Response Time Analysis of Websites Using Jmeter Tool

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Abstract- Academic institutions use websites for several purposes like examination enrollment, form submission, result declaration and more. However, while accessing those websites applicants encounter several issues like server errors or response timeout failures. Several factors are responsible for such technical issues like heavy traffic, infrastructure limitations etc. The aim of this research paper is to evaluate the response time of different academic websites (both public and private) with the help of jmeter tool. The findings of this research indicate the critical factors behind delayed response time. The paper discusses these results and on their basis, provides certain insights for achieving better response time.

Keywords - Response time, Jmeter tool**.**

I. INTRODUCTION

Omnipresent aspect of daily life of people across the globe. With the rise in usage of internet, the educational and academic institutions have also welcomed this change [1]. For academic websites especially, those that support features like heavy content, data uploading, etc. it is imperative that they are designed keeping in mind response time as unresponsive or slow websites are more likely to quickly lose the interest of its users and fail to engage them further. Typically, the objectives of academic websites contrast with other genre of websites in many ways [4]. Apart from knowledge sharing, which is the primary aim of such websites, many other features are increasingly being incorporated in academic websites like form submission, examination enrolment, result declaration, video testimonials of students etc.

Usability is a key criterion for a website over the web to survive [4]. A lot of common factors influence the usability of a website like its design, user friendliness, content organization and some technical factors like loading time, server response time etc. Thus, the usability factors of the academic websites are ease of access, responsive, well structured, interactive, engaging for its users, etc.

Response time is one of the defining attributes of websites that either attract or repel users from accessing them. This can be analyzed from the fact that Yahoo observed a decline of web traffic by 5-9% when the response time of the web page was slower by 400ms; Amazon registered 1% less sales for every 100ms addition in response time. Moreover, Google registered 20% less searches [2] and the traffic at Facebook dropped by 3% when their response time got increased by 500ms [3]. From user's point of view, the response time can be defined as the time interval between the instant when request call made at client machine to the time when the response is fully received by the client. The surveys conducted by the GVU (Graphic, Visualization and

Usability) Centre at Georgia Institute of Technology [5] and Bose, Lightner and Salvendy (1996) [6] finds that web users find long download times as a major problem in accessing websites.

The objectives of this research paper are to -
1. Evaluate the performance of different websites belonging to public and private academic institutions by calculating their actual response time using jmeter tool. JMeter is an application tool that lets usersconFig. And execute performance, load and stress tests using different protocols and technologies. It allows and supports simulating various type of requests against all type of servers, databases and protocols like HTTPS, FTP, HTTP.

2. Discuss and analyse the results obtained from the findings and use them as a basis to generate insights for achieving better response time.

The rest of this research paper is structured as follows: The subsequent section talks about the reviews of various literatures and studies conducted around this area and analyse them. Section 3 describes the experimental study undertaken in order to achieve the objectives of this research. The results obtained in previous section are discussed and analyzed in Section 4. Section 5 finally concludes the section with formulating insights.

II. PRIOR RESEARCH

Response Time - Response time is defined as the time duration between the moment the user triggers an activity until the system begins to display or present results [12, 13]. Or in other words response time is the time duration between the time users initiates a request and receives its response. It signifies how long the user has waited to get his/her request processed by the application. For example,

while opening a webpage, two main factors determine its speed of opening: the webpage size as well as server performance. Performance-testing is conducted to determine the response time and behavior of the system [15].User triggering activity could be a mouse click, keystroke, voice instruction, or touch screen.

Performance Testing - Performance Testing is undertaken to determine the throughput and response time of any web application [15]. By using performance-tests, load handling capacity, reliability and speed of a website can be computed. The performance testing includes recording and monitoring the performance cycles for any website during peak, regular and low hours [15]. Mostly performance testing tools helps in determining the time taken by the system to perform a task. However, [14] argued that several limitations exist while conducting the performance testing like testing tool's compatibility with the system, its setup and installation, testing flexibility etc. [16] further stated that dependencies arise as some requests rely upon the response from other requests. This makes performance-testing challenging. Generally, performance tests are bifurcated into Load test, Stress test, Volume test and Strength tests [16]. Performance of web applications is directly related to the profitability of the enterprises. Therefore, performance-testing should be done to ensure the reliability of the system.

