each respondent have shown their willingness to answer our questionnaire, also respondents have given more valuable suggestions and registered their accessibility issues and challenges about the multilingual web. Respondents were well equipped with computer access. Our result shows that 33.3% users are advance level users, 38.1% are average level

users, 14.3% users are expert level user and 9.5% are beginners. We have formulated few questions to analyse the browsing difficulties in multilingual web access as shown in following subsections.

We also gave an option for users to provide their invaluable suggestions and the web developers and policy makers so that a better understanding of the exact problems they are facing in the multilingual

Table II: Demographic Details of Respondents

No	Age	Impairments	Screen Readers	Experiencing in computer	Usage of Internet	Frequently visiting websites
20	< Than 20 = 5% 21 to 35 = 60% 36 to 55 = 35 %	Blindness = 77.3% Low vision = 22.7%	JAWS = 55 % NVDA = 45	Expert= 14.3% Advanced = 38.1% Average= 38.1% Beginner= 9.5%	< Less than an hour=Nil 1 to 2 hours = 15% 2 to 4 hours=Nil 4 to 6 hours=25% More than 6 hours=65%	Educational=31.8% Newspaper=22.7 Social Networks=13.6% Email and business=27.3% Banking=Nil E-Commerce=Nil

Platform can understand the preferences about the multilingual development.

### A. Spending hours with Computer / Smartphone per day

Computer and Smartphones are the two major devices used to connect to the Internet for providing services like communication, chatting, information retrieval, sharing data. 55% respondents are using Internet more than 6-hours per day, 25% respondents are using 4 to 6 hours, 15% respondents are using 1 to 2 hours per day.

### B. Websites preferring to visit

We have asked questions to find the websites preferred and mostly visited by respondents. 40% respondents visit educational websites, 30% respondents prefer visiting Email and Business, 15% newspapers and 15% respondents chosen social networks.

### C. Usage level of screen Readers

We have placed a question to find the usage level of screen readers. Many screen readers are available today like JAWS, NVDA, Windows Eye, E-speak, ORCA, Browser Add-ons, and Voiceover. JAWS scored maximum 55%, NVDA 45%, other screen readers' options are not been chosen.

### D. Default browsing language

We have fixed a question, what is your default browsing language? and given multiple choices in Indian context which included English, Tamil, Hindi, Telugu, Malayalam, Kannada, Bengali and others. 80% respondents chosen English as the default language and 20% respondents selected Tamil as the default browsing language.

### E. Usage of language changing options

Screen reader users are facing difficulties while changing the language of the web page. when we asked about language changing options usage level, 60% responded "YES", 40% people chose "NO".

### F. Preferred language for browsing Internet

70% respondents have chosen English as the preferred browsing language. 20% respondents have chosen Tamil language. 10% respondents have preferred Telugu to browse Internet.

### G. Usage of regional languages in search engines

We have placed a question to find out regional language usage in search engine while browsing. 61.9% users have chosen "YES", and 38.1% respondents

chosen "No". This result shows that person with visual impairments are interested in multilingual browsing.

#### **H. Screen reader reads non-English content properly**

We have placed a question to analyse the screen reader performance in regional languages. Most of the screen reader users prefer for browsing other languages than English. Given a multiple choice option Yes or No. 57.1% respondents chose "Yes", 42.9% respondents choose "No".

#### **I. Screen reader does not read properly**

We have placed a question to analyse the screen reader pronunciations difficulties in regional languages. We asked a question to users, which regional language that the Screen Readers does not read properly. Respondents have registered their comments. Not all-regional language pronunciation quality of screen reader is up to the perfection level. Another comment mentions Hindi, Gujarati, and Telugu language pronounce issues and navigational accessibility is very less while browsing.

