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Comparative Analysis of Indian Government Websites by using Automated Tool and by End-User Perceptive

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Abstract: E- Governance is the major application of ICT for providing government services effectively and efficiently to the citizens of a country. The main two factors i.e. “Usability and Accessibility” defines whether a website is a failure or a success. Managing and maintaining of E- government projects in India indicates that the e-Government websites in India are facing many problems and need to overcome for improving the usability and accessibility of websites. In this paper, we investigate the status of usability and accessibility of some of the existing Indian E-Government websites from the end-user perspective. Some of the automated tools that are available to check the accessibility features of websites are used in the study. The studied websites are also checked against the WCAG 2.0 Guidelines and the guidelines provided on “www.guidelines.gov.in” for developing an Indian E-Government websites. The study points out number of issues relevant to accessibility and usability features of Indian government websites that must be satisfied against end-user perspective.

Key Words: *E-Governance, Usability, Accessibility, WCAG 2.0, Reliability*

1. Introduction

E-Governance is the facility that provides information relevant to government, their policies and services to the end user through its online feature/ websites. These government websites boost the access and delivery information and services to all end users whether they are citizens, businesses, government agencies and alternative agencies in any respect levels of government.

At present most of the Indian government ministries, government departments have individual websites that provide information and services directly to the citizens. The websites are developed so that citizens can easily perform their tasks related to the government departments and can access any information relevant to government, its procedures, policies, services. The concept of e-governance helps in providing the transparency between government and citizens.

The Indian Government websites must follow the WCAG 2.0 guidelines and the Guidelines for Indian Government Websites (GIGW). Following are features of GIGW, which should satisfy by Indian Government website to be usable and accessible by the end user: (i) Government of India Identifiers, (ii) Building Confidence (iii) Scope of Content (iv) Quality of Content (v) Design (vi) Development (vii) Website Hosting (viii) Website Promotion (ix) Website Management. The main features requires by the users from an E-Governance website are high quality content, Often update, Minimum download time, Ease of use.

Usability is defines as “*the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment*” (Jordan, 1998; Keevil, 1998; Usability.gov, 2010). While usability is defined in a general context, web usability is more specifically defined as clarity, simplicity, and consistency in the website design, in order to allow users to perform their tasks easily (Cappel&Huan, 2007).Some of the attributes of usability given by Brooke, 1991; Jordan, 1998; Becker, 2002, Abran et al., 2003, Nielsen, 2003, are effectiveness, efficiency, satisfaction, learn ability, error tolerance and memorability.

Web accessibility defines that a person with disabilities can perceive, understand, navigate, and interact with the Website, and that they can contribute to the Website. The basic principle of accessibility is to design the websites that are flexible to meet different user requirements, needs, preferences, and situations. [<https://www.w3.org>]

1.1 Usability and accessibility Problems:

Quality of usability and accessibility features of an E-Governance website plays an important role in making the user decides to leave or use a website. With regard to the structure, the user looks for a clear, straightforward and well-organized website. Some of the problems faced by E-governance websites relevant to the usability and accessibility are as follows:

- Not able to find required information easily
- Feel confused about location in the website
- Do not find site map useful
- Website structure is in need of change
- Layout is distracting or hard to read
- Text is too small, too wordy or uses jargon
- Information is out-of-date, incomplete, inconsistent ,confusing, or there is too much of it
- Links are difficult to pick out or their purpose/destination is unclear
- Response time is unacceptable
- Browser cannot present site content
- website language is not easy to understand

- Website is not visually attractive
- Screen reader Access
- Skip to the navigation
- Availability of Language in more than one language
- Options to change the color of screen
- Availability of browser settings, text-to-speech, voice recognition

The failure to attain acceptable levels of accessibility and usability for E-Governance services threatens not only the E-Governance initiatives, but also the link between citizens and government. The objects of the website are considered as necessary aspects of accessibility, because it helps to interact and communicate the system and citizens. While designing a website, accessibility and usability must be the major features to consider for providing the convenient and satisfactory services to the citizens, otherwise E-Governance will continue to find problems during user interaction.

II. Methodology

The main objective of this study is to find out the quality of accessibility and usability features available in Indian E-Government websites from user point of view. Citizens who actually use the websites can able to judge the quality of websites and can give considerable views. Therefore, in this paper experience of end user about the Indian E-governance websites plays an important role. The participants were asked to perform number of pre-defined tasks on the selected Indian Government websites. The Set of questions were prepared based on Perceivable, Understandable, Operable, robust, quality of services, and overall satisfaction features to check the accessibility and usability of the selected Indian government websites by the end users. Along the questionnaire we used "TAW" The automated tool, developed by the "CTIC Centro Tecnológico", to check the selected Indian government websites against WCAG 2.0 guidelines for accessibility violations.

The study includes 160 candidates. The candidates performed given tasks on selected eight Indian government websites. Twenty (20) candidates explored each website and performed the given task through that website. The study measurements include:

1. Perceivable Features of a website
2. Operable Features of a website
3. Understandable feature of a website
4. Robustness feature of a website
5. Features relevant to the Quality of E-services provided
6. Overall Satisfaction through end user point of view

The questionnaire has two parts:

(i) **Pre Test Questionnaire:** This includes seven (7) questions relevant to a candidate to know about his/her demographics & background, Internet knowledge, knowledge about e government websites.

(ii) **Post Test Questionnaire:** Total forty one (41) questions were designed which were further divided into six (6) categories called Perceivable (8), Operable(7), Understandable(7), Robustness(5), Quality of service provided(6), overall end user satisfaction(8) .

