

Evaluating the Internal Quality Aspects of Universities' Websites in Punjab

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Abstract

Objectives: In this globalized competitive world, websites have become so important that an academic institution cannot think of surviving for a long time without an appropriately designed and engineered website. Therefore, the key objective of this study was to evaluate the internal quality aspects of some selected universities' websites of Punjab, northern state of India. **Methods/Statistical Analysis:** For the sample selection of universities, stratified random sampling was used by categorizing all the universities' websites of Punjab into four groups such as State, Private, Deemed, or Central universities on the basis of their status. For the measurement of website's internal quality attributes such as load time, total size of web page, requests per content type during loading, HTML check errors and broken links which cannot be perceived by users otherwise, three web testing tools such as W3C validator, Web Page Test and Selenium were used in this study. **Findings:** The results obtained in this study shows that the efficiency/performance of Lovely University' website is the best among the websites of other universities considered in this study. This particular website which represents a private university takes the least download time. Minimum number of HTML errors and broken links were found on this website as compared to other websites. It shows that web designers and administration of private universities are utmost concerned regarding their website quality. **Application/Improvements:** By improving the internal quality parameters of websites considered in this study, website's visibility in search engines can be improved which is an imperative aspect for high traffic rank.

Keywords: Automation Testing, Internal Quality Factors, Universities' Websites, Website Evaluation, Web Testing Tools

1. Introduction

In the current scenario, web based applications are having key role in the assorted application domains including education, business, entertainment and industry. With this, there are escalating issues and aspects about the methodologies by which the web based applications are developed and quality of service is presented. The development of a website includes passing the portal via assorted design guidelines and layers in order to ensure and confirm that the web based application can be effective and having higher integrity and purpose of deployment. Unfortunately, the design of website is classically driven by the organizational structure, technology or business objectives as compared to the usage by the access levels or

simply users. Quality refers to the attribute which changes on the preceptor's perception and action with the product's cost. Three views are prevalent and exist to describe the quality of a website: User, manager and developer. The end users or access layers are generally interested in the external quality factors associated with the usability and functionality of the application. In the context of developers as well as managers, the internal quality factors are addressed and these affect the portability, maintainability, cost effectiveness and related dimensions. The evaluation of website quality needs suitable and effective evaluation criteria on multiple parameters and dimensions. Most of these existing or classical criteria are having complexities and not easy for measurement and finally it require the methods including heuristic evaluations in association

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with pragmatic usability tests. The heuristic evaluation refers to the unique and novel method which is having key characteristics and methodologies with rules of thumb, knowledge, general skill and experience of the evaluators. This approach includes the analysis of usability experts on the parameters, and their judgements whether the users interface abide by the set of protocols and usability principles, named as Heuristics¹. In the pragmatic usability tests and investigation, a faction of users having assorted age, background and skills based characteristics are asked to access the web application so that the evaluation and related satisfaction level can be checked. Such quality assessment approaches are based solely on the qualitative criteria that can be having errors or related issues. Second, the evaluation approaches which are exercised by human users or experts assess the external factors and attributes related to the website as compared to the internal attributes including size of images, load time, broken links and many others. Internal attributes of the website depends on how the website has been designed and developed. These internal attributes of the website can be assessed and evaluated using automated tools. Therefore, in this study, only those quality aspects are taken into account which can be objectively measured through fully automated process/tools in order to minimize human intervention. In the following section, internal attributes of the Universities' websites evaluated in this study are discussed.

2. Internal Attributes of the Website

The attributes included in this study as follows:

2.1 Load Time

In its simplest terms, page load time is the average amount of time it takes for a page to show up on your screen. It's calculated from initiation (when we click on a page link or type in a web address) to completion (when the page is fully loaded in the browser). Usually measured in seconds, page load time is made up of two different parts:

- Network and Server Time: Based on how speedy the internet connection is and how swiftly static assets like photos and other files are served up.
- Browser Time: How long it takes for the browser to parse and execute the document and render the page to make it available for user interaction².