Load Testing - Load testing can evaluate the operations of a Web server like network movement situation, response time and can even check the cause of network delay. Load testing can help to optimize web applications and can even provide suggestions to mitigate the delay causing troubles. Load testing refers to the process that triggers service request by including web client number in the input, and steadily increases the client number of web service request. The testing tool can catch the average response time of the client request, and compare it with the average response time every time after the client number is increased [7]. [8] Stated that the principle of load testing tools is to simulate the behavior of "real users" via "virtual users". This provides results regarding the performance of application under load as well as the information about the experience of virtual users. [9] Concluded that load testing tools helps to test web applications under various load conditions. In load testing, many users access web application simultaneously which helps identify the potential bottlenecks that hinder the delivery of better performance [10]. Thus, load testing is important to access the health of the application.

Jmeter - Jmeter is an open source performance-testing tool that can be used for load testing to analyse and measure the performance of web applications and other related services like measuring success/failure ratio, throughput and response time [11]. By generating multiple user threads simultaneously, heavy load scenario on the server can be created to test its strength. The results are also easy to understand as they are represented in the form of trees, graphs, flat files etc. and can be viewed simultaneously [12]. Though jmeter can be arranged as a monitor, it is typically regarded as an ad-hoc solution instead of advanced monitoring solutions [10]. [13] Stated that one key area that puts JMeter ahead of other performance-testing tools is that it supports and provides plug-in architecture, i.e., any custom requirement can be added easily by scripting a Java plug-in. Moreover, it offers a graphical interface to design the test plan and can represent results in a user-desired form. Thus, it can be inferred from the above literature that JMeter is an ideal testing tool to conduct performance testing.

III.   RESEARCH METHODOLOGY

A Test Plan was created in the JMeter tool to test the performance of websites. In order to execute the test plan, 100 virtual users send requests to the server for a response. Therefore, the total number of requests sent to the serve are (100 virtual users) x (repeat 1 time) x (1 request) = 100 HTTP requests.

To begin with the methodology, a test case project was initiated in JMeter post which user thread group was defined to send requests to the server. In that window, the user thread group was added along with other variables like ramp up period (that defines the time gap between two successive user requests), number of threads to be executed (100) and count (1; for the number of times the user sends the request) (refer Fig. 1 and 2). After that information about the service request parameters is defined in the HTTP execution window (refer figrue-3).

In this execution stage 100 user threads will send the requests to the server and the ramp-up interval was set to 100 seconds. This means that JMeter will execute one thread every second and it will take 100 seconds for JMeter to make 100 threads up and running.
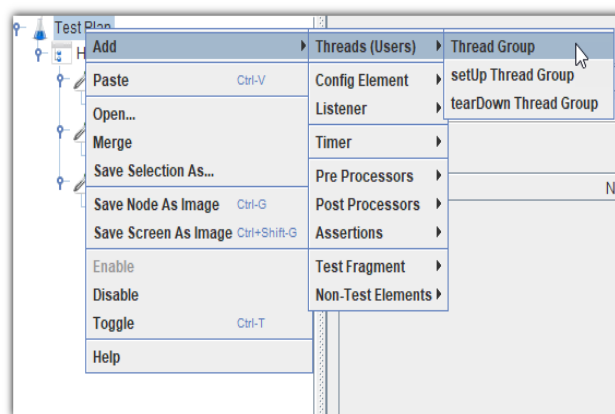

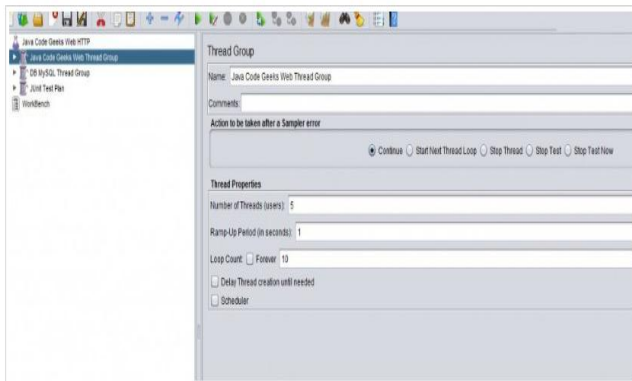Figure 1: Initiation of thread group in Jmeter (Source: JMeter tool).