#### **J. Accessibility rating regarding web pages that have more than one language**

We analysed the accessibility rating about the web page that has more than one language. We fixed Likert's scale values from 1 to 5 for our measurement with low value 1, 5 as high value. 21.1% respondents given low value as 1, 21.1% chosen 2, 42.1% respondents chosen 3, 10.5% respondents chosen 4, highest value is chosen by 5.3% respondents.

#### **K. Rating on image alternate descriptions in non-English website**

We analysed the rating about image alt description in non-English website. For measurement, we have fixed scale value 1 as low value and 5 as high value. 47.4% respondents chose low value, 26.3% respondent chose 2, 15.8% respondents chose 3, no respondent's chose 4. 10.5% respondents chosen highest value 5.

#### **L. Rating in regional language advertisement in web pages**

We placed a question on advertisements barrier in web pages. Sudden ads, pop-ups, and video ads cause more browsing difficulties for visual impairments per-sons. To measure the difficulties we have fixed Likert's scale values 1 as low value 5 as high value. 31.6%

respondents have chosen low value, 47.4% chosen 2, 15.8% chosen 3, 5.3% respondents have chosen 5.

### **VIII. SUGGESTION**

The ultimate aim of our experimental analysis is to find the accessibility issues in multilingual websites. After finding accessibility problems in multilingual web portals it is necessary to improve the design and development process of the web sites. Also suggesting the accessibility procedures can fix the multilingual barrier of the web.

- Provide an easily accessible option to change user-preferred language. It has observed that many websites do not provide a clear indication about language changing option. Screen reader users are facing difficulties in finding the language option as compared to sighted users.
- Provide proper alternate text for all non-text content. While navigating web pages, we analysed that a large amount of images and icons are not having proper and valid text alternative labels. Screen readers when encounter an image without an alt text they pronounce it as button1, button 2, img1, img2 etc.
- Indian developers should follow checklines issued by WCAG and GIGW guidelines, to support accessible multilingual content for building web pages.
- Provide user interfaces, which support dynamic web content so that they can easily accommodate the language changing options. Modern web technologies like HTML5, JavaScript, Ajax, and CSS (Cascading Style Sheet) can be very helpful.
- Create multilingual metadata about titles, keywords, abstracts etc. Multilingual metadata makes an impact in language aware search.
- Multilingual search engines should provide an option for auto-completion and suggestions in language based type queries.
- Provide content with high readability. Readability checking shall incorporate four dimensions (1.Content, 2.Style, 3.Format, 4.Organization).
- Traditional CAPTCHA has found highly inaccessible for persons with visual impairment. In regional language websites, CAPTCHA have provided in English with digits, which is inaccessible to some users. CAPTCHA content transformation

mechanisms should place to accommodate the language transformation.

- Incorporate user preferences in multilingual information access. Use the method to group click-through data, queries, implicit user browsing behaviour.
- Use proper speech synthesizer in screen readers to overcome the multilingual pronunciation barriers.
- Use proper language attributes while creating the web content for example : `<html lang="en">`, `<html lang="hi">`.
- Provide proper web content reading directions for example `<html dir="RTL">`tag for right direction, `<html dir="LTR">`tag for left direction.
- Provide some easily accessible notification method for screen reader users to detect multilingual content.

## IX. CONCLUSION

Web provides a way for users to browse the Internet in multiple languages. With the increase in size and variety of contents in Internet, Web accessibility problems have also gradually increased. This study aimed towards analysing the accessibility problems in multi-lingual websites. Experimental analyses conducted with persons experiencing visual impairments to gather the specific issues, which they encounter while navigating the web. We prepared the online questionnaire, and placed before the aforementioned forum of users. A structured questionnaire formulated to collect their accessibility issues and real user suggestions in the multilingual domain. The results of our analysis show that several accessibility problems still faced by screen reader users in multilingual domain. Based on this preliminary analysis, we have provided suggestions to increase the accessibility level of multilingual websites. In future work, we will focus on evaluating the accessibility and readability level of multilingual websites belonging to various domains and provide an exploration analysis with quantitative observations.

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