The post- test questions had measured through standard five-point Likert Scale. The participants navigated through the specified website after they were allotted the pre-defined tasks. The end-user expertise is taken into account one among the foremost vital factors touching the success or failure of e-Government websites usability. Hence, in work the standing of usability of the present e-Government websites in India, this study centered on the end-user perspective and assessed.

The result of study helps to identify some points that could help in improving the usability and accessibility of Indian e-Government websites from the perspective of Indian end-user.

Table1. List of selected websites with assigned tasks to be perform by the candidates

S.No .	Name of the Departments	Website address of departments	Participants task in corresponding websites
1	Delhi Police	www.delhipolice.nic.in	Find The Link Of e- FIR Check The Complaint Status
2	Ministry Of Human Resource Development	www.mhrd.gov.in	Check The List Of Institutes For Higher Education Find The Link For Central Universities
3	Department Of State Transport, Haryana	www.hartrans.gov.in	Find The Link For Fare Structure Booking In Volvo
4	Chandigarh City	www.chandigarh.nic.in	Check OPD Appointments Find The Link For Paying Electricity, Water Bills & Property Tax
5	Indian Railway	www.irctc.co.in	Find The Link For Booking In Train & Bus Easy Payment For Booking The Ticket
6	MTNL	www.mtnldelhi.in	Find The Link For Mobile Bill Payment Check The Link For Shifting The Landline
7	Delhi University	www.du.ac.in	Schedule of UG Admissions Find The Link Of Result
8	Information and public relation department (UP)	www.information.up.nic.in	Check The Link For Right To Information About Rules & Regulation Find The Link For Going Back To Home Page

III. Analysis of data and its Outcomes

3.1. By using “TAW”The automated tool:

Web Content Accessibility Guidelines (WCAG) 2.0 states that how to make Web content more accessible to people with disabilities. WCAG 2.0 is developed through the W3C process in cooperation with individuals and organizations around the world, with a goal of providing a shared standard for Web content accessibility that meets the needs of individuals, organizations, and governments internationally.

In order to meet the varying needs of end user, several layers of guidance are provided in WCAG guidelines, like *principles*, *guidelines*, *success criteria* and, *advisory techniques* to make the website accessible.

- **Principles-** *Perceivable, operable, understandable, and robust* are the 4 principles that provide the foundation for Web accessibility. Guidelines - Under the principles are guidelines. The 12 guidelines provide the basic goals that authors should work toward in order to make content more accessible to users with different disabilities.
- **Success Criteria** - For every guideline, WCAG 2.0 is necessary to test the success criteria where design specification, purchasing, regulation and contractual agreements are necessary to test. In order to meet the needs of different groups and different situations, three levels of conformance are defined: A (lowest), AA, and AAA (highest).

To check that whether the selected Indian e-government websites meets the WCAG 2.0 Guidelines we use “T.A.W”automated tool, developed by the “CTIC Centro Tecnológico. Only the home pages of selected Indian Government websites analyzed with T.W.A. tool. The table below shows the numbers of errors find out by T.A.W tool, based on the four principles of website accessibility i.e. perceivable, Operable, Understandable, Robust.

Table2: Errors present in home page of websites.

S.No.	Website	Perceivable Errors	Operable Error	Understandable Errors	Robust Errors	Total Errors
1	www.delhipolice.nic.in	1	4	1	3	100
2	www.mhrd.gov.in	3	1	1	9	50
3	www.hartrans.gov.in	9	1	1	1	221
4	www.chandigarh.nic.in	1	1	1	9	123
5	www.irctc.co.in	5	1	3	2	96
6	www.mtnldelhi.in	1	9	4	6	224
7	www.du.ac.in	4	3	1	3	74
8	www.information.up.nic.i	3	7	1	7	45
	Total errors	5	9	1	3	933

From Table 3, we found thatwww.mtnldelhi.in (MTNL) has maximum perceivable errors i.e. 146 whereas www.delhipolice.nic.in (Delhi Police) has minimum 19 perceivable errors.www.delhipolice.nic.in (Delhi Police) has maximum operable errors i.e. 41 whereas www.chandigarh.nic.in (Delhi Police) has only 1 operable errorswww.mtnldelhi.in(MTNL) and www.irctc.co.in(IRCTC) have maximum understandable errors i.e. 4 & 3 whereas rests of the websites have only 1understandable errors.www.hartrans.gov.in

(Haryana Transport) has maximum perceivable errors i.e. 117 whereas “www.information.up.nic” has only 7 perceivable errors. MTNL (www.mtnldelhi.in) reports total of maximum accessible errors (224) whereas Information and public relation dept. U.P. (www.information.up.nic) shows minimum errors (45) in their websites.

The result shows that there are more Perceivable (524) and Robust (301) errors were present in the selected Indian Government Websites and require improvement to make the websites more effective and efficient for the end user perspective.

Through T.A.W. analysis tool, we found that most of the errors in selected Indian Government websites come under the same WCAG guidelines and same success criterion of four accessibility principles. Table 4 shows the classification of errors found in the selected websites in respect to WCAG guidelines and its success criterion.

