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Performance Analysis of the Resource Loading Time for Borneo Biodiversity Information System

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Abstract—The problem of speed of page load time in the Borneo Biodiversity information system which is decreasing has an impact on the level of user satisfaction. The amount of resources used and the amount of data stored causes the system to be slow. The paper analyzes the load time of web pages based on key indicators performance for page loading timings. The variable analysis of webpage for calculates value; loading time (Time to First Byte, First paint time, First contentful paint time, DOM interactive time, DOM loaded time content, Onload time), total page size, and the number of requests. The results of the analysis have given a grade to the web performance and evaluated the results by providing a solution to optimize the low parameter values.

Keywords— key-performance-indicators load-time, Borneo, performance, biodiversity-information-system.

I. INTRODUCTION

Web performance will affect the income and ranking of web pages. In addition, performance also affects the level of success on Web Performance Optimization (WPO). WPO is a knowledge of improving the performance of web pages. WPO looks at page components such as HTML content, presentation components, page elements, page assets and the like. In addition, the WPO involves and provides techniques, best practices, best rules, and methodologies for optimizing end-to-end web performance.

Quality is the characteristic totality of an entity that has the ability to meet stated and implied needs [1]. The requirements for website evaluation appear from the above definition, i.e.: a general evaluation of all the characteristics of the website, and how well the site meets specific needs.

The Borneo Biodiversity Information System (BBIS) is a special portal for the management of data and information on plant natural resources from the island of Borneo, Kalimantan-Indonesia. The BBIS was built using the LARAVEL framework, and is now in the process of testing the system online. The need for the importance of BBIS to be developed is a challenge for managers and developers in its creation. various methods and technology approaches are applied in an effort to optimize the system against the problem of biodiversity data complexity and the use of large resources.

Biological diversity (biodiversity) as meant all living things on earth, including all plant species, animals, and microbes. Species within biodiversity relate to each other and need each other to grow and bloom form a living system [2].

The greatest challenge in biodiversity management is to maintain a balance between sustainability (ecological) and sustainable benefits (economic). This challenge is not easy to deal with. This is because most of the biodiversity is a cross-border administrative resource and is managed by various parties/sectors. There is considerable pressure from utilization forest [3-4].

Regard this, it requires follow-up in the form of data handling and monitoring activities so that the sustainability of the biodiversity of the plant can be maintained for its sustainability, then developed a biodiversity information system of plants in the rainforest of Kalimantan-Borneo in an effort to integrate the data that has collected from various sources.

The Borneo Biodiversity Information System (BBIS) that has been built [5], [6], is an open source information system of Borneo island information management systems. The modules developed in BBIS be able to accommodate all data management and information on the biodiversity of plants in the rainforest of Kalimantan, from front desk process to back office (transaction & interaction enabler).

This paper discussion Key Performance Indicators (KPI) for Biodiversity Information System, analysing the load time of web pages based on key indicators performance for page loading timings. The variable analysis of webpage for calculates value; page load-timings (Time to First Byte, First paint time, First Contentful paint time, DOM interactive time, DOM loaded time content, On-load time), total page size, and the number of requests. The results of the analysis have given a grade to the web performance and evaluated the results by providing a solution to optimize the low parameter values.

II. RELATED WORK

A. Borneo Biodiversity Information System

The development of plant biodiversity information systems in the Borneo island rainforest has been discussed and developed by various approaches and methods, research that has been discussed about; development of plant database management system that discusses plant name taxonomy referring to International Code of Botanical Nomenclature (ICBN) [7], Ethnobotany, Exploring diversity medicinal plants of Dayak tribe Borneo [8]. Borneo biodiversity [9]: this paper about is Exploring endemic tree species and wood characteristics. The paper [5], development a BBIS, the system focuses on diversities of plants (tree,

wood, and medicinal plants) based on traditional knowledge from ethnic of Dayak. This work also intended as a support to the government initiatives to develop data management of plants in Borneo and as a part of efforts towards achieving the Aichi Biodiversity Targets 2020, and Agenda 2030 for SDGs [5].

B. Network Performance Testing

According to [10], performance tests used to test a part of a server/web application to increase web traffic, this type of trial without asking for a page image to focus the test on the code script.

