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Technical Review and Analysis on Students Academic Website Projects Using *GTmetrix* Web Speed and Optimization Tool

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Abstract:

Three local government website projects in the province of Misamis Oriental deployed by the Bachelor of Science in Information Technology students of Mindanao University of Science and Technology-Jasaan Campus were subjected for review using the GTmetrix web speed optimization tool. The purpose of this study was to evaluate the general performance of the websites in terms of access speed and page efficiency by determining whether the design of the websites follow the global best practices of web page optimization. It aims to identify specific aspects of the websites that need major improvements and how it can be improved. The study uses data collection from the result of individual website review. Statistical mean was used to compute the general performance score based from the individual aspect-grades of each website. The study found out that the websites are unoptimized based on the predefined speed category and GTmetrix PageSpeed set rules.

Key words: Web Analytics, Web Speed Optimization, Web Page Performance

INTRODUCTION

Internet has become the backbone of every field. Over the last years, web development is affecting the society from all aspects i.e. business environment, educational field, communicating ways between people. (Naazir, et. al, 2013). Websites have become an important channel for organizations to make transaction and provide service to customers. In recent years, the applications of information technology have provided an even more powerful platform for new website applications (Chen, 2009). Web pages must be fast and effective. To estimate serviceability, the features of web pages must be measurable (Lamichhane & Meesad, 2011). Since web pages are one of the most significant components of e-government strategy, evaluation itself is a wide concept. It depends on multiple qualitative and quantitative factors (Rogers, et.al, 2007). The quantitative factors such as download delay, errors in pages, broken links, and server response time and so on can be measured by web diagnostic tools (Jati & Dominic, 2010). There are various web diagnostic tools available in the internet today like *Pingdom, WebPageTest, Sucuri Load Time Tester, Google PageSpeed Insights, PageScoring, and GTmetrix.* These web diagnostic tools help the web developer analyse the performance of their web pages and also help them how to optimize their codes and web elements for better performance. In the setting of this study the *GTmetrix* was used. *GTmetrix* evaluates page performance based on key indicators of page load speed. It uses both the Google *PageSpeed* and Yahoo! *YSlow*. It provides track performance with monitoring, graphs and alerts. It provides visual performance graphs like *Page Load Time, Page Size* and *Request Counts.* It displays the *PageSpeed* and *YSlow* scores after reviewing the entire web files.

Three websites were deployed by the Bachelor of Science in Information Technology (BSIT) students of Mindanao University of Science and Technology – Jasaan Campus, (MUST-Jasaan) in three different local government agencies in the province of Misamis Oriental. The *jasaan.gov.ph* was used as the official website of the Municipality of Jasaan. The *balingasag.net* for the Municipality of Balingasag and the *pnpmisorppo.org* was used as the official website for the *Philippine National Police – Misamis Oriental Police Provincial Office (PNP-MOPPO)*. The general objective of this study is to review the general performance of the websites based on *GTmetrix*'s set rules. This study is to determine whether the websites are optimized and fast enough when they are accessed. Specific objectives includes the identification of the website elements that are considered *unoptimized*, *very unoptimized* or *extremely unoptimized* based on grade category. Findings of this study will be useful in the improvement of future website projects in the academe in terms of efficiency and optimization. This will also align the academic website projects according to the global best practices and standards.

LITERATURE

Krug (2006) suggests that for any user, the website of an institution must be understandable. Some institutions or universities for example, pay attention to design usable website to meet needs of coming visitors. Not only serving to its current students and employees, a website of an educational body also gives services to new visitors, seeking any kind of information about the organization. A website not only provides cost effective and timely platform for communication with stakeholders, but also helps to shape and present its image on the internet (Mentes & Turan, 2012). As organizations try out new ways of selling and communicating over the Internet, it is

becoming increasingly apparent that the performance of their websites in terms of the extent to which they can attract and retain traffic, strongly influences the volume of business transacted on them (Tarafdar & Zhang, 2008). It is important for organizations to identify factors that influence website performance for appropriately focusing website development efforts towards specific parameters and including relevant performance-influencing features within the website. Analysis of website performance in terms of design criterion and related factors is therefore an important area of enquiry (Torkzadeh & Dhillon, 2002). Technical properties of the websites include security, access speed and accessibility. Access speed determines how fast the website can deliver and display web pages (Rose, et. Al, 1999).