Table3: List of erroneous guidelines and success criterion of selected websites

Principles	Guideline	Success Criterion:	Delhi Police	MH RD	Dept. of State Transport	Chandigarh City	Indian Railway	MTNL	Delhi University	Information and public
Perceivable Principle	1.1 Text Alternativ	1.1.1 : Non-text Content	16	21	12	101	22	15	34	19
	1.3 Adaptable	1.3.1: Info and Relationships	3	9	81	11	33	131	6	11
Operable Principle	2.2: Enough Time	2.2.2: Pause ,stop, hide	2	0	1	0	3	2	2	0
	2.4: Navigable	2.4.2 – Page Titled	0	0	1	0	0	0	0	0
		2.4.4 - Link Purpose (In Context)	39	10	9	1	10	7	1	7
Understandable Principle	3.1: Readable	3.1.1 : Language of page	1	0	1	1	0	1	1	1
	3.3: Input Assistance	3.3.2: Label & Assistance	0	1	0	0	3	3	0	0
Robust Principle	4.1: Compatible	4.1.1 Parsing	38	6	116	8	21	63	30	6
		4.1.2 Name , Role, Value	1	3	0	1	4	2	0	1
		Total errors:	100	50	221	123	96	224	74	45

3.2. By creating the Questionnaires:

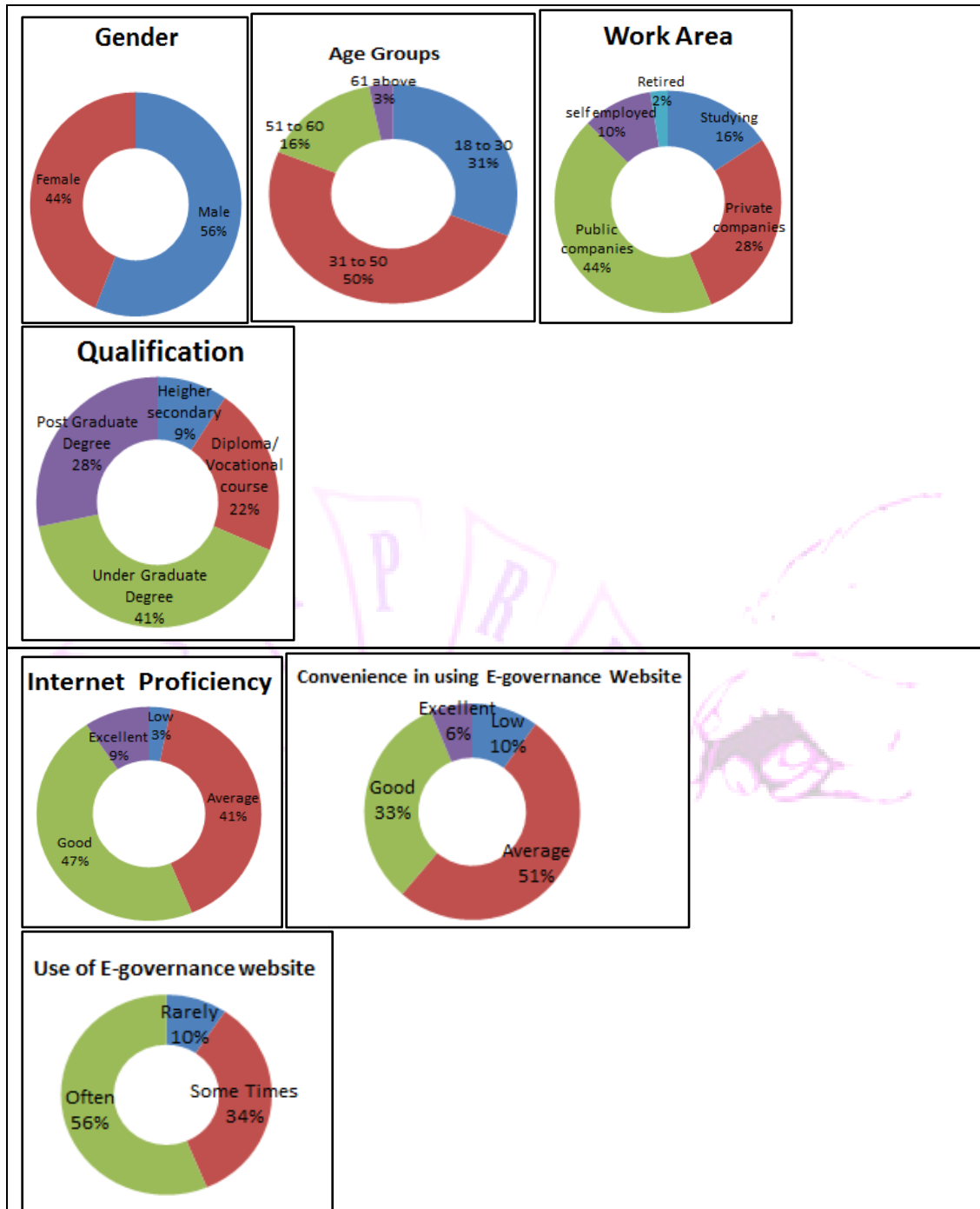
3.2.1. Sample distribution of Pre-test questionnaires: It includes Demographic & Background details and Technology proficiency information.

Table4. Sample distribution of Pre-test questions

S. No.	Factors	Attributes	Values	
			In numbers	In percentage
1.	Gender	Male	90	56%
		Female	70	44%
2.	Age Groups	18 to 30	50	31%
		31 to 50	80	50%
		51 to 60	25	16%
		61 above	05	3%
3.	Job details	Studying	25	16%
		Private	45	28%
		Public	70	44%
		self	16	10%
		Retired	04	2%
4.	Educational details	Higher	15	9%
		Diploma/	35	22%
		Under	65	41%
		Post	45	28%
5.	Internet proficiency	Low	5	3%
		Average	65	41%
		Good	75	47%
		Excellent	15	9%
6.	Convenience in using E-government Website	Low	16	10%
		Average	82	51%
		Good	52	33%
		Excellent	10	6%
7.	Use of E-government websites	Rarely	15	10%
		Some	55	34%
		Often	90	56%

3.2.1.1. Representations of Sample distribution by graphs:

Table5: Graphical representation of sample distribution



3.2.1.2 Alpha Reliability Test: The post test questions were measured through five Likert Scale and analyzed with the use of SPSS software (Statistical Package for Social Sciences). Internal consistency ("reliability") of any variable can measure by Cronbach's alpha. It is used commonly where we have multiple Likert questions to conduct survey/questionnaire that form a scale and want to determine if the scale is reliable.

