

Comparative Study of Page Loading Speed as Design Issue in Various Websites

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Abstract - Websites are very important means of communication in this current era of information technology. Different institutions / organizations put lot of efforts to portray complete information on beautifully designed websites. Dedicated efforts are required to provide users with all the facilities of the concerned institutions / organizations online through websites, which act as an online agent through which a user can get his work done without physically visiting the organizations. With this the responsibility of the designer and the concerned institutions / organizations increases manifold so that the websites behavior should remain interactive enough for the user to avail provided facilities of the website comfortably. Page loading speed of a website is one of the most important criteria which make users to access complete information from a given website with optimal internet connectivity. Author in this paper developed an online tool using .NET Framework using C# to study feedback facility as Design issue in various categories of the websites like Government, Commercial, Educational, Social networking and Job portals. The automated tool developed by author function on the basis of the different standards prescribed in W3C [2] and act like a parser which renders the complete code of a website and produces result by examining the page loading speeds of the websites over various modem speeds and their effects from the communication perspective between user and the web. The results produced shows that out of the five different categories of the websites employed for analysis the educational sites follow the maximum of standards as far as page loading speed parameter is concerned.

Key Words: Websites, Design, page loading speed, standards, .NET.

1. INTRODUCTION

Website is combinations of related web pages served through single domain. Numbers of different kinds of websites are there but the most widely used categories of the websites are Educational, Commercial, Government, social networking and job portals. These days it has become mandatory for an organization big or small to develop a website to render its services online through different networks. With increase in the number of websites and its popularity it becomes necessary for an organization to put lot of efforts to design websites carefully so that it can easily cater to the need of all the different categories of the users. A number of website design issues are there which needs to be kept into consideration while designing websites. One of the most important issues among all is the page loading speed of WebPages. The quicker accessibility to the WebPages of a website with negligible wait time results in making website more user-centric and engaging. With the advent of large increase in the size of websites due to newer features and facilities resulting in increased loading time of WebPages it has becomes mandatory for a website to implement strategies that will result in reduced page loading speeds. Numbers of different organizations are there which are responsible for developing and implementation of different website development standards. To evaluate the website design according to the different standard so that it provide better interaction facilities to users different types of automated tool are available and to evaluate the websites design w.r.t. the standards developed by W3C, an automated tool is developed which will take URL of the website as an input and then parse the complete code of the website and compare it with the website code that it is written according to the standards of W3C or not. The working of the parser / automated tool developed is explained in the below given "Fig. 1,".

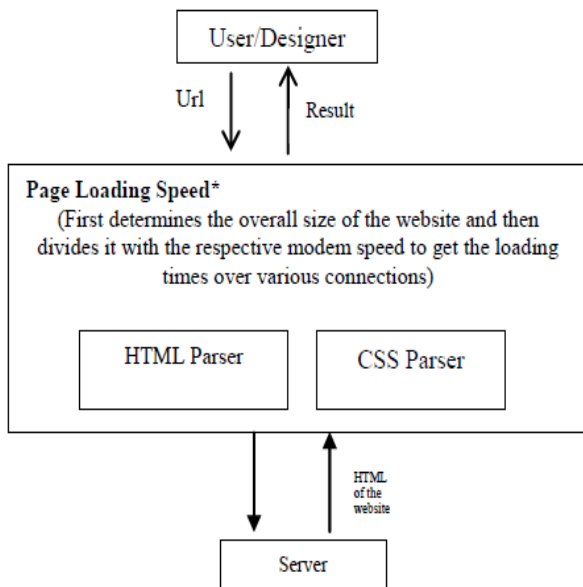


Fig 1. Block Diagram of Page loading speed Parameter.

The parser will take URL of the website as input and then send it to the server and from the server HTML code of the website is supplied to the interface for making comparison with the existing standards.

The algorithm of the automated tool developed is given below:

Algorithm: For determining page loading speed of a website over different modem connections.

Input: URL of the website

Output: Page loading speed of a website (in sec.)

Method: (steps are numbered for better understandability)

Begin

Step I: Calculates the speed of the current connection by taking the average of the bytes received over a period of time.

Step II: Calculate the total size of the website by employing the algorithm 4 described above.

Step III: Obtain the loading speeds for a website over current connection and different modem speeds by dividing the total size by the respective connection speeds.

End

2. METHODOLOGY

2.1 Problem Identification

By page loading time we mean the time taken by a webpage to get completely loaded on to a web browser. Load speed optimization is an important factor in web page designing. In today's fast paced mobile environment

no one wants to wait. Most potential customers do not want to wait for a seemingly endless page to load. Instead, they hit the browser 'stop' button and go elsewhere. Even though your website may be unique, you are not the only result when someone searches for your type of business. That being said, if your website takes too long to load, potential users will quickly move on to your competition. One of the research finding mention that website which has slow download time are less attractive compare than website with faster download time [1]. There are several ways to fix your current site, but being conscious of page loading times during the website design process will save your headache in future.

Another factor is that search engines hate websites with heavy load times. Now a days search engines like Google are using page speeds in its search ranking algorithms [2]. They know that if a person gets frustrated by high loading times, they are likely to leave the site very quickly. This exodus of visitors causes a site to have high bounce rate. A bounce rate is based on how quickly a visitor leaves a site once having arrived. If they detect a high bounce rate and slow page load speeds, they are likely to send users to another site. According to a survey conducted by Hamilton (1997) speed (i.e., slow speed) was the number one complaint of Web users (77%) [3].

By employing best practices during your website design process, you will ensure the best possible experience for your customer, and this will contribute to better page speed score. Fast loading times mean higher visitor engagement, visitor retention, and ultimately a higher conversion rate. These are all goals of any successful web development strategy.

Page loading speed is directly proportional to size of the web page [2]. As size increases the more time it takes to load a page. Another factor that shows up on the load time of a web page is the type of modem employed by the user.

2.2 Online tool for testing Websites

The tool Website Design Evaluator developed for the purpose to determine the deviations in the design issues among different categories of websites from the standards provided by the concerned organizations considered various features of the design parameters. For page loading time parameter the loading speeds of the websites were calculated with reference to the various types of modems employed by the user. A number of modems are currently available with different bit rates. The modem speeds that are considered by this tool to compute statistics regarding page loading time for websites are as under [4]:

1. 14.4k
2. 28.8k
3. 56k
4. 112k

In addition to the above, the modem speed and the loading time for the connection on which the user/designer will be operating on is also provided by this tool.

2.3 Sample Data

The Sample data taken in gathering statistics for the website size parameter is given in the Table 1 below. A

total of 100 websites belonging to different categories were considered. Since different categories of websites are designed in consideration with the constraints that apply to them as per the category they belong to. Therefore the diversity among the categories of websites considered helped in better understanding the variations in the features undertaken for the parameter and the statistics collected from the tool.