The same web page can have different load times in different browsers (e.g., Google Chrome vs. Internet Explorer), and on different platforms (e.g., mobile vs. desktop). The significance of this attribute comes from the fact that slower page response time results in an increase in page/user abandonment, as demonstrated in Figure 1. The average user has no patience for a page that takes too long to load. Second, search engines like Google use page load time in their algorithms that determine website' visibility in search engines which means that end users are more likely directed towards those sites that load quickly³. In general, a delay of one-second (or three seconds of waiting) decreases the customer satisfaction by 16%⁴.

2.2 Page Size

The delay occurs while fetching a web page from the server headed for Internet is essentially a function of three aspects. These aspects are mainly portal application page size in bytes, data transfer speed/rate and the users requesting web pages on common or central connection attributes between the server and Internet⁵. A normal web page is just about 12 KB, and that generally loads very rapidly. The superfluous media, for example, images, flash, embedded videos, audio etc. present on a page will leads to increase its size and that will take more time to download.

2.3 Requests per Content Type

When a web page loads, it makes many HTTP (Hyper Text Transfer Protocol) requests. These requests will usually consists of: Images, stylesheets (CSS), scripts, videos, etc. Each image, stylesheet and script file will make a separate request to a server for the information. By reducing the number of request, webpage download time can be reduced.

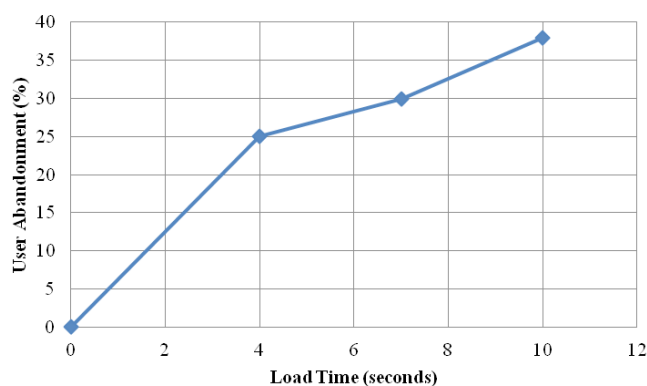


Figure 1. Loading time vs user abandonment rate.

2.4 HTML Check Errors

These errors indicate those locations in the coding part of web pages where the web pages do not follow and abide by the rules and protocols for valid HTML code guidelines. In very specific aspect, the HTML validator verifies that whether the HTML code on a web portal complies with the protocols and standards lay down by World Wide Web Consortium (W3C), the organization which issues the HTML standards or not⁶. The reasons behind to validate the web pages as follows:

- Assistance in the cross-platform and cross-browser compatibility.
- Search engine visibility.

Otherwise, the errors of such type may contribute to display the page imperfectly under diverse browsers.

2.5 Broken Links

When we click on a link that is believed to take us somewhere, yet instead it takes us somewhere else or shows a 404 error message, then it is called a broken link. Broken links do damage by:

- Stopping search engine website crawlers in their tracks – damage the website ranking by preventing Google, Yahoo, Bing, etc. from indexing the page.
- Negatively affecting user experience – by redirecting visitors to error pages^{7,8}.

3. Methodology

3.1 Sample Selection

This study was primarily focused on the websites of universities which are located in Punjab, northern state of India. For the sample selection purpose, stratified random sampling was used. In this, all the universities' websites of Punjab state are stratified into four classes such as State, Private, Deemed, or Central universities on the basis of their status. Following this, random sampling was made for the selection of one university website from each class. The universities' websites which were included in this study are shown in Table 1.

3.2 Automated Tools

For the evaluation purpose, two automated online tools such as W3C validator and WebPageTest, and one open

Table 1. List of Universities included in this study

University' Status	Name of University	Web Address
Central	Central University, Bathinda	http://www.cup.ac.in/
Deemed	Thapar University, Patiala	http://www.thapar.edu/
Private	Lovely Professional University, Phagwara	http://www.lpu.in/
State	Punjabi University, Patiala	http://www.punjabiuniversity.ac.in/

source automation testing tool such as Selenium were used in this study. The W3C validator checks the markup validity of web documents in HTML, XHTML, SMIL, MathML, etc. Selenium software runs directly on a browser and supports more or less all existing browsers such as Google chrome, Firefox, Internet explorer, Safari, Opera, etc., when it is used for the testing of web applications. It can run on any operating system platform such as Windows, Linux, and Macintosh etc.