Therefore, here we also used Cronbach's Alpha Test to assess the data reliability, which finds out that the variables in same measuring group are correlated within others. If the Cronbach Alpha was found to be above 0.70 (varying between 0.72-0.89), such values are considered acceptable according to Hair et al (2006).The Cronbach Alpha was carried out to check the correlation between variables of Perceivable, Operable, Understandable, Robust, Quality of E-services, Overall End-User Satisfaction features.

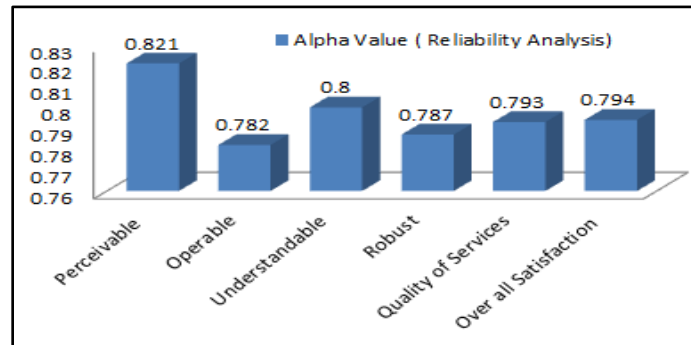


Figure1. Reliability Analysis of WCAG principles for e- Government Websites

3.2.2 Post-test questionnaires: Total forty one (41) questions were designed which were further divided into six (6) categories. These questions were based on the different factors associated to accessibility and usability of Indian government websites i. e. Perceivable (8 questions), Operable(7 questions), Understandable(7 questions), Robustness(5 questions), Quality of service provided(6 questions), Overall end user satisfaction(8 questions).

All the questions relevant to the above-mentioned features for E-Governance websites scored above 3 mean, which shows that Indian E-Governance websites lack in user friendly designs, inefficient regarding the good quality of content and flexibility in navigation. All the values are greater than the mean scale in five scale Likert questionnaire form (1= strongly agree, 2= agree, 3= neutral, 4= disagree, 5= strongly disagree). This reflects that Indian E-government websites require major improvements in its services, user interface, provided information and make it more convenient and easy to understand to facilitate the people to access the websites and to make e-Government a successful mission for India as well as for its citizens.

3.2.2.1 Perceivable Principle:It provides guidelines related with information and user interface components of websites, which should be presentable to users in any way. The figure 1 shows the mean and standard deviation score of the questions related with perceivable features varying in between 3.03 to 3.49. This study shows that the Indian E- Governance websites have some requirement of improvement in appearance of the website. The color & size of the text must be appropriate so that it can be easily readable by any end user or by disabled people. The website must be user friendly so that user can take advantage of services from the e-governance.

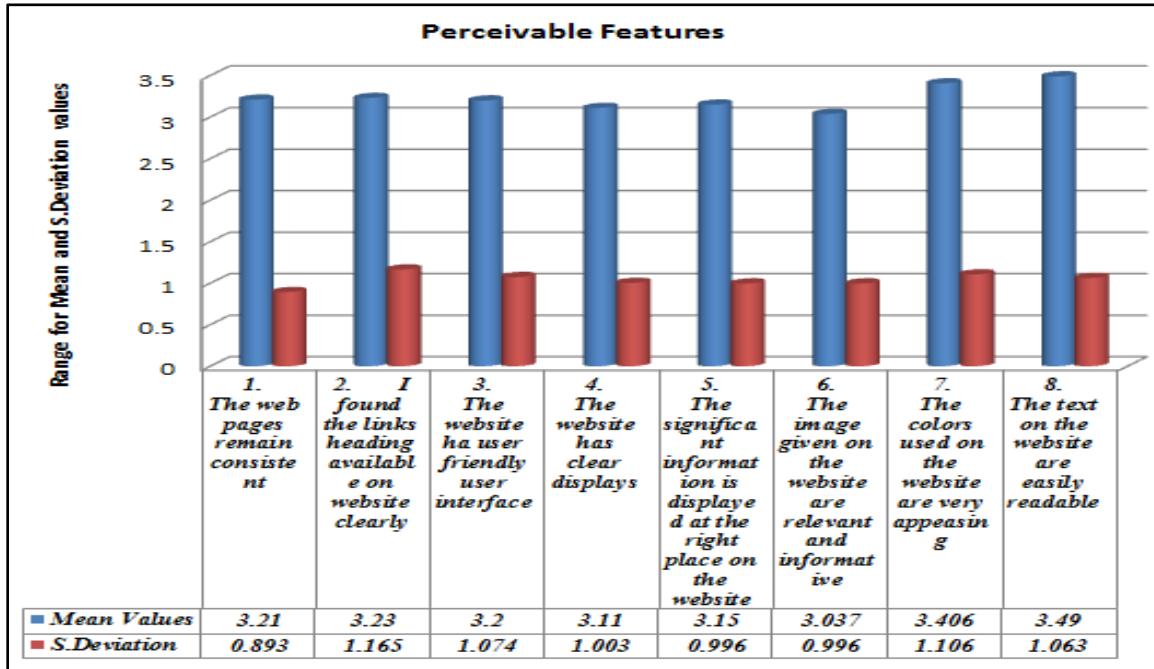


Figure2. Questions for Perceivable Features with their Mean & Standard Deviation Scores