Table 1 : Sample Data

S. No	Govt. Websites	Educational Websites	Commercial Websites	Social Networking Websites	Job Portal Websites
1.	www.mit.gov.in	www.upsc.gov.in	www.bsnl.co.in	www.facebook.com	www.monster.com
2.	www.indianrail.gov.in	www.shiksha.com	www.onlinesbi.com	www.gmail.com	www.careerbuilder.co.in
3.	www.moia.gov.in	www.apple.com	www.airtel.in	www.orkut.com	www.indeed.co.in
4.	www.rajasthan.gov.in	www.schoolcircle.com	www.india.philips.com	www.yahoo.com	www.simplyhired.co.in
5.	www.jkgad.nic.in	www.classteacher.com	www.libertyshoes.com	www.rediffmail.com	www.nakui.com
6.	www.maharashtra.gov.in	www.jammuuniversity.in	www.bata.in	www.frenzo.com	www.glassdoor.com
7.	www.assam.gov.in	www.kashmiruniversity.net	www.hp.com	www.bebo.com	www.usajobs.gov
8.	www.india.gov.in	www.coeju.com	www.tata.in	www.goibibo.com	www.reed.co.uk
9.	www.aponline.gov.in	www.kashmiruniversity.ac.in	www.godrej.com	www.jakpinch.com	www.monesterindia.com
10.	www.nagaland.nic.in	www.jmi.ac.in	www.hul.co.in	www.myspace.com	www.placementindia.com
11.	www.upsc.gov.in	www.jamiahamdard.edu	www.marutisuzuki.com	www.mycantos.com	www.timesjobs.com
12.	www.petroleum.nic.in	www.smvdu.net.in	www.britannia.co.in	www.friendster.com	www.beyond.com
13.	www.rbi.org.in	www.islamicuniversity.edu.in	www.pg.com	www.viber.com	www.findtherightjob.com
14.	www.dotindia.com	www.du.ac.in	www.colgatepalmolive.com	www.netlog.com	www.bright.com
15.	www.coal.nic.in	www.jnuonline.in	www.hindwarehomes.com	www.flickr.com	www.ziprecruiter.com
16.	www.tn.gov.in	www.amu.ac.in	www.pepejeans.com	www.watsapp.com	www.theladders.com
17.	www.tourismoindia.com	www.skuastkashmir.ac.in	www.ashokleyland.com	www.plus.google.com	www.monester.co.uk
18.	www.upgov.nic.in	www.skuaast.org	www.dabur.com	www.tagged.com	www.career.com
19.	www.darpg.gov.in	www.pondiuni.edu.in	www.pepsico.com	www.ning.com	www.tweetmyjobs.com
20.	web.guidelines.gov.in	www.bujhansi.org	www.coca-cola.com	www.pinterest.com	www.smartbrief.com

2.4 Results and Discussion

The below given table 2 shows percentage of websites following different standards while running various categories of the websites on different modems and “Fig. 3,” to “Fig. 7,” shows the download time in different modem speeds. Based on the analysis from the below graph the sites with maximum time to load on all types of modems used during analysis are social networking sites and the sites which take minimum time to load on all types of modems are educational sites which means that out of the five different categories of websites employed for analysis the educational sites follow the maximum of standards as far as page loading speed parameter is concerned prescribed in W3C and as prescribed in analysis performed in [2].

Fig. 3. Download time against standards (in %) using 14.4k modem

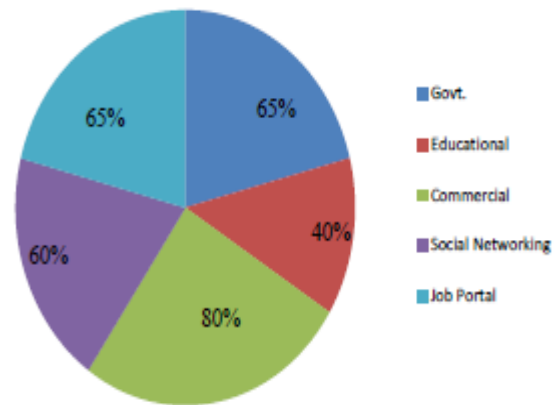


Table 2. Data collections on different modems (%).

Modem Speeds	14.4k		28.8k		56k		112k	
	Download time as per standards (in %)	Download time against standards (in %)	Download time as per standards (in %)	Download time against standards (in %)	Download time as per standards (in %)	Download time against standards (in %)	Download time as per standards (in %)	Download time against standards (in %)
Educational Websites	35	65	45	55	70	30	85	15
Job Portal Websites	60	40	60	40	75	25	80	20
Social Networking Websites	20	80	50	50	85	15	85	15
Commercial Websites	40	60	50	50	65	35	80	20
Govt. Websites	35	65	45	55	65	35	85	15

Table 3. Data collections on different modems for individual websites.

S. No.	Govt. Sites (time in sec.)				Educational Sites (time in sec.)				Commercial Sites (time in sec.)				Social Networking Sites (time in sec.)				Job Portal Sites (time in sec.)			
	14.4k	28.8k	56k	112k	14.4k	28.8k	56k	112k	14.4k	28.8k	56k	112k	14.4k	28.8k	56k	112k	14.4k	28.8k	56k	112k
1.	29.44	14.72	7.36	3.7	0.045	0.022	0.011	0.005	6.1	3.05	1.53	0.79	38.84	19.42	9.989	4.99	36.2	18.1	9.05	4.525
2.	4.93	2.47	1.23	0.63	7.19	3.6	1.79	0.9	3.99	1.99	0.997	0.498	23.77	11.88	6.11	3.05	5.08	2.54	1.27	0.64
3.	0.07	0.036	0.018	0.009	60.87	30.43	15.21	7.6	6.9	3.46	1.73	0.87	13.53	6.76	3.47	1.73	2.35	1.17	0.6	0.303
4.	88.5	44.25	22.12	11.06	0.09	0.047	0.023	0.011	18.3	9.15	4.57	2.29	21.68	10.84	5.42	2.71	28.06	14.03	7.21	3.6
5.	13.43	6.71	3.35	1.69	4.46	2.23	1.11	0.6	37.2	18.6	9.3	4.65	17.5	8.75	4.37	2.18	6.08	3.04	1.56	0.78
6.	6.5	3.25	1.62	0.83	13.76	6.88	3.44	1.8	106.8	53.44	26.72	13.38	5.01	2.5	1.28	0.64	6.54	3.26	1.63	0.82
7.	56.41	28.21	14.1	7.2	333.5	166.7	83.38	41.7	59.42	29.71	14.85	7.44	16.33	8.16	4.2	2.1	5.37	2.68	1.38	0.69
8.	84.89	42.45	21.22	10.7	23.95	11.97	5.98	3	8.84	4.42	2.21	1.13	7.025	3.51	1.8	0.9	8.75	4.37	2.25	1.12
9.	26.16	13.08	6.54	3.3	333.5	166.7	83.38	41.7	42.53	21.26	10.63	5.35	11.33	5.66	2.91	1.46	6.13	3.064	1.53	0.77
10.	6.8	3.4	1.7	0.9	44.66	22.33	11.16	5.6	34.96	17.48	8.74	4.39	157.8	78.93	40.59	20.29	68.99	34.49	17.74	8.87
11.	0.045	0.022	0.011	0.006	29.93	14.96	7.48	3.8	86.03	43.01	21.5	10.77	35.32	17.66	9.08	4.54	181.8	90.92	46.75	23.37
12.	22.98	11.48	5.74	2.9	84.2	42.1	21.05	10.6	25.26	12.62	6.31	3.16	169.3	84.69	43.55	21.77	89	44.5	22.88	11.44
13.	0.16	0.079	0.039	0.02	55.89	27.94	13.97	7	3.66	1.83	0.91	0.47	26.88	13.44	6.9	3.4	158.2	79.13	40.69	20.34
14.	3.42	1.71	0.85	0.43	20.76	10.38	5.19	2.59	7.24	3.62	1.81	0.91	10.78	5.39	2.77	1.38	28.25	14.12	7.26	3.63
15.	35.42	17.71	8.85	4.5	13.09	6.54	3.27	1.63	52.75	26.37	13.18	6.61	32.39	16.19	8.2	4.16	262.0	131.0	67.38	33.69
16.	48.13	24.06	12.03	6.02	30.91	15.45	7.73	3.9	16.36	8.18	4.09	2.1	0.094	0.047	0.024	0.011	4.68	2.34	1.17	0.58
17.	47.65	23.83	11.91	5.98	28.71	14.35	7.17	3.6	5.21	2.6	1.3	0.71	13.63	6.8	3.5	1.7	1.01	0.51	0.254	0.127
18.	139.786	69.89	34.94	17.5	5.44	2.72	1.36	0.68	175.6	87.84	43.92	22	96.29	48.14	24.76	12.38	0.013	0.006	0.003	0.001
19.	19.5	9.75	4.87	2.45	7.78	3.89	1.94	0.98	215.5	107.7	53.89	27.01	5.72	2.86	1.43	0.71	3.29	1.64	0.82	0.41
20.	67.32	33.66	16.83	8.42	0.02	0.01	0.005	0.003	8.52	4.25	2.13	1.064	22.03	11.01	5.5	2.75	5.77	2.88	1.44	0.72

Fig. 4. Download time against standards (in %) using 28.8k modem.

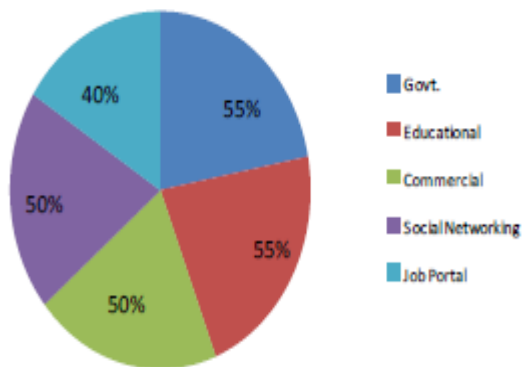


Fig. 5. Download time against standards (in %) using 56k modem.

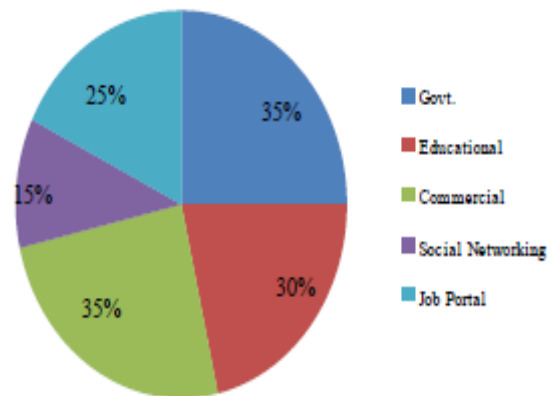


Fig. 6. Download time against standards (in %) using 112k modem.

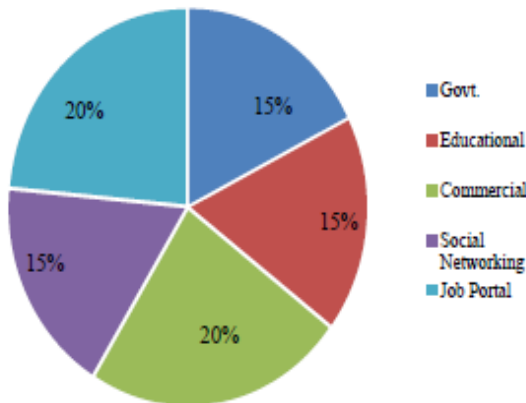
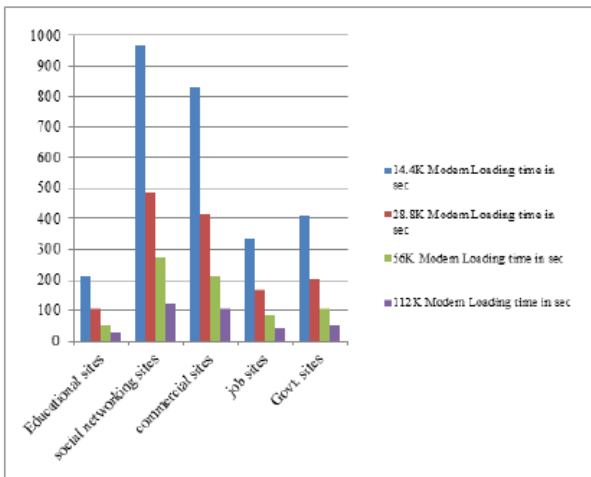


Fig.7. Graphical analysis for page loading speed.



are with less than or equal to 9.8 seconds load time which means rest all does not follow the standard of having a page loading time less than or equal to the recommended[2]loading time of 9.8 seconds.

Fig 8. Graph showing deviation of Govt. sites from the standards.

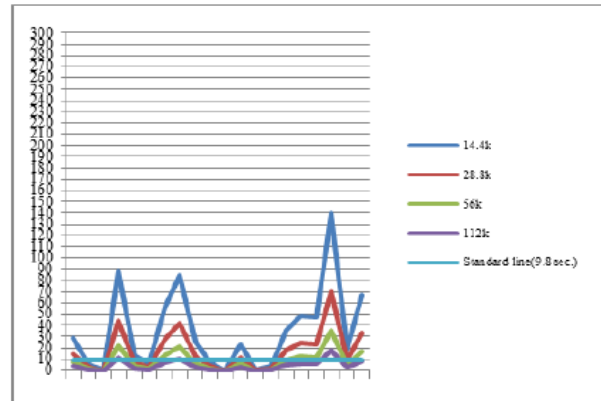
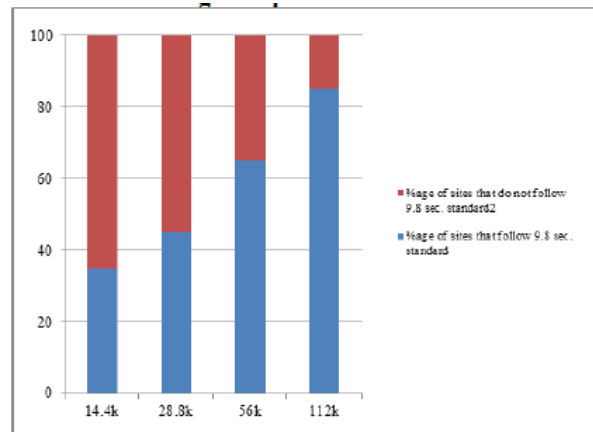


Fig. 9 Percentage Graph for Govt. websites.



Analysis based on different categories of websites separately for Page Loading Speed parameter: Statistics taken from Website Design Evaluator for Page Loading Speed parameter for different categories of websites taken from Sample Data is given below in table 3.

Government websites

The testing of all the govt. sites was done by using the website design evaluator tool which was developed to calculate the page loading time of websites on various types of commonly used modem speeds and results are shown in "Fig. 8," and "Fig. 9,". It has been observed that on average 58.75 percent of govt. sites

Educational websites

The testing of all the educational sites was done by using the website design evaluator tool which was developed to calculate the page loading time of websites on various types of commonly used modem speeds and results are shown in "Fig. 10," and "Fig. 11". It has been observed that on average 58.75 percent of educational sites are with less than or equal to 9.8 seconds load time which means rest all does not follow the standard of having a page loading time less than or equal to the recommended[2]loading time of 9.8 seconds.

Fig. 10 Graph showing deviation of Educational sites from the standards.

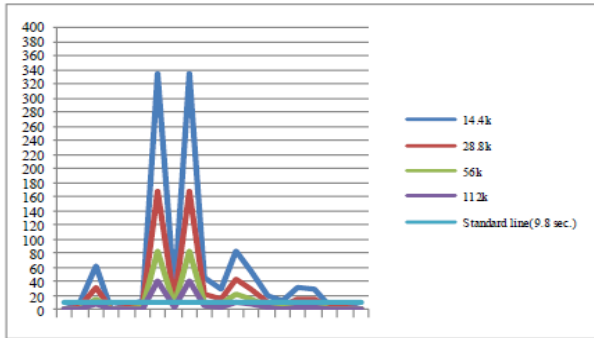
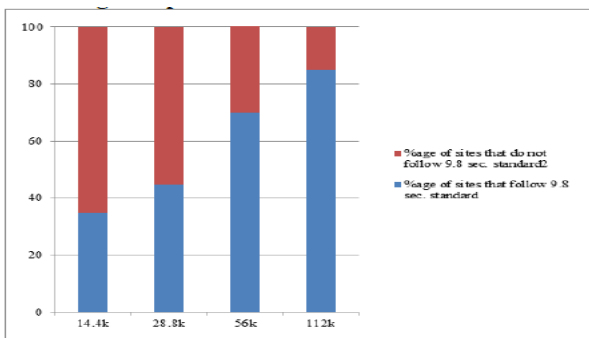


Fig. 11 Percentage Graph for Educational websites.



Commercial websites

The testing of all the commercial sites was done by using the website design evaluator tool which was developed to calculate the page loading time of websites on various types of commonly used modem speeds and results are shown in “Fig. 12,” and “Fig. 13”. It has been observed that on average 58.75 percent of commercial sites are with less than or equal to 9.8 seconds load time which means rest all does not follow the standard of having a page loading time less than or equal to the recommended[2]loading time of 9.8 seconds.

Fig. 12 Graph showing deviation of Commercial sites from the standards.

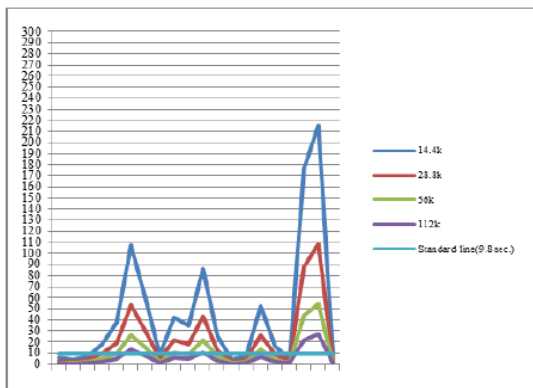
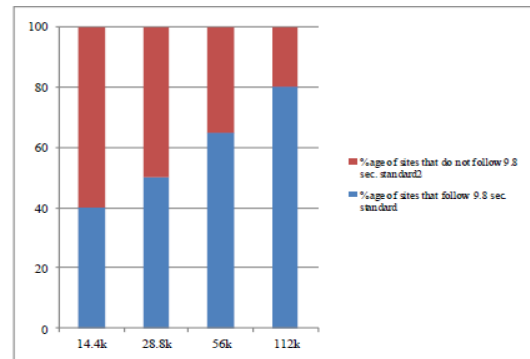


Fig. 13 Percentage Graph for Commercial websites.



Social Networking websites

The testing of all the social networking sites was done by using the website design evaluator tool which was developed to calculate the page loading time of websites on various types of commonly used modem speeds and results are shown in “Fig. 14,” and “Fig. 15”. It has been observed that on average 60 percent of social networking sites are with less than or equal to 9.8 seconds load time which means rest all does not follow the standard of having a page loading time less than or equal to the recommended[2]loading time of 9.8 seconds.

Fig. 14 Graph showing deviation of Social Networking sites from the standards.

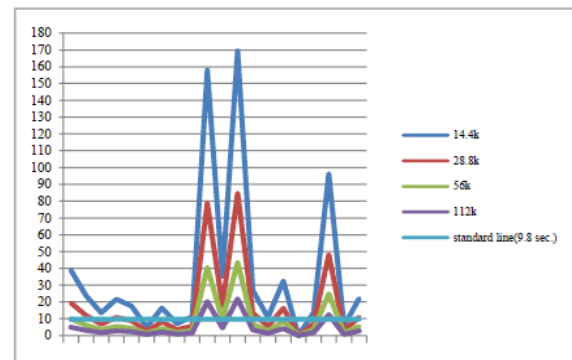
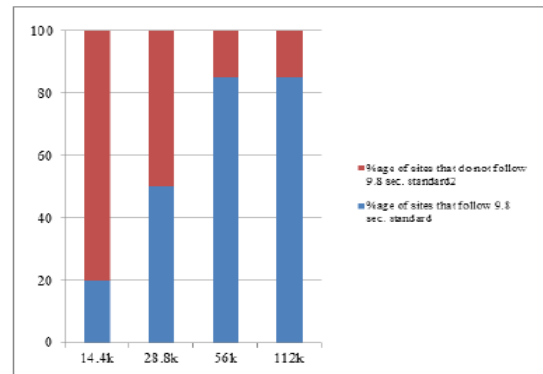


Fig. 15 Percentage Graph for Social Networking websites.



Job Portal websites

The testing of all the job portal sites was done by using the website design evaluator tool which was developed to calculate the page loading time of websites on various types of commonly used modem speeds and results are shown in “Fig. 16,” and “Fig. 17”. It has been observed that on average 68.75 percent of job portal sites are with less than or equal to 9.8 seconds load time which means rest all does not follow the standard of having a page loading time less than or equal to the recommended [2]loading time of 9.8 seconds.

Fig. 16 Graph showing deviation of Job Portal sites from the standards.

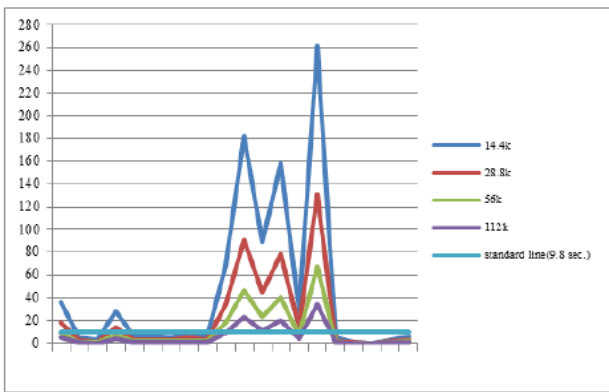
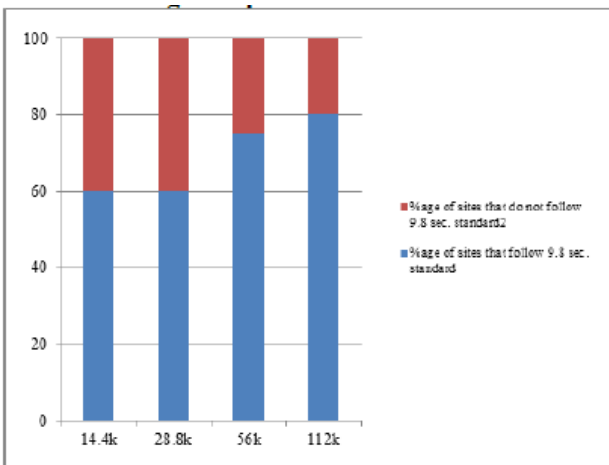


Fig. 17 Percentage Graph for Job Portal websites.



3. LIMITATIONS

There are various ways through which presence of feedback within a website can be determined. Although the method used in Website Design Evaluator provides statistics regarding feedback up to exact levels but the method involved may fail at instances. Almost all website designers provide feedback via an anchor tag but certain designers though very few include feedback within the design inside the xml of the website. Website Design

Evaluator determines the feedback within the websites by parsing anchor tag but it fails to find out when designer has provided it within xml during the design. In websites where feedback is included inside xml the tool is not able to determine its existence and hence provides incorrect statistics regarding them for this parameter.

4. FUTURE SCOPE

In future more detailed study of this parameter can help in bring out the features that have been over sighted due to their negligible effects on this parameter and will be taken into consideration. Provisions for the factors that are either external or internal to the parameter will be considered to make their inclusion into this parameter in order to make this tool a solution for maximum number of webpage design issues related to page loading speed problem and to provide statistics that are more accurate and will help the designers to find out the deviations in the page loading speeds of websites from the standards provided by concerned organizations and hence create page that are more efficient and user centric.

5. CONCLUSION

It is clear from the above statistics and analysis more effort is required to meet with these criteria in the context of website design as far as page loading speed is concerned. Very small percentage of websites among the website categories considered for evaluation are having page loading times that are up to required mark. In the recent time the average time of the connection speed is 5Kbps (kilobytes per second). This facts give an implication that one web page with 40Kb page size will be downloaded during 8 second. This matter in accordance with the 'eight second rule', this 8 second is a normal time for loading webpage and will not be tolerable from the user. This result are supported by many research result mentioned that mean of tolerable download time in the user side is 8.57 with standard deviation 5.9 second [5].

Hence it can be concluded that to gain better performance and user count it is necessary that page loading time of the websites be restricted to the tolerable figures as it is one of the important performance factor for websites. . It is clear that more efforts are required to meet with the criteria in context of webpage loading speeds for websites provided by concerned institutions/organizations.

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REFERENCES

- [1] HandaruJati, Dhanapal Durai Dominic, Quality Evaluation of E-Government Website Using Web Diagnostic Tools: Asian Case, International Conference on Information Management and Engineering 2009.
- [2] www.addedbyte.com.
- [3] Dave Gehrke, Efraim Turban, Determinants of Successful Website Design: Relative Importance and Recommendations for Effectiveness, 32nd Hawaii International Conference on System Sciences – 1999.
- [4] www.websiteoptimization.com/services/analyze.
- [5] Bouch, A., Kuchnisky, A., Bhatti, N. .Qualityis in the eye of the beholder: Meeting users' requirements for Internet quality of service. InSIGCHI conference on Human factors in computing systems. 2000. The Hague,Netherlands.