Problems with server performance and network availability in the Kalimantan region, we have also analyzed and discussed them in previous studies, including; paper [11-18].

III. METHODOLOGY

A. Variable Analysis

This study consists of variables that refer to [19], i.e.: Page Load Timings (Time to First Byte – TTFB; First paint time; First Contentful Paint; DOM interactive time; DOM content loaded time (DOM loaded or DOM ready for short); Onload time;), Page-size and Request [19].

B. Variable Measurement and Testing Methods

This test uses the GTMETRIX [19], measuring tool developed by GT.net, a Canadian company, which aims to help customer hosting to see website performance, is one tool to check website speed.

Basic parameter used is the document size, http request, to obtain a predetermined Grade from the measuring instrument. After getting score from test result then calculated percentage with formula of percentage and interpretation according to recommendation of Yahoo Developer Network [20].

IV. RESULTS AND DISCUSSION

The purpose of this paper is to evaluate the performance of the Borneo Biodiversity Information System using the Key Performance Indicators (KPI) of a web page. Analyze Resource Loading Time based on key indicators performance indicators, for measuring page variables that calculate loading time, number of page sizes, and number of requests. The Borneo Biodiversity Information System website is online at the URL: http://borneodiversity.org/index.

To date, BBIS has stored 233 records of Medicinal plants, 1482 records of Tree species, 86 records of Wood species and characteristics, 80 records of Bamboo species.

A. Variable Measurement and Analysis Results

The BBIS web page measurement, by conducting a series of tests on several pages to determine the value of the variables studied. The measurement results presented in TABLE I.

The testing for the BBIS webpage focuses on five (5) main pages of each biodiversity data module, i.e. page modules: home, tree, wood, medicinal plant, and bamboo data. The measurement results on each BBIS web page (URL) based on TABLE I explain that for the results of the

PAGESPEED performance measurement generally get Grade F (20%). The YSLOW'S overall performance earned Grade D (69%).

TABLE I. THE MEASUREMENT RESULTS OF VARIABLES

BBIS Web page	Performance Score		Page Details		
	PageSpeed Grade (score)	YSlow Grade(score)	Loaded Time(s)	Total Page Size(Mb)	Requests
home	F(13%)	D(69)	2.9	8.66	54
Tree	F(9%)	D(69)	2.3	8.06	48
Wood	D(63%)	D(69)	2.3	2.25	49
Medicinal	F(9%)	D(69)	2.6	7.42	55
Bamboo	F(9%)	D(69)	2.3	5.57	47
Average	F(20%)	D(69)	2,48	6.39	50

For page-detail measurement section, the highest full loading time variable is on the home page (borneodiversity.org/index) with a load time of 2.9s, and the loading time of other pages is below 2.6s, so the average time of loading time is 2.48s.

The largest total page size in the home page (index) module, with a total page size of 8.66Mb, and the smallest in the data wood page module of 2.25Mb. So that the average total page size is 6.39MB. For the variable number of requests, the medicinal data plant of page module (borneodiversity.org/index/medicinal) has the most requests, which is 55 requests, and the smallest in the bamboo data of page module is 47 requests. So that the average number is 50 requests.

B. Results of Measuring the Key Indicators Performance for loading timings

Website load time is the time needed by a visitor to be able to see the overall site appearance. A website that has very fast load time provides comfort to its visitors. Measurement of loading time in main modules of the BBIS webpage with Key Indicator Performance is as shown in "Fig. 1".

"Fig.1", the chart displays the request-by-request loading behavior of the BBIS website. Every script, media file, and/or third-party resource page requests is displayed, there are 54 requests that are successfully displayed to users with an average loaded time of 2.88s (onload: 2.72s). The total page size of the resource file is 8.6MB with a download speed of 2.5KB/s. From the waterfall graph in "Fig. 1", explains that the bigger the page size of a resource file, the higher the loading time needed.

Explanation of the waterfall chart:

- Brown – Blocking, Blocking is the time the request spent waiting in the browser's queue to start the request.

- Teal – DNS Lookup, before a connection can be made to the server, the hostname needs to be resolved to an IP, DNS lookup time indicates how long it takes to resolve the domain name to an IP address.