3.2.2.2 Operable: It provides the guidelines related to assistance to accessibility for looking out on website, and permit users to go looking directly for the specified services or data within the web site and the way its accuracy. It helps to move through the website and find the easy way to get services and information with ability of users to find their location at any moment of navigation. The figure2 shows the mean and standard deviation score of the questions related with Operable features varying in between 3.01to 3.16. Links on websites can be easily found but sometimes we feel lost between pages of the websites and not able to find relevant information through available links. Therefore, based on this study we can conclude that Indian E- Government websites should improve the operable feature on websites.

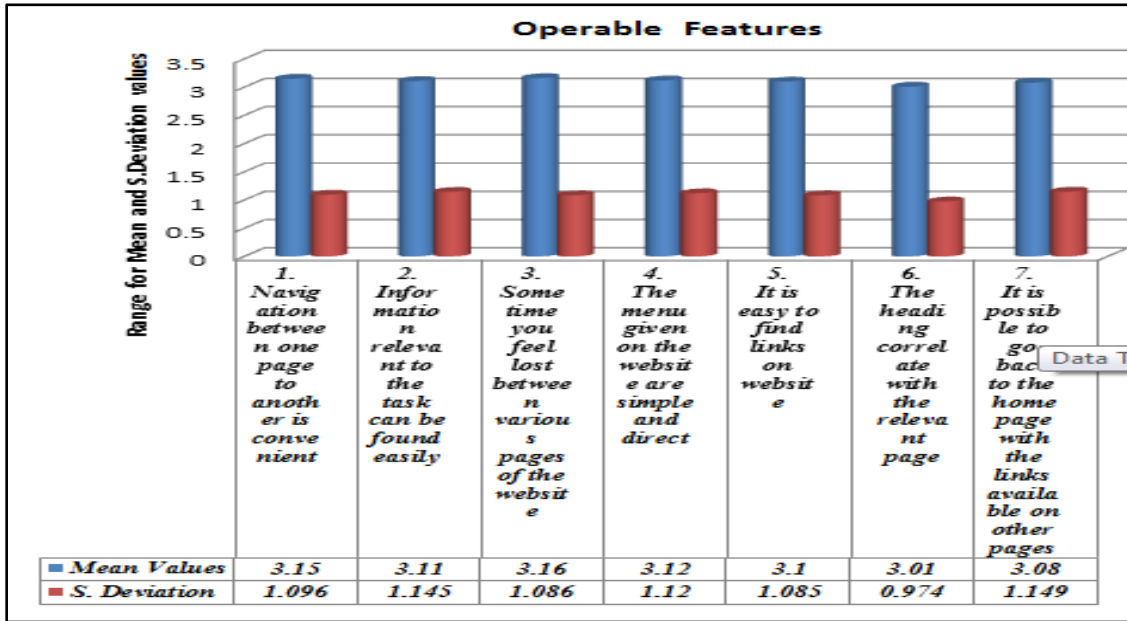


Figure3. Questions for Operable Features with their Mean & Standard Deviation Scores

3.2.2.3 Understandable: This includes the guidelines about language of content, whether the webpages operate in a user predictable manner or not, availability of Search options on website, whether Submit/Go buttons triggers an action or not etc. The figure3 shows the mean and standard deviation score of the questions related with Understandable features varying in between 3.12to 3.32.This shows that Indian government websites lacks in understandable features of websites and needs improvement.

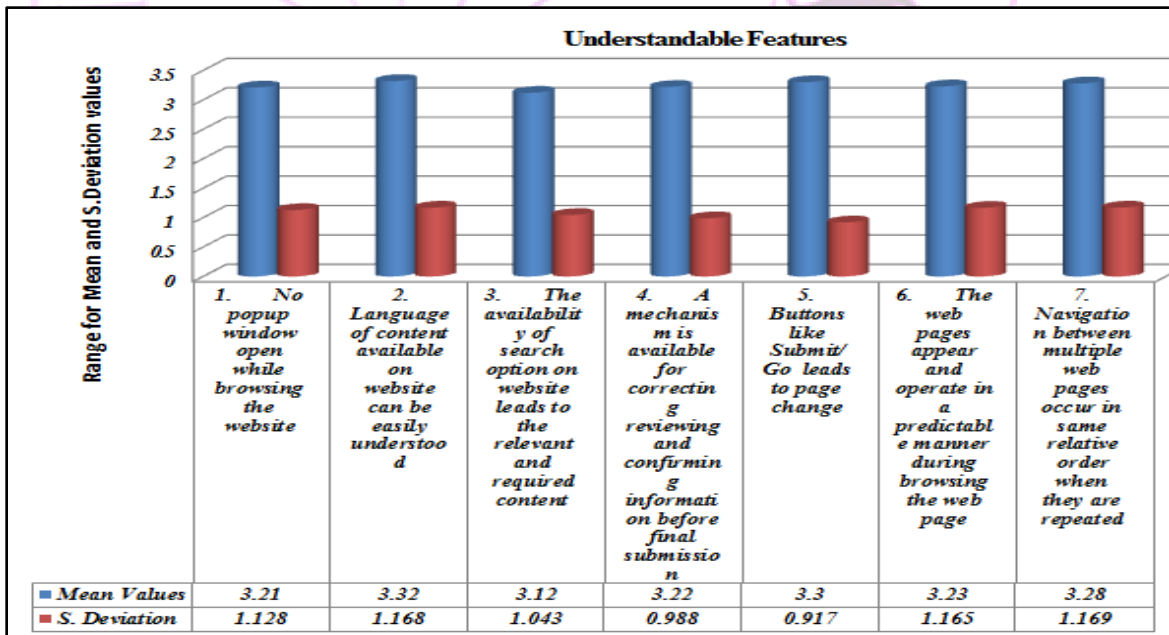


Figure4. Questions for Understandable Features with their Mean & Standard Deviation Scores