3.3 Flow of Process

Figure 2 is the depiction of detailed process associated with the web based application testing used in this study.

4. Experimental Result

4.1 Load Time Analysis

The load time characteristics has been calculated for the webpage of identified universities through the use of Selenium software with the help of Google Chrome browser on desktop platform and the results are shown in Table 2. From the results as shown in Table 2, it shows that website of lovely professional university takes the least download time. It is also shown graphically in Figure 3.

4.2 Size (bytes) per Content Type Analysis

The results shown in Table 2 shows that the webpage of universities considered in this study does not load within the recommended time limits. A number of issues and factors are associated with the web application and server

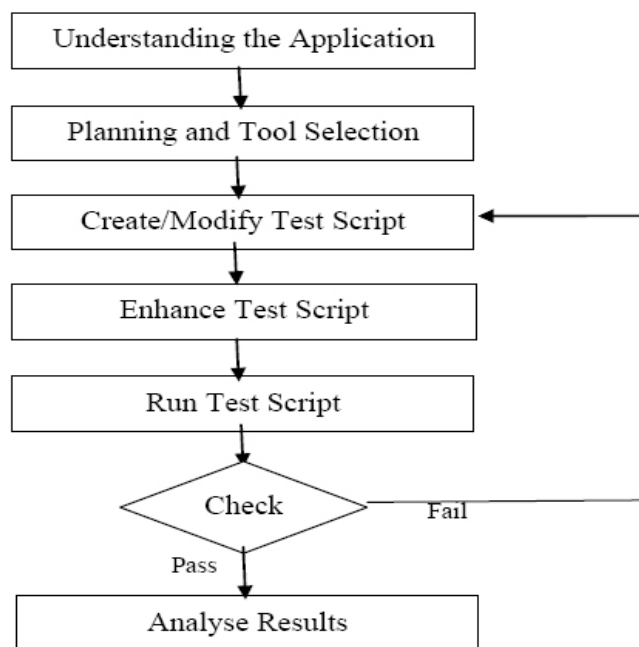


Figure 2. Process associated with web testing.

Table 2. Load time statistics

Name of University	Load Time in Seconds	Speed Index	Time to start Render in Seconds
Central University, Bathinda	33.9	8,271	3.489
Thapar University, Patiala	22	11,783	7.796
Lovely Professional University, Phagwara	10.8	10,355	9.593
Punjabi University, Patiala	30.6	6418	3.174

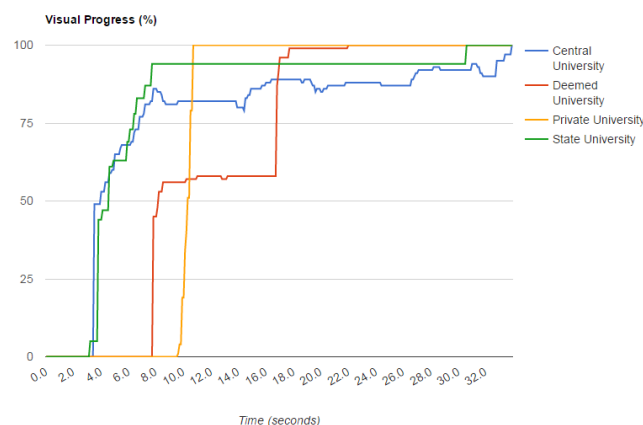


Figure 3. Visual progress (%) vs time (seconds).

which influence and contribute towards the loading time of a page; for example, size of the page, attached files and the graphics with multimedia content present on a webpage. Heavy pages tend to be slow pages and slow pages mean unhappy users. In view of this, page size of universities websites has been calculated and the results are shown in Tables 3 and Table 4. It is shown graphically in Figure 4 also. It is observed that although the webpage of Lovely Professional University is the heaviest among other universities' websites, yet it takes the least download time.