Users coming to an educational website are usually concerned with two major points- one is finding the information essayed with ease and the other is finding the information in a timely fashion (Mustafa & Al-Zoua'bi, 2008; Ivory & Hearst, 2001). Dominic and Jati (2009) evaluated the usability and quality of Malaysian University websites based on factors like load time, frequency of updates, accessibility errors, and broken links using the following tools: Website optimization, Check link validator, HTML validator and accessibility testing software. Jati & Dominic (2009) confirmed in their study that the E-government websites of Asian countries are neglecting performance and quality criteria. They argued that webmasters, web applications developers, and website quality assurance managers need tools and methods that can match up to the new needs (Jati & Dominic, 2009). PR Newswire (2015) reported that speed is a critical element of running a successful website and should always be a priority for site managers. In addition to providing a lag-free and responsive user experience, a fast loading website also has a direct impact on the overall performance of the website. Faster loading websites benefit

from better user engagement, higher conversion rates and higher Search Engine Optimization (SEO) rankings.

Web analytics refers to a combination of measuring, acquisition, analysing and reporting of data collected from the Internet with the aim of understanding and optimizing web experience. (Web Analytics Association, 2008). Web analytic tools automatically calculate statistics about the detail use of site. The method studies the web as whole by calculating statistics about the detail use of the site and providing Web-traffic data, visibility, connectivity, ranking and overall impact of a site on the Web (Mvungi & Tossy, 2015). Website analysis is an ongoing process (Kaur & Singh, 2015). Web analysis perform several inspections on the websites and software and use usability criteria to determine some faults on the systems (Mvungi & Tossy, 2015). The analysis is required during the development of a website to cognize about its potential users so that layout design and content can be placed on the web accordingly. Also, once the website is developed, the analysis process does not end there but it continues for further maintenance and optimization (Kaur & Singh, 2015).

Despa (2014) employed *GTmetrix* to evaluate the NUVE applications. In formalizing the ISDF Software Development Methodology for the ALPHA project, Despa (2015) also employed the GTmetrix to collect data regarding quality. Same tool was also used by AbanteCart latest version 1.2.7 to evaluate its speed. The Progressive Digital Media Technology News (2015) reported that shoppers from UK see website speeds and functionality equally important than design and style. The Retail Speed League created by Citrix utilized *GTmetrix* to extract data to rank UK's online retailer by website performance.

METHODS

Three academic website projects were selected to undergo review and analysis using *GTmetrix*: *jasaan.gov.ph*, *balingasag.net* and the *pnpmisorppo.org* websites. The *Uniform Resource Locator (URL*) of each project was keyed in the *GTmetrix* web page whose server is located at Vancouver, Canada. The *GTmetrix* tool meticulously scanned the contents of the website and analysed the performance based on its test speed criteria. After each evaluation, *GTmetrix* then displayed the overall score based on the Google *PageSpeed* and Yahoo! *YSlow* set rules. It also shows the specific criterion-based grade and recommendations based from both *PageSpeed* and *YSlow* tests. The lowest possible grade is zero (0) and the highest possible is one hundred (100). Page and content speed category is grounded to the following grade range: *very optimimized (85-100), optimized (71-84), unoptimized (56-70), very-unoptimized (30-55) and extremely unoptimized (0-29).* Figure 1 shows the technical review and analysis process of this study.

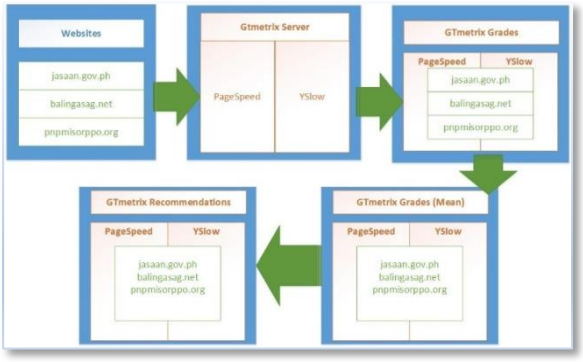

Figure 1. Technical Review and Analysis Process

GTmetrix result displays the overall score for both the *PageSpeed* and *YSlow*. The criterion grade is also displayed together with the type of file and the priority category. Figure 2

shows the portion of the sample screenshot of the *GTmetrix PageSpeed* test result for the *balingasag.net* website.