3.2.2.4 Robust: It provides the guidelines about the compatibility of websites that allow the users to access the websites without losing any contents and flexibility of websites where websites should support current and incoming technologies. The figure 4 shows the mean and standard deviation score of the questions related with robust features varying in between 3.32 to 3.56. Many selected websites does not support screen reader and voice command access. This shows the problem in Indian E- Governance websites for disabled people access

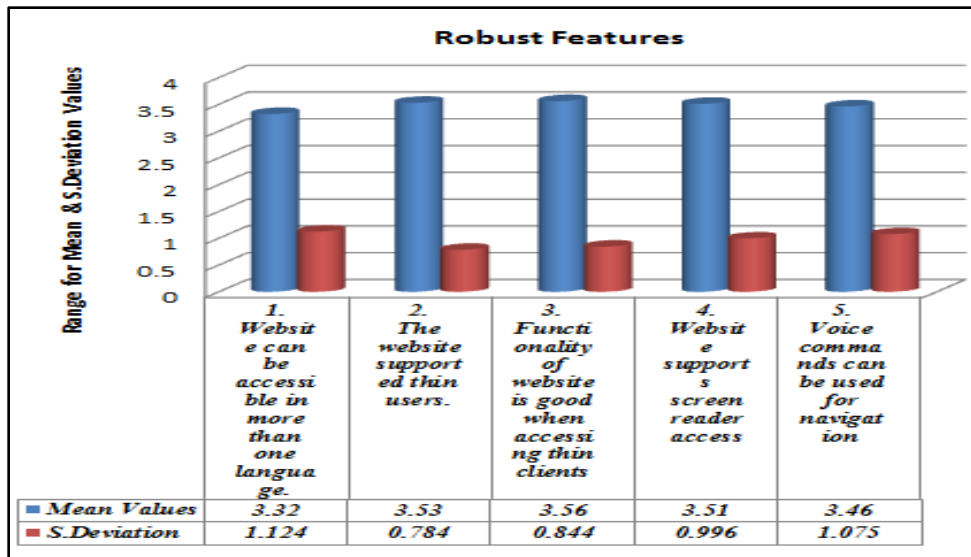


Figure5. Questions for Robust Features with their Mean & Standard Deviation Scores

3.2.2.5 Quality of e-services provided: These questions helps to find out whether the services provided through websites could be completed incrementally, how much time it take to load the service page and in returning the acknowledge. The figure 5 shows the mean and standard deviation score of the questions related with e-service features varying in between 3.03 to 3.49. This shows the requirement of improvement in the quality of e-service provided.

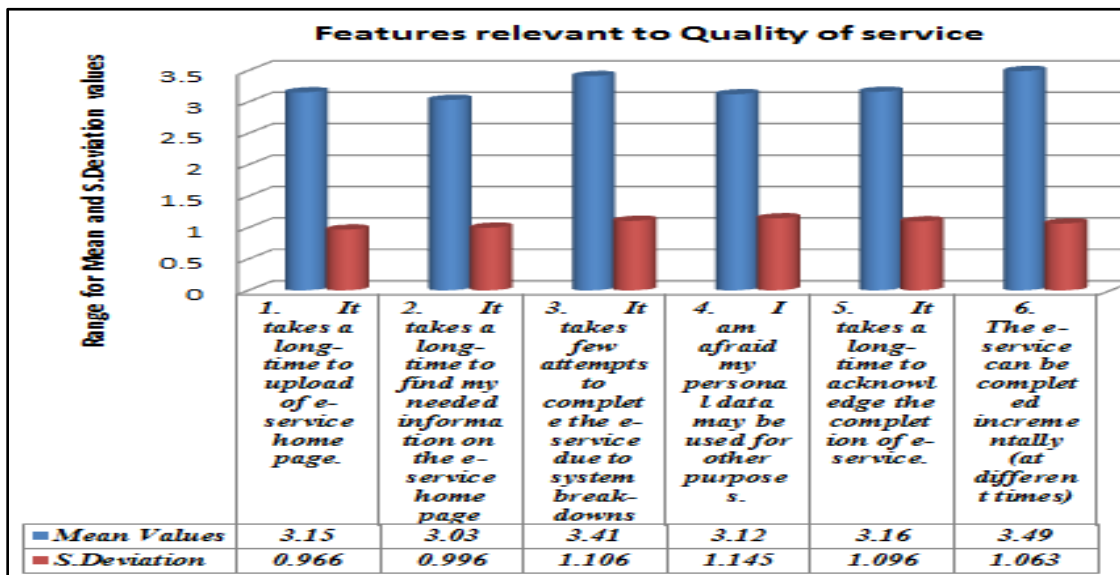


Figure6. Questions for Quality of e-services provided with their Mean & Standard Deviation Scores

3.2.2.6. Overall End User Satisfaction: This questionnaire related with how many users likes or dislikes the use of India Government websites. Questions of this section are related with the overall satisfaction of disabled people about selected E- Governance websites after completing the perceivable, operable, understandable, robust feature questions. The only aim is to know the observation of the people whether they prefer to use these websites or prefer to consult the peoples regarding their queries. In Figure 6 the mean and standard deviation of the overall satisfaction about selected websites score varying between 3.13 to 3.34. This analysis shows that the participants of this study are not satisfied with the current designing of selected websites.