Table 3. Total page size in bytes

Name of University	Page Size in Bytes
Central University, Bathinda	12,032,508
Thapar University, Patiala	1,661,976
Lovely Professional University, Phagwara	67,490,252
Punjabi University, Patiala	9,392,137

Table 4. Size in bytes per Content type

Name of University	HTML	JavaScript	CSS	Image	Font	Others
Central University	7,280	2,20,643	36,431	3,396,097	0	8,372,057
Thapar University	15,056	1,57,438	53,609	1,381,217	49,158	5498
Lovely Professional University	3,76,856	1,469,361	3,80,635	64,422,543	3,70,945	4,69,912
Punjabi University	112,905	63,451	5973	9,209,808	0	0

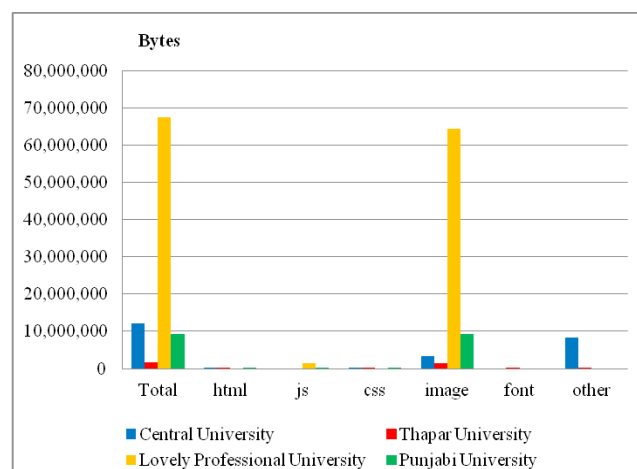


Figure 4. Size (bytes) per content type.

4.3 Requests per Content Type Analysis

The results for the requests per content type are shown in Table 5 and Table 6. It is shown graphically in Figure 5 also. It is observed that although the maximum numbers of HTTP request are made by the webpage of Lovely University' website, still it takes the least download time.

4.4 HTML Errors Analysis

The results obtained from the W3C validator are presented in Table 7 and graphically in Figure 6. By analysing these results, it is concluded that Lovely Professional University is the best in this aspect, where there are only 2 errors. On the other hand, maximum number of errors (53) is found in the Website of Punjabi University. Few and remarkable issues associated with this aspect are the usability of HTML tags and attributes with the international standards. All errors contained within HTML files should be repaired.

4.5 Broken Links Analysis

The results obtained from the Selenium software are presented in Table 8 and graphically in Figure 7. By analysing these results, it is concluded that Lovely Professional University is the best in this aspect, where

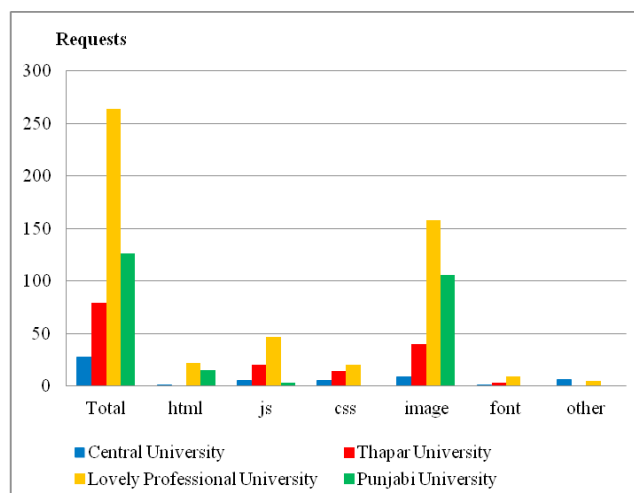


Figure 5. Requests per content type.