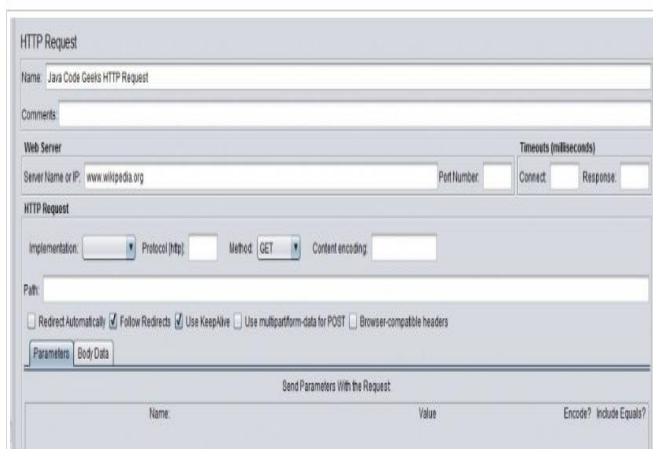Figure 2: Setting threads group parameters (Source: JMeter tool).

Figure 3: Setting HTTP request parameters (Source: JMeter tool).

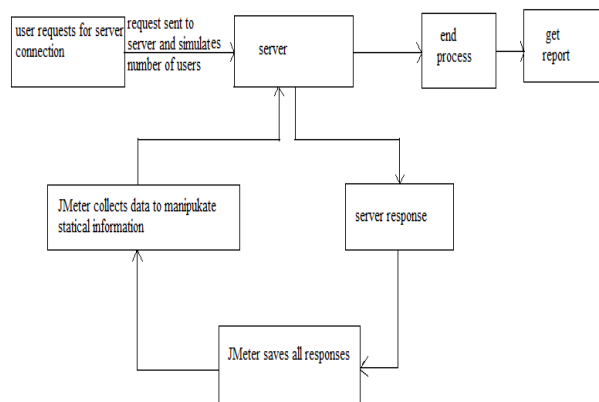The architecture of JMeter is shown in Fig. 4 explaining how the whole process is performed.

Figure 4: JMeter architecture (Source: Jha & Popli, 2017).

Data Analysis - In the current study, 5 academic institution's websites of both public as well as private domain were selected for analysis. The public websites that were analyzed are University of Rajasthan (uniraj.ac.in), MDU Rohtak (result.mdurtk.in), UPSC (upsconline.nic.in), IGNOU (onlineadmission.ignou.ac.in) and Delhi University (duexam.du.ac.in). The private institutions websites that were analyzed were Bits (www.bitsadmission.com), Amity university (portal.amity.edu), JNU Jaipur (apply.jnujaipur.ac.in), Sikkim Manipal University (apply.smu.edu.in) and Symbiosis International University (www.examination.siu.edu.in).

The results that were obtained can be observed from table 1 and 2. The average response time of the private academic websites came out to be 296.86 ms while the average response time of the public websites was 85.53 ms. The response time is related to the performance of the website as lesser the response time, better is the performance. In addition to the response time, the average latency period and connection time of the private websites were found to be significantly greater than the public websites. While the private websites had a latency period and connection time of 534 ms and 237 ms respectively, the public websites were found to have a latency period of 139 ms and connection time of 53 ms.

It can also be observed from the table 1 and 2 that the response time of a page varies independently of the number of bytes sent by the website. While JNU Jaipur and Symbiosis International University almost have same amount of bytes sent, their response time differ significantly. The difference observed between the response times of the websites can be attributed to the website structure and design elements. For example, the website of Symbiosis International University uses a lot of animation, heavy images, styles etc. that are used to make the page more interactive while the public websites do not contain such elements in excessive amount. On the contrary, public academic websites are emphasizing more upon functional aspects rather than making the page interactive.

Table 1: Response Time data of public academic websites

Public academic websites				
Label	Elapsed	Latency	Connect	Response Time	Bytes sent
UNIRAJ	64.06	64	2.3	61.7	1327
UPSC	319.02	250.92	206.98	43.94	11991
DU	194.52	94.8	4.9	89.9	24261
IGNOU	187.88	161.98	38.38	123.6	28323
MDURTK	592.62	123.08	14.54	108.54	106631
Mean	271.62	138.956	53.42	85.536	34506.6

Table 2: Response Time data of private academic websites

Private academic websites					
Label	Elapse d	Laten cy	Conne ct	Response Time	Bytes sent
JNUJAIP UR	189.64	113.1 6	6.74	106.42	26986
SMU	2910.7 4	1207. 66	892.5	315.16	15161
BITS	144.36	143.9	4	139.9	8784
SIU	2103.1 4	1124. 42	273.8 4	850.58	26543
AMITY	121.1	83.94	11.68	72.26	60026
Mean	1093.7 96	534.6 16	237.7 52	296.864	27500

The individual response time of different public websites is shown in Fig. 5 while Fig. 6 shows the response time of private websites. Among the public websites, UPSC website tops the list with the least response time while IGNOU's website had the highest response time of 123 ms. The response time of Symbiosis international university is the highest with a response time of 850 ms while the response time of Amity university is the lowest among the private universities.
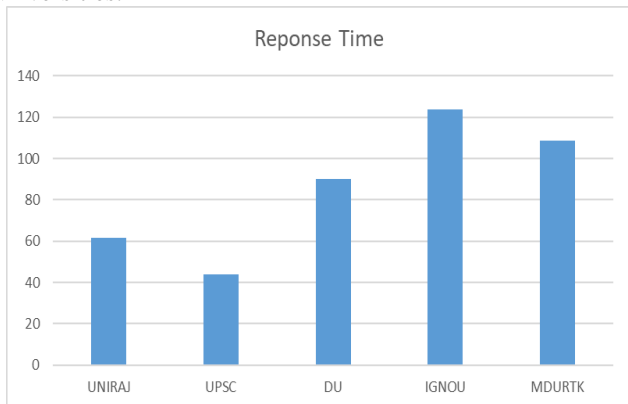
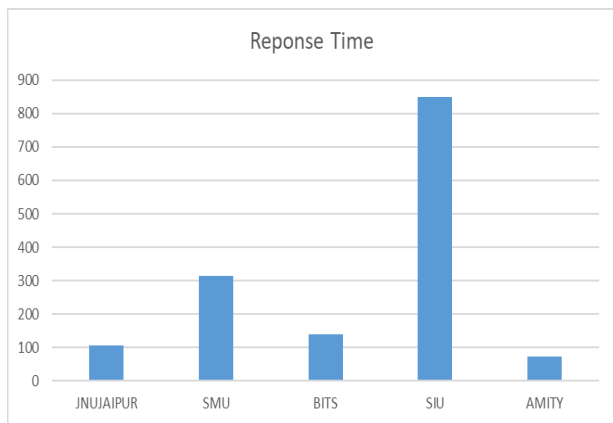
Figure 5: Response Time of public academic websites

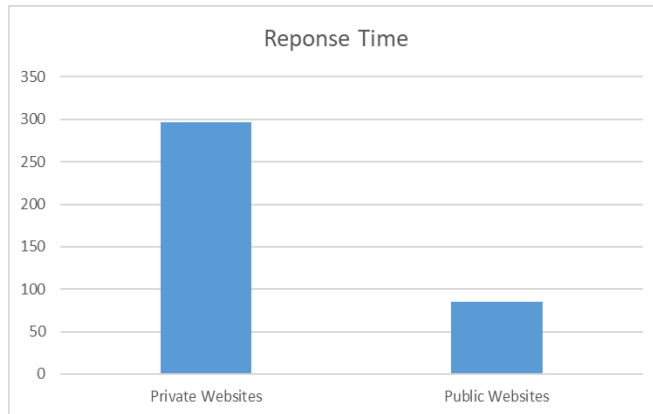Figure 6: Response Time of private academic websites

Figure 7: Comparison between response time of public and private academic websites

A comparison between the response time values of public and private academic websites is shown in Fig. 7. The Fig. 7 clearly indicates that public websites are better in terms of response time than the private websites.

IV.   CONCLUSION

In this paper, response time analysis of different academic websites of public as well as private domain was analyzed with the help of JMeter, a testing tool. The results from the data analysis part indicate that clearly the performance and response time of pubic academic websites in general is better than the private academic websites. Along with the response time elapsed time, connection time and latency period were also analyzed. Their results also indicate the same results. Moreover, the difference observed between the response times of the websites can be attributed to the basic requirement behind it. The public domain academic websites focused more on utility and function while the private domain academic websites laid more focus upon user engagement. The limitation of the research paper was its scope as only a limited number of websites (10) were analyzed to study the response time. For future research, scholars are advised to increase the scope as well as take into account other metrics that determines the overall performance of a website, not just only response time.

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