- Green – Connecting, This is the time required to form a TCP connection between the server and host/client.

- Red – Sending, This is the time it takes the browser to send the request to the server. If it's a PUT or POST request, then this will also include the time spent uploading any data with that request.
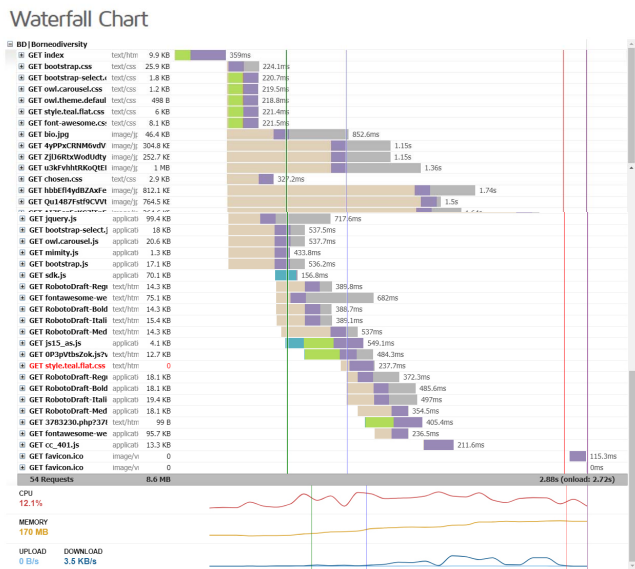

Fig. 1. The waterfall a request-by-request visualization of the page load

- Purple – Waiting, Generate a response.

- Gray – Receiving, This is the time it takes from the browser to download the response from the server.

- Green Line – First Paint, First paint is the moment at which any rendering begins on the web page. This could be showing the logo, loading an image – anything at all that the user could see appear on the page.

- Blue Line – DOM Loaded, This is when the Document Model Object (DOM) is deemed ready by the browser.

- Red Line – Onload, Onload means that the page and all of its constituent elements have finished downloading and processed by the web browser.

- Purple Line – Fully Loaded, Fully loaded means that the Onload event has already fired, and no network activity has occurred for 2 seconds.

1) Page Load Timings for Homepage

The homepage for the BBIS system access on the site URL: http://borneodiversity.org/index, the results of the Page load timing measurements, presented in TABLE II.

TABLE II.   THE PAGE LOAD TIMING MEASUREMENTS FOR HOMEPAGE

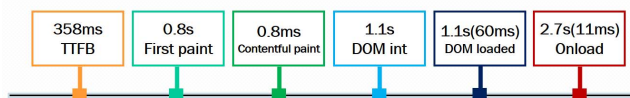| Characteristics of Page Load Timing Performance	Load Time(onload)
Time to First Byte (TTFB)	358ms
First paint time	0.8s
First Contentful Paint	0.8s
DOM interactive time	1.1s
DOM content loaded time	1.1s (60ms)
Onload time	2.7s (11ms)

For the marker view, shown in "Fig. 2".

Fig. 2. The marker view of behaviour page loading timing for home page

2) Page Load Timings for module page of Tree

The homepage for the BBIS system access on the site URL: http://borneodiversity.org/index/tree, the results of the Page load timing measurements, presented in TABLE III.

TABLE III.   THE PAGE LOAD TIMING MEASUREMENTS FOR TREE

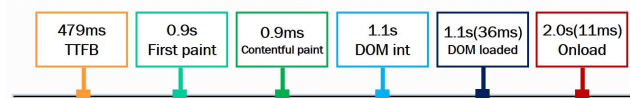| Characteristics of Page Load Timing Performance	Load Time(onload)
Time to First Byte (TTFB)	479ms
First paint time	0.9s
First Contentful Paint	0.9s
DOM interactive time	1.1s
DOM content loaded time	1.1s (36ms)
Onload time	2.0s (11ms)

For the marker view, shown in "Fig. 3".

Fig. 3. The marker view of behaviour page loading timing for tree page

3) Page Load Timings for module wood page

The homepage for the BBIS system access on the site URL: http://borneodiversity.org/index/wood, the results of the Page load timing measurements, presented in TABLE IV.

TABLE IV.   THