

Evaluating Qualitative Measures for Effective Website Design

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Abstract: The primary goal of this paper is to investigate and evaluate qualitative measures for improving the website design of various universities in India. The website of each university is scanned using W3C guidelines. The parameters such as download time, website size, broken links, etc., are considered in the procedure. Different kinds of tools are used to examine the components of website. These tools include: W3C Link Checker, W3C Markup Validation Service, Webpage Analyzer and Website Extractor. The W3C Link checker accepts URL address of Web page and parses each and every hyperlink to find broken links in the page. The W3C Markup Validation Service finds the errors regarding HTML tags' usage errors, properties of Web page and standards of the Web page mentioned by W3C Consortium. The Webpage Analyzer finds the number of objects used in each Web page, Web page size, downloading time etc., The Website Extractor extracts URL addresses of all Web pages of the Website. The errors of each web site are grouped into major and minor errors. A set of qualitative measures are identified based on these errors. The qualitative measures are evaluated in 5-point scale. The area of the website which requires improvement in website design can be identified from the value of 5-point scale.

Keywords: Major errors, Minor errors, page formatting measure, page performance measure, text formatting measure, graphics elements measure, link architecture measure, site architecture measure.

1. Introduction

A Website is a collection of Web pages containing text, images, audio and video etc. Thus Web is a vast collection of completely uncontrolled documents. Today, Web is not only an information resource but also it is becoming an automated tool in various applications. Due to the increasing popularity of Web, one can be very cautious in designing the Website. Poor and careless web design leads to hard ship to public utility and does not serve the purpose. For example, if a student wants to join a course in a university through online mode, the Website must provide maximum facilities to the candidate so that he does not get any

difficulty in admission process. To design a Website with high quality, one has to follow certain guidelines for achieving the quality Web design.

Despite of many recommendations, ideas and guidelines, designing a quality Website is still burning problem. It [1] is suggested that always Web design is continuous process. The authors Flanders, Vincent and Michel Wills [2] insist that always design should be improved into good by looking from a bad design. Thus in this paper it is attempted to find various qualitative measures from the existing web design in order to evolve an approach to improve the web design. This paper presents various aspects on analyzing the quality of Website design with a case study with particular reference to University websites in India.

2. Tools used in Analysis Process

A case study was conducted on Indian universities Website related to the structure, content and other functional aspects. The main modules of each university Website are Departments, courses, administration, staff, library, admissions, examinations etc. Analysis was carried out using various web standard tools. These include W3C link checker, W3C Markup Validation Service, Web Page Analyzer and Website Extractor.

2.1 W3C Link Checker: The W3C Link checker [3] finds number of broken links in the Website. It accepts the URL address of Web page and parses each and every hyperlink in the page. It finds the status code of each link and by using the status code it identifies the broken links related to the page.

2.2 W3C Markup Validation Service: The W3C Markup Validation Service [4] finds the errors related to the HTML pages. It validates the Web page regarding errors in HTML tags, properties of Web page and standards of the Web page mentioned by W3C organization.

2.3 Web Page Analyzer: The Web Page Analyzer [5] finds the number of objects used in each Web page, Web page size and downloading time of all objects. It accepts URL address of a Web page and generates a

report containing details like number of image files, number of HTML files, number of script files, download time etc., of the Web page..

2.4 Website Extractor: The Website Extractor [4] extracts the all the components of Website. It accepts Website address and produces URL addresses of all Web pages.

3. Guidelines framed from W3C

World Wide Web Consortium (W3C) [6], [7] defines a set of guidelines for quality of Web design. It is summarized into 12 guidelines for simplicity. Every guideline provides a technique for accessing the content of Website. The guidelines are as follows.

Guideline 1: Provide a text equivalent for every non-text element. This includes images, graphical representations of text, image map regions, animations, applets and programmatic objects, frames, scripts, spaces, audio and video files.

Guideline 2: Do not rely on color scheme only. The content of Web page must match with foreground and background color. Also provide sufficient contrast to the content for visibility.

Guideline 3: Use markup and style sheets instead of images to convey information. Style sheets control the layout and presentation of the Web page and decreases the download time of the Web page.

Guideline 4: Clearly mention the text information of Web page with natural language. Specify the expansion of each abbreviation or acronym in the document.

Guideline 5: Use tables properly in the Web document. For data tables, clearly specify row and column headers and number of rows and columns exactly.

Guideline 6: Ensure that Web pages featuring new technologies transform gracefully. When dynamic contents are updated, ensure that content is changed. Ensure that pages are available and meaningful when scripts, applets or other programmatic objects are not supported by the browsers. If this is not possible, provide equivalent information as alternative in the Web page.

Guideline 7: Ensure user control of time sensitive content changes. Until user agents provide the ability to stop the refresh, do not create periodically auto-refreshing pages.

Guideline 8: Ensure direct accessibility of embedded user interfaces. Make programmatic elements such as scripts and applets directly accessible or compatible with assistive technologies.

Guideline 9: Design for device-independence. Ensure that any element that has its own interface can be operated in a device-independent manner.

Guideline 10: Provide context orientation information. Title each frame to facilitate frame identification and navigation. Divide large blocks of information into more manageable groups wherever appropriate.

Guideline 11: Provide clear navigation mechanisms. Clearly identify the target of each link. Provide information about the general layout of a site such as site map or table of contents.

Guideline 12: Ensure that documents are clear and simple. Create a style of presentation that is consistent across pages.

4. Web Program Structure

The study was conducted on nearly 50 Indian Universities' Websites and considering approximately 5000 Web pages. A Web program was developed to study each university's Website. The Web program consists of four modules: Website Extractor, Link Checker, HTML Validator and Web Page Analyzer. The URL address of each Website is thoroughly scanned using Website Extractor to get all Web pages of Website and Web pages of each university are stored in separate files. A Website is verified with Link Checker module to get number of broken links in the Website. The components that include: text, images, forms, graphics, audio and video files etc., and download time of Web page are gathered using Web page analyzer and stored in separate file. The errors of Web page related HTML tags are traced using W3C HTML Validator and they are stored in files. The overall structure of Web program is shown in Figure 1.

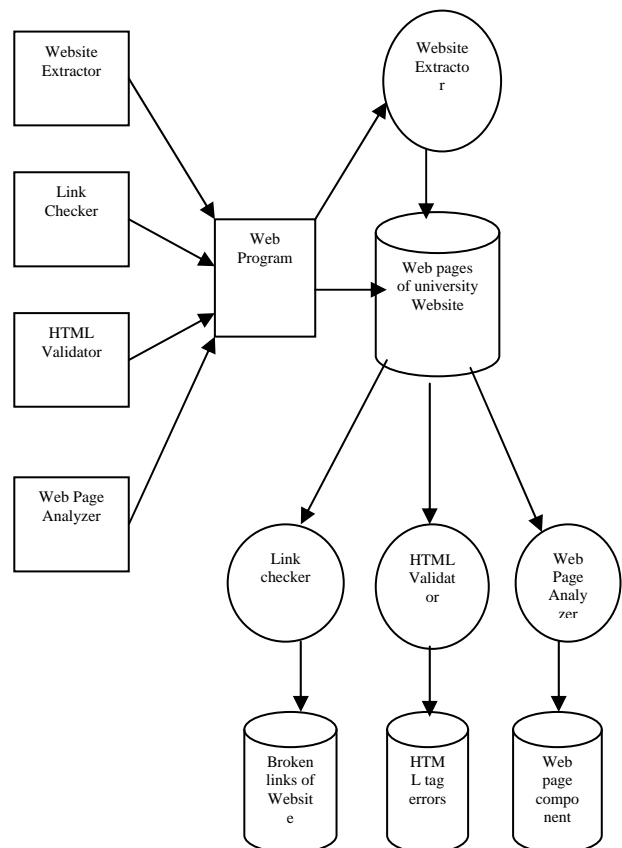


Fig. 1. Architecture of Web program

The snapshot of all the tools used in web program is shown in figure 2. The components of some universities' Websites such as number of Web pages,

size, number of errors, download time, broken links etc., are summarized in the table 1.

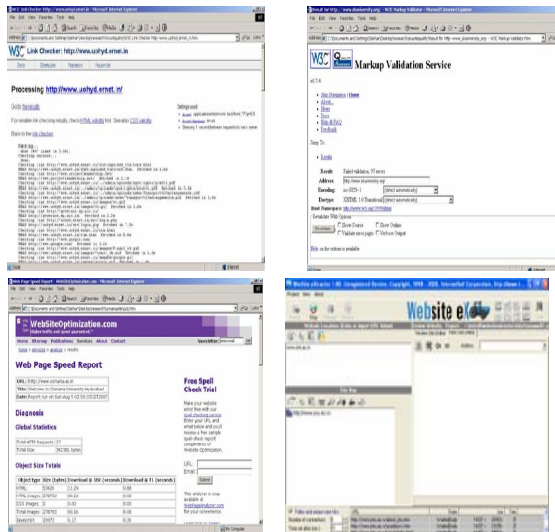


Fig. 2. Tools used in web program

5. Website Errors

The Web page errors that are generated using Web program are considered to identify the measures for quality of Website design. These errors are further divided into major and minor errors using statistical techniques.

5.1 Major errors: The major errors directly affect the quality of Web site design and developers must concentrate on this category of errors and these should be eliminated. The major errors include: broken links, document type declaration errors, applet usage errors, server connectivity errors, image load errors, frames tag usage errors and title tag with no keyword errors. The major errors are proportional to the down load time of the Web pages. If major errors are minimized then down load time will be automatically reduced and hence it leads to the better quality. The figure 3 shows the graph that depicts different major errors and their effect on Website design.

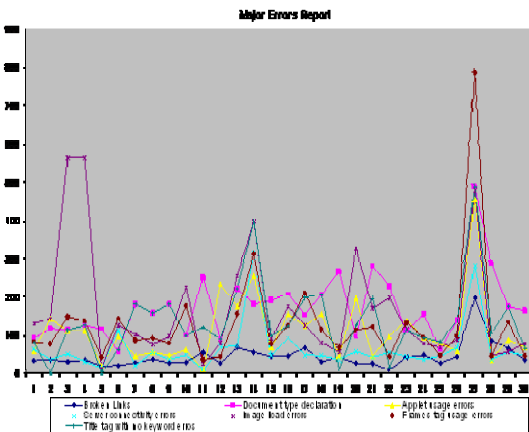


Fig. 3. Major errors of Websites of various universities

5.2 Minor errors: The minor errors are HTML tag errors and these may cause incorrect display of some components of Web pages. The minor errors include: table tag errors, body tag errors, image tag errors, head tag errors, font tag errors, script tag errors, style tag errors, form tag errors, link tag errors and other tag errors. The developers must be attentive so that Web pages can be properly designed with appropriate HTML tags. The graph in figure 4 shows various minor errors of various universities' Websites.

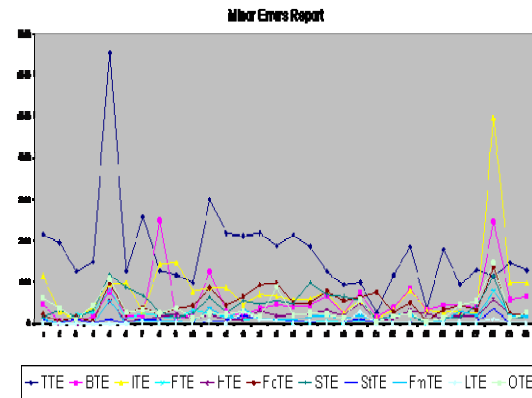


Fig. 4. Minor errors of websites of universities

6. Evaluating Qualitative Measures for improved Website Design:

The errors that are found in Websites' of various universities lead to the necessity of qualitative measures for effective Website design [8]. The head tag errors (HTE), font tag errors (FoTE) and body tag errors (BTE) identify the problems in the text elements of we page. Thus Text formatting measures are to be evaluated. The image tag error (ITE), body tag errors (BTE) and image load errors related to image identifies the errors in display of images and hence Graphic element measures to be evaluated. The table tag errors (TTE), frame tag errors (FTE), style tag errors (StTE), font tag errors (FoTE), frame tag usage errors and document type declaration errors cause the invention of page formatting measures. Link Tag Errors (LTE) and broken links identify the need of link formatting measures. The form tag errors (FmTE), script tag errors (STE) and title tag with no keyword errors identify the need of page performance measure. The script tag errors (STE) applet usage errors, server connectivity errors and broken link errors contribute the need of Website architecture measure. All these measures are shown in table 2. Each qualitative measure is evaluated based on 5-point scale. Formula for each measure is determined based on consideration of minor and major errors and each formula is shown in table 3.

$$\begin{aligned}
 m1 &= (BTE+FTE+HTE)/n \\
 m2 &= (LTE/n) \\
 m3 &= (TTE + FTE+StTE+FoTE)/n \\
 m4 &= (ITE+BTE)/n \\
 m5 &= (FmTE+STE)/n \\
 m6 &= (STE)/n
 \end{aligned}
 \tag{1}$$

attempt is made to verify the quality assessment of Web Design. This would enable to adjudge the quality status of web design of the various universities and would indicate the necessity of improvement in the design of the Website. We can further extend this work to identify other components of web site design for quality assessment which would further enable to improve the design as a part of the ideology of TQM which emphasizes the continuous improvement of Design aspect and promote Excellence of Web Design.

$$\begin{aligned}
 k1 &= (\text{Broken links}/n)*100 \\
 k2 &= (\text{Frame tag usage errors} + \\
 &\quad \text{DTD errors})/n \\
 k3 &= (\text{image load errors})/n \\
 k4 &= (\text{Title tag with no key word} \\
 &\quad \text{errors})/n \\
 k5 &= (\text{Applet usage errors} + \text{server} \\
 &\quad \text{connectivity errors})/n
 \end{aligned}
 \tag{2}$$

Where n is number of web pages in a website. Each qualitative measure is evaluated using equations (1) and (2) in 5-point scale. The value 0 indicates lowest value and value 5 indicates the highest value in the scale. The qualitative measure the value 5 in the 5-point scale indicates maximum quality of the website design and the value 0 indicates the very low quality website design.

Table 4 shows the values of various qualitative measures in the scale for various universities' web sites in India.

7. Conclusion

This paper aims to evaluate various measures required for quality Website design. In this paper a focused approach has been made to identify all possible errors in the web design with specific reference to some of the major universities in India. Thus in this paper an

Sno	University Name	Web Site address	No. of Web pages	Total Web pages size	Total no. of web page errors in web site	Average no.of errors in each page	Download time at 28 Kbps	No. of broken links
1	Acharya Nagarjuna University	www.nagarjunauniversity.org	115	7176402	4395	38.21739	1987	31
2	Alagappa University	www.alagappauniversity.ac.in	127	8272036	4216	33.19685	2290	36
3	Anna University	www.annauniv.edu	117	6187357	2145	18.33333	1713	21
4	Assam University	www.assamuniversity.in	58	3197361	3689	63.60345	885	23
5	Bangalore University	www.bub.ernet.in	659	18297162	19555	29.67375	5065	117
6	Bharathidasan University	www.bdu.ac.in	159	7263910	4596	28.90566	2011	38
7	Bharatiar University	www.b-u.ac.in	182	7571965	5568	30.59341	2096	29
8	Guru Jambheshwar University	www.gju.ernet.in	101	5112758	4685	46.38614	1415	31
9	IGNOU	www.ignou.ac.in	252	9881675	4573	18.14683	2736	56
10	JNTU	www.jntu.ac.in	91	5663958	3885	42.69231	1568	28
11	JNU	www.jnu.ac.in	224	8749265	8894	39.70536	2422	67
12	Kakatiya University	www.kakatiya.ac.in	182	7928718	6584	36.17582	2195	56
13	University of Kerala	www.keralauniversity.edu	175	7762891	5839	33.36571	2149	65
14	Mangalore University	www.mangalore.ac.in	192	8256715	6428	33.47917	2286	45
15	Mumbai University	www.mu.ac.in	209	8528175	6892	32.97608	2361	47
16	Nagpur University	www.nagpuruniversity.org	155	6872167	5481	35.36129	1902	67
17	North Bengal University	www.nbu.ac.in	208	8321769	5619	27.01442	2304	32
18	North Gujarat University	www.ngu.ac.in	268	9528179	5896	22	2638	43
19	North Maharashtra University	www.nmu.ac.in	97	5808462	4017	41.41237	1608	28
20	Osmania University	www.osmania.ac.in	283	9864729	5789	20.45583	2731	28
21	Pondicherry University	www.pondiuni.org	229	9521763	2299	10.0393	2636	11
22	Punjab Technological University	www.ptu.ac.in	113	5607321	3489	30.87611	1552	43
23	Rajiv Gandhi University	www.rgu.ac.in	157	6082654	5389	34.32484	1684	48
24	Rashtriya Sanskrit Vidyapeetha	http://rsvidyapeetha.ac.in	63	3287466	2407	38.20635	910	29
25	S.K.University	www.skuniversity.org	92	6173292	3544	38.52174	1709	34
26	S.V.Univeristy	www.svuniversity.in	119	6248216	3879	32.59664	1730	37
27	University of Calcutta	www.caluniv.ac.in	140	6478258	4263	30.45	1793	45
28	University of Delhi	www.du.ac.in	489	12846398	18266	37.35378	3556	87
29	University of Hyderabad	www.uohyd.ernet.in	183	7826493	4814	26.30601	2167	17
30	University of Mysore	www.uni-mysore.ac.in	166	6483965	4612	27.78313	1795	36

Table 1: Universities' Website Report

Note: Universities Websites data collected as on September 2008

Sno	Measures to be evaluated	Errors considered	
		Minor errors	Major errors
1	Text formatting measures	BTE, FTE, HTE	
2	Link formatting measures	LTE	Broken links
3	Page formatting measures	TTE, FTE, StTE, FoTE	Frame tag usage errors, document type usage errors
4	Graphics element measures	ITE, BTE	Image load errors
5	Page performance measures	FmTE, STE,	Title tag with no keyword errors
6	Site architecture measures	STE	Applet usage errors, server connectivity errors, broken links

Table 2: Errors considered in qualitative measures

S.No	Qualitative Measure	5-point scale value
1	Text formatting measure	if $m_1 < 5$ then value = 5 else if $m_1 < 10$ then value = 4 else if $m_1 < 15$ then value = 3 else if $m_1 < 20$ then value = 2 else if $m_1 < 25$ then value = 1 else value = 0
2	Link formatting measure	if ($m_2 < 5$ and $k_1 < 10\%$) then value = 5 else if ($m_2 < 10$ and $k_1 < 20\%$) then value = 4 else if ($m_2 < 15$ and $k_1 < 30\%$) then value = 3 else if ($m_2 < 20$ and $k_1 < 40\%$) then value = 2 else if ($m_2 < 25$ and $k_1 < 50\%$) then value = 1 else value = 0
3	Page formatting measure	if ($m_3 < 5$ and $k_2 < 2$) then value = 5 else if ($m_3 < 10$ and $k_2 < 4$) then value = 4 else if ($m_3 < 15$ and $k_2 < 6$) then value = 3 else if ($m_3 < 20$ and $k_2 < 8$) then value = 2 else if ($m_3 < 25$ and $k_2 < 10$) then value = 1 else value = 0
4	Graphics element measure	if ($m_4 < 5$ and $k_3 < 0.5$) then value = 5 else if ($m_4 < 10$ and $k_3 < 1$) then value = 4 else if ($m_4 < 15$ and $k_3 < 1.5$) then value = 3 else if ($m_4 < 20$ and $k_3 < 2$) then value = 2 else if ($m_4 < 25$ and $k_3 < 2.5$) then value = 1 else value = 0
5	Page performance measure	if ($m_5 < 5$ and $k_4 < 0.5$) then value = 5 else if ($m_5 < 10$ and $k_4 < 1$) then value = 4 else if ($m_5 < 15$ and $k_4 < 1.5$) then value = 3 else if ($m_5 < 20$ and $k_4 < 2$) then value = 2 else if ($m_5 < 25$ and $k_4 < 2.5$) then value = 1 else value = 0
6	Site architecture measure	if ($m_6 < 5$ and $k_5 < 0.5$) then value = 5 else if ($m_6 < 10$ and $k_5 < 1$) then value = 4 else if ($m_6 < 15$ and $k_5 < 1.5$) then value = 3 else if ($m_6 < 20$ and $k_5 < 2$) then value = 2 else if ($m_6 < 25$ and $k_5 < 2.5$) then value = 1 else value = 0

Table 3: The 5-Point Scale formula for various qualitative measures

Sno	University	text formatting measure	link formatting measure	page formatting measure	graphics element measure	page performance measure	site architecture measure
1	Acharya Nagarjuna University	5	3	1	3	4	3
2	Alagappa University	5	3	2	3	5	3
3	Anna University	5	3	3	0	4	3
4	Assam University	4	0	0	0	1	0
5	Bangalore University	5	5	3	5	5	5
6	Bharathidasan University	5	3	3	4	4	3
7	Bharatiar University	5	3	2	4	3	5
8	Guru Jambheshwar University	0	1	2	0	2	3
9	Indira Gandhi National Open University	5	4	4	4	4	5
10	Jawaharlal Nehru Technological University	4	1	2	0	3	3
11	Jawaharlal Nehru University	4	3	2	4	4	5
12	Kakatiya University	5	3	2	4	4	2
13	Mangalore University	5	1	2	3	3	3
14	Mumbai University	5	3	2	1	1	0
15	Nagpur University	5	3	3	4	5	4
16	North Bengal University	5	1	2	3	4	2
17	North Gujarat University	5	1	3	4	4	4
18	North Maharashtra University	5	4	4	4	4	4
19	Osmania University	5	1	2	4	4	4
20	Pondicherry University	5	5	4	3	5	4
21	Punjab Technological University	5	4	5	4	4	5
22	Rajiv Gandhi University	5	5	3	2	5	3
23	Rashtriya Sanskrit Vidyapeetha	4	3	2	3	4	3
24	Sri Krishnadevaraya University	4	0	3	3	3	1
25	Sri Venkateswara University	4	1	1	4	4	3
26	University of Calcutta	4	2	3	4	3	3
27	University of Delhi	5	2	1	0	0	0
28	University of Hyderabad	4	4	4	2	5	5
29	University of Kerala	4	2	3	4	4	4
30	University of Mysore	4	3	3	4	5	4

Table 4: 5-Point Scale values for various universities' websites in India

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