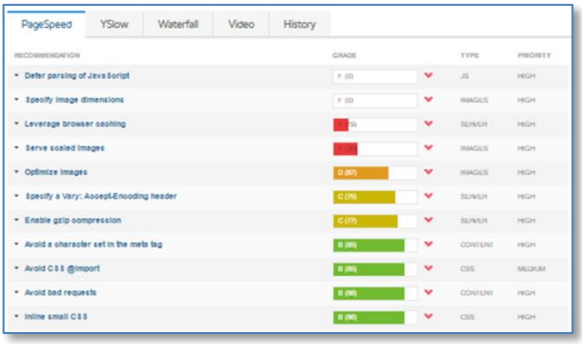

Figure 2. Screenshot portion of PageSpeed test result for balingasag.net

The display of exact time each of the website component can be seen in the waterfall display. Figure 3 shows the portion of the *GTmetrix* result through the *waterfall* display.

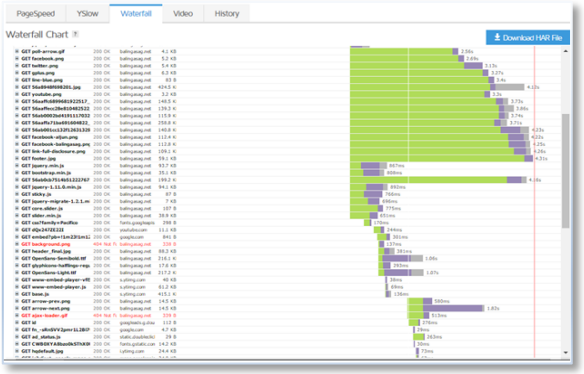

Figure 3. Screenshot portion of GTmetrix waterfall test result for balingasag.net

The statistical mean was calculated for both *PageSpeed* and *YSlow* tests. The *PageSpeed* mean and the *YSlow* mean were sorted accordingly from lowest to highest in order to easily

determine the aspects of the projects that needs major improvements. Recommendations provided by the *GTmetrix* based on the scores are listed down.

RESULTS

The technical review and evaluation of the websites using *GTmetrix* shows that *jasaan.gov.ph* got a *PageSpeed* score of 57.00 *(unoptimized)*, *balingasag.net* scored *62.00 (unoptimized)* and *pnpmisorppo.org* scored 50.00 *(very unoptimized).* Their *PageSpeed* mean is *56.33* which is categorized as *unoptimized* . On the other hand, the three websites got higher scores in the *YSlow* test. *jasaan.gov.ph* scored of 76.00 *(optimized)*, *balingasag.net* scored *73.00 (optimized)* and *pnpmisorpo.org* scored *76.00 (optimized).* Their *YSlow* mean is *75.00* which gave the impression that the overall website performance is *optimized*

Table 1. Summary of GTmetrix Performance Score Result

	***GTmetrix* Performance Score Result Grade (100%)**			
Key Indicator	**(A)**	**(B)**	**(C)**	**Mean**
PageSpeed	57.00 (unoptimized)	62.00 (unoptimized)	50.00 (very unoptimized)	56.33 (unoptimized)
YSlow	76.00 (optimized)	73.00 (optimized)	76.00 (optimized)	75.00 (optimized)

(A)- jasaan.gov.ph (B) - balingasag.net (C)- pnpmisorppo.org

Going into the details of the *GTmetrix PageSpeed* evaluation the result shows that various aspects of the websites were rated as *extremely unoptimized*. Top on the list is the *specification of image dimension (mean = 4.67).* The websites' images have no width or height attributes. *Leverage browsing caching (mean = 12.33).* The cacheable resources have a short freshness lifetime. The resources expiration were not set. *Served scale images (mean = 12.33).* Many of the content images were not properly resized that could have saved 85% of image size. Among the *very unoptimized* aspects are: *Enable gzip compression (mean =*

42.00). The resources were not compressed with *gzip* which could reduce their transfer size by 69% and *Defer parsing of Javascript (mean = 52.33)* in which a considerable amount of *Javascript* is parsed during initial load.