Table 7. HTML errors

Name of University	Total number of Errors
Central University, Bathinda	18
Thapar University, Patiala	31
Lovely Professional University, Phagwara	02
Punjabi University, Patiala	53

Table 5. HTTP requests

Name of University	Total number of requests
Central University, Bathinda	28
Thapar University, Patiala	79
Lovely Professional University, Phagwara	264
Punjabi University, Patiala	126

Table 6. Requests per content type

Name of University	HTML	JavaScript	CSS	Image	Font	Others
Central University	1	5	5	9	1	6
Thapar University	1	20	14	40	3	0
Lovely Professional University	22	47	20	158	9	5
Punjabi University	15	3	1	106	0	0

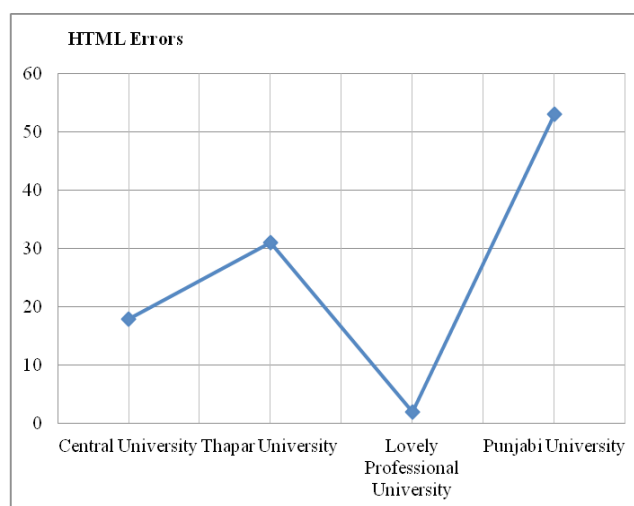
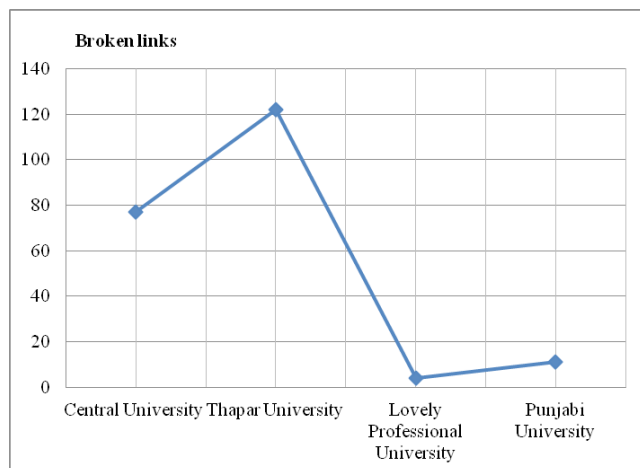


Figure 6. HTML errors statistics.

there are only four broken links. On the other hand, maximum number of broken links (122) is found in the Website of Thapar University. Following are the reasons or factors which directly or indirectly influence the quality of web page with respect to broken link:

Table 8. Broken links

Name of University	Total number of Broken Links
Central University, Bathinda	77
Thapar University, Patiala	122
Lovely Professional University, Phagwara	04
Punjabi University, Patiala	11

**Figure 7.** Broken links statistics.

- Unavailability of the target Website.
- Deletion of target web Page.
- Modifications in the Server attributes and settings.

5. Conclusion

By evaluating the internal quality aspects of universities' websites located in Punjab, India with the help of automation tools, an attempt is made to identify the weak areas in the designing and development of these websites. It will be a significant move in the direction of the development of quality websites. The results obtained in this study shows that the performance of Lovely University' website is the best among the websites of other universities.

This particular website takes the least download time. Minimum number of HTML errors and broken links were found on this website as compared to other websites. It shows that web designers or/and administration of private universities are utmost concerned regarding their website quality. The results of this study should view with the fact that the design of universities' websites changes from time to time due to its dynamic nature. It would be useful to carry out a more comprehensive study by covering more universities and diagnosis tools. The findings of present study open the door to carry out further studies in this area in nearby future.

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