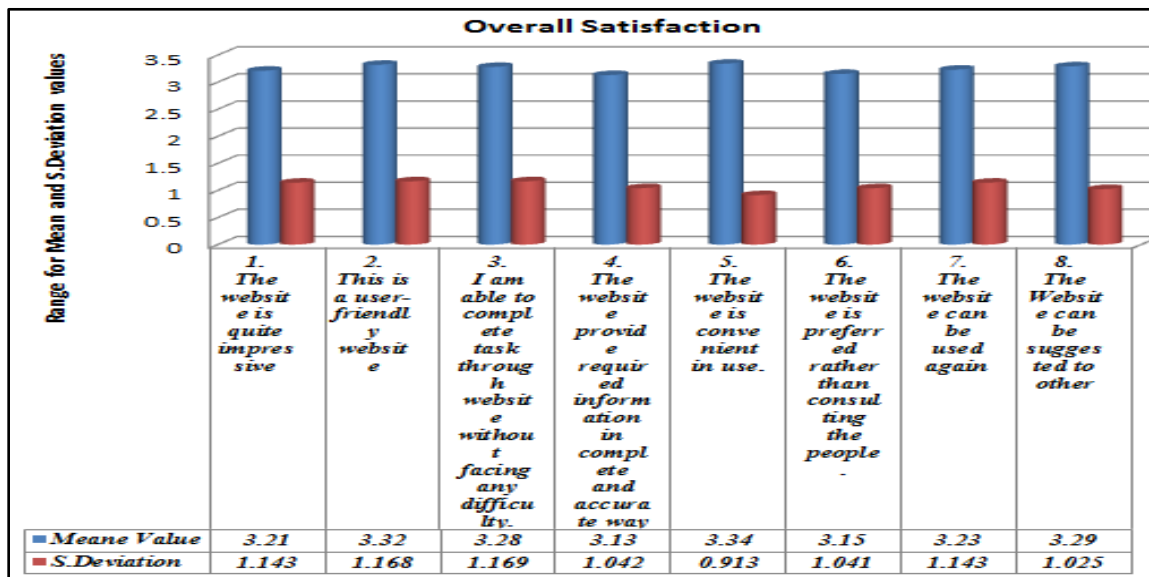


Figure7. Questions for Overall End User Satisfaction with their Mean & Standard Deviation Scores

3.2.3.Comparison of Mean score of Selected Indian Government websites

As shown in figure 7, Mean score of the all the Six Factors of selected Government websites shows that the mean score of MHRD (Ministry of Human Resource & Development) website is 3.07 which is less than other selected E- Governance websites whereas mean score of IRCTC (Indian Railway) is 3.81, which is highest among the selected E- Governance websites. Lowest Mean score shows that websites has good accessibility and usability features whereas higher mean score show the need of improvement regarding accessibility and usability features of the website.

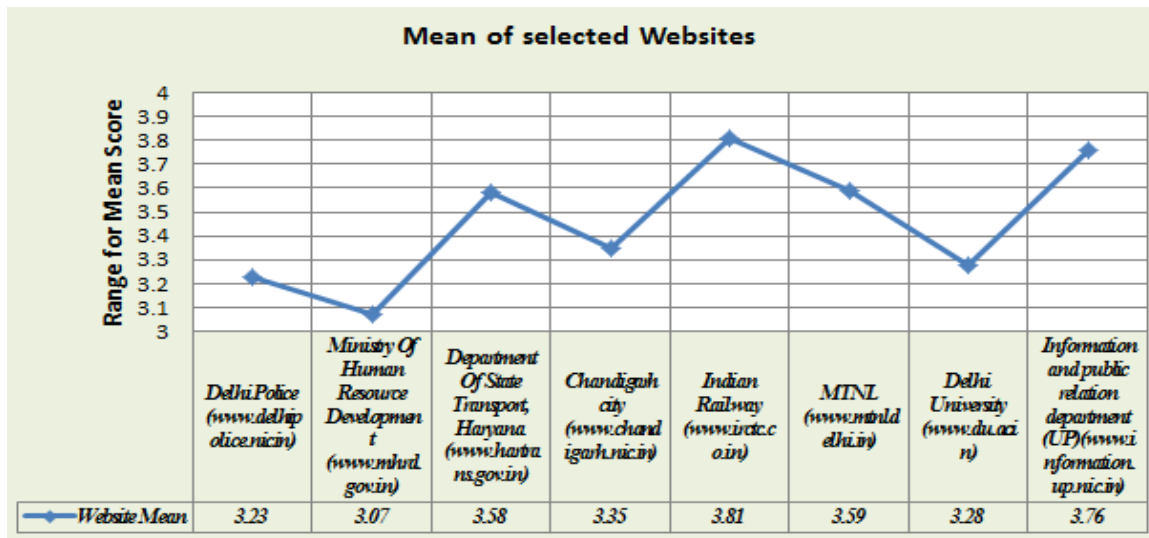


Figure 8: Mean comparison of tested websites.

3.2.4. Observations during browsing of selected Government websites

Various government websites were browsed and the problems encountered were noted regarding the 'Perceivable', 'Operable', 'Understandable' and 'Robust' features of selected Government websites .

- No search option is available on the home page of the Delhi Police, Haryana Transport, Information and public relation department (UP) websites. The search option available on DU and Chandigarh websites are not easily noticeable. 'Search' is an important feature as it helps in moving into the system and in locating any data on the website directly and conveniently.
- The font size given on web pages varied between 7 and 10, which is not easily readable. Websites like Police, Haryana Transport, MTNL, Information and public relation department (UP), IRCTC, DU have font size below 10, which leads to the eyestrain and fatigue. MHRD websites have greater text values for font.
- The website shall be multilingual (like Hindi) while some of the websites have no option to change the language of the content. The websites Delhi police, Haryana transport, Chandigarh city are available only in English language and no language change option is provided on the websites. Whereas the website of "Information and public relation department (UP)" provided the content in three languages at the same time on the screen which seems to be wastage of website space. Only language tabs are sufficient to change the language of content. Website space can be used to provide more information.
- Sometime you feel lost between the web pages of Delhi police, Haryana transport, Information and public Relation dept.(U.P.) websites. These websites provides links to other pages of the websites but there is no provision for the user to come back to the home page of website.
- All the tested websites excepts MHRD does not provide text size changing options & color contrast options based on the user needs .these options should be provided to customize the page based on users need.it helps to improve the readability of information presented on the webpage for the

individual with special visual needs. The font size of TRCTC website is too small to read by normal user.

- No websites except MHRD provides screen reader access, text size changing options and Text to speech option on their websites. Therefore, most of the selected websites are not capable to help disabled people to easily understand the information and due to lack of these facilities disabled people not able to perform their tasks easily and unfortunately divers to pointless destinations that leads to frustration in disabled end users.
- The color schemes used on the most of the websites are not appropriate. Color used for Delhi university (DU) website is too bright whereas the headings with grey color on white background are not distinctly visible on Chandigarh website. Content available in red color with small font size on Information and public Relation dept.(U.P.) website put strains on eyes of end user.
- IRCTC & MTNL websites looks messy due to the unannounced advertisement (popup windows)
- No other tested websites except MHRD are connected to national portal of Indian Government, social Medias like Facebook, twitter etc. This fails the mission of making Indian governance as digital governance.
- Non-text content /images without “alt” attribute is the major perceivable error in all the selected websites. “Alt” attribute of image tag helps in providing little information about the missing image on the websites.
- In MTNL website, the headings and labels are of h3 only, which make it difficult for uses to determine and find the header content. The label text is empty and does not provide input assistance and not able to help the users to avoid and correct mistakes.
- Headings of some of the selected websites do not clearly identify their targeted pages and the information available on the targeted pages is not sufficient and meaningful to justify the heading of that directed page.
- In Haryana Transport, website user is not able to submit complaints and suggestions. When “submit” button is clicked after giving complaint details, the page does not move you to the acknowledgement page or the “submit” button does not trigger any action when clicked on. Similarly, Forms have been provided on DU website without standard submission methods.
- According to the operable principle, moving around the website should be convenient and must help user to keep track of where they are. However, of Delhi, police and Haryana transport has many forbidden links /broken links/empty links which do not lead to the target page. As the links are either not updated or show no information or have no provision to come back to home page cause inconvenience to user in navigation on the website. Some of the websites have consecutive text and images which links to the same resource in the website. The links “Haryana Tourism” and “CM Grievance redressal system” of Haryana transport website leads to the new webpages but have no provision to go back to the home page. Website has broken link “public Grievance portal of Haryana” and “harsamadhan”. In Delphi Police Website links like “crime”, special cell”, “shahadra” when clicked, provides no information. Further, the “Headlines” tab is also not displaying any information. The link “security of N. E. Residents” does not show any information when clicked on.

- The IRCTC website has many loading problems. The time taken to login, to fill the information and viewing availability of train through website is quite high especially during morning hours. Problems are encountered during content loading on the website. This website is not optimized for all types of internet connections, it is difficult to effectively search, book or cancel tickets on the websites. The website is quite content heavy and looks messy due to the sudden openings of advertisements.
- The websites are not compatible to support thin client access but in laptops these websites give little flexibility.
- MTNL, Haryana Transport, Information and public Relation dept.(U.P.) have very poor content quality. On some of the pages only one or two lines are used to represent the page. The website interface leaves a great impact on the mind of the end user. So one of the reasons for the failure of e-government websites is the non-availability of a user-friendly interface and poor layout of the websites.
- Involvement of the end user in terms of user feedback helps to improve the functionality of the websites according to users' expectations, which in turn fulfill the user needs from the websites. The poor quality and not meeting user expectations is another factor, which creates a gap in terms of trust and satisfaction between the end user and Indian government websites. Now days' people are well aware with internet and more educated than earlier, so Indian government should pay more attention on all the factors relevant to the accessibility and usability of websites from the citizens' point of view.

IV. Conclusion

Now in the present scenario where India is continuously increasing the IT sector and has technically sound citizens who are willing to use online facilities for all kinds of routine transactions. But the problem arises when the websites are not properly tested and monitored according to the requirements of end users where the study indicates that the Indian Government websites have the requirements of improvements in usability and accessibility issues. Most of the websites have maximum errors in perceivable features, robust errors, absence of user involvement, poor standardization, and inefficient and unclear framework of coordination, absence of user trust and satisfaction. There is a relatively good number of citizens who want to use e-government websites, but there are still challenges in using e-government websites, accessing information available, related to end user interaction, availing the services provided, lack of end-user satisfaction and expectations, user needs etc. The study concluded that the Indian government websites need improvement for their accessibility and usability for better utilization and successful implementation of E-Government projects in India.

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