The *unoptimized* aspects includes *Minify CSS (mean = 60.00)* and *Specify a Vary: Accept-Encoding header (mean = 68.33).* Many *Cascading Style Sheet (CSS)* files were not minified which could save many bytes of data and speed up downloading, parsing and executing time. Various resources that are publicly cacheable and compressible do not have "Vary: Accept-Encoding" header. The absence of these header unable to instruct the proxy server to store both a compressed and uncompressed version of the resource.

Aspects that were considered *optimized* comprises *Optimize images (mean = 72.33).* Some content images were not appropriately sized which could be reduced by 12%. *Minify HTML (mean = 74).* Some *HTML* codes were not compacted or minified which can saved many bytes of data and speed up downloading, parsing and execution. Avoid CSS @import (mean = 75.33). There are CSS external stylesheet that were included which uses @import. This external stylesheet can add additional delays during the loading of the webpage. *Avoid a character set in a meta tag (mean = 85).* Specifying a character set in a *meta* tag disables the *lookahead* downloader in IE8. The rest of the aspects got above 85 grade so they were categorized as very fast. Table 2 shows the summary of the *GTmetrix PageSpeed* result with the corresponding criterion-based mean.

Table 2. Summary of GTmetrix PageSpeed Result

***GTmetrix PageSpeed* Evaluation Result**					
	Grade (100%)			**Mean**	
Aspects	**(A)**	**(B)**	**(C)**		**Remarks**
Specify image dimension	14	0	0	4.67	
Leverage browsing caching	3	29	5	12.33	
Serve scaled images	0	30	7	12.33	Extremely Unoptimized
Enable *gzip* compression	47	77	2	42.00	

Defer parsing of *Javascript*	72	0	85	52.33	Very Unoptimized
Minify CSS	38	95	47	60.00	
Specify a Vary: Accept-Encoding header	70	75	60	68.33	Unoptimized
Optimize images	78	87	52	72.33	
Minify HTML	80	84	58	74.00	
Avoid CSS @import	85	85	56	75.33	Optimized
Avoid a character set in a meta tag	85	85	85	85.00	
Avoid bad requests	100	88	72	86.67	
Inline small CSS	80	88	100	89.33	
Inline small *Javascript*	84	91	100	91.67	
Specify a character set early	95	90	95	93.33	
Serve resources from a consistent URL	100	89	100	96.33	
Minify *Javascript*	99	99	92	96.67	
Specify a cache validator	100	98	94	97.33	
Remove query strings from static resources	100	98	100	99.33	Very Optimized
Avoid landing page redirects	100	100	100	100.00	
Enable keep-alive	100	100	100	100.00	
Minimize redirects	100	100	100	100.00	
Minimize request size	100	100	100	100.00	
Optimize the order of styles and scripts	100	100	100	100.00	
Put CSS in the document head	100	100	100	100.00	
Combine images using CSS sprites	100	100	100	100.00	
Prefer synchrounous resources	100	100	100	100.00	

(A) jasaan.gov.ph (B) - balingasag.net (C) pnpmisorppo.org

Furthermore, the evaluation of *GTmetrix* using *YSlow* shows almost similar result. The *extremely unoptimized* aspects includes *Add Expires header (mean = 0.00)*. Static components of the websites have no far-future expiration date. Expires headers let the browser know whether to serve a cache version of the page. This criteria is similar to the *Leverage browsing caching* in the *PageSpeed* test. *Use a Content Delivery Network (CDN) (mean = 0.00).* The websites did not use a CDN which supposedly can give an equally fast web experience across the globe. *Compress components with gzip (mean = 4.00)*. Many of the plain text components were not compressed using *gzip* during data transfer. This criterion is similar with the *Enable gzip compression* in the *PageSpeed* test.

Make fewer HTTP request (mean = 47.33) which is similar to the *Defer parsing of Javascript* and *Minify CSS* in the *PageSpeed* test found to be *very unoptimized*. An impression that there were multiple external *Javascript* scripts and multiple external CSS stylesheets that were not combined into one. There was only one *unoptimized* aspect found in this test, the *Use of cookie-free domains (mean = 65.00)*. This means

that there are website components which are not cookie-free. Web *cookies* cause unnecessary web traffic. The rest of the website aspects got a grade above 85 and they were categorized as *very optimized*. Table 3 below shows the summary of the *GTmetrix YSlow* result.

Table 3. Summary of GTmetrix YSlow Result

***GTmetrix YSlow* Evaluation Result**					
	Grade (100%)			**Mean**	
Aspects	**(A)**	**(B)**	**(C)**		**Remarks**
Add Expires headers	0	0	0	-	
Use a Content Delivery Network (CDN)	0	0	0	-	Extremely
Compress components with *gzip*	12	0	0	4.00	Unoptimized
Make fewer HTTP requests	78	8	56	47.33	Very Unoptimized
Use cookie-free domains	0	95	100	65.00	Unoptimized
Reduce DNS lookups	100	65	100	90.00	
Avoid HTTP 404 (Not Found) Error	100	90	90	93.33	
Minify *Javascript* and CSS	100	90	100	96.67	
Avoid empty src or href	100	100	100	100.00	
Avoid URL redirects	100	100	100	100.00	
Make AJAX cachable	100	100	100	100.00	
Put CSS at the top	100	100	100	100.00	
Remove duplicate *Javascript* and CSS	100	100	100	100.00	Very
Put *Javascript* at bottom	100	100	100	100.00	Optimized
Avoid AlphaImageLoader Filter	100	100	100	100.00	
Reduce the number of DOM elements	100	100	100	100.00	
Do not scale image in HTML	100	100	100	100.00	
Use GET for AJAX requests	100	100	100	100.00	
Avoid CSS expressions	100	100	100	100.00	
Reduce cookie size	100	100	100	100.00	
Make favicon small and cachable	100	100	100	100.00	
Configure entity tags (Etags)	100	100	100	100.00	
Make *Javascript* and CSS External	100	na	na	na	

(A)- jasaan.gov.ph (B) - balingasag.net (C)- pnpmisorppo.org

CONCLUSION AND RECOMMENDATIONS

The technical review and analysis of the websites deployed by BSIT students of MUST-Jasaan made a significant learning discoveries in the area of website speed optimization. The test results from *GTmetrix* highlighted both the strengths and weaknesses of the projects. This study was able to identify specific aspects of web page development that needs to be improved and the inputs on how to improve it. In the context of this study, the websites that undergone the review found to be average in its speed performance and brings a big space for

improvement. It is highly recommended that the websites need to specify the widths and heights for all images which allows faster rendering of web page images through the elimination of unnecessary reflows and repaints. Expires headers must be used in the web pages in order to let the web browsers know whether to serve a cache version of the page. The use of *Content Delivery Network (CDN)* matters a lot to deliver a faster web experience across the internetwork. Reduce the load times of pages by storing commonly used files from the website to the visitor's browser. The compression of resources using *gzip* which reduce the size of files sent from the server increases the speed to which the web files are transferred to the user's browser must be a priority. Parsing of the *Javascripts* must be deferred. The browser must parse the contents of all <script> tags in order to minimize the amount of *Javascript* needed to render the page. Multiple external CSS files should be combined and compacted into one to minimize *HTTP* requests. Specifying a Vary: Accept-Encoding header which instructs the proxy to store both a compressed and uncompressed version of the resource also help improve the load speed of the page. Using a cookie-free domains prevents unnecessary data traffic in the web.

The use of web diagnostic tools for web speed test like *GTmetrix* is very helpful in web page optimization. Such tool truly analyses the performance of each web page components and provides recommendations on how these components can be optimized for faster loading and access. The insights provided by the tool certainly helps web developers and web enthusiasts make efficient web pages thus minimizing data traffic in the internet. Academic institutions especially those that are integrating web development in their curriculum are encouraged to emphasize in their instruction the importance of web page optimization and to continually apply the global best practices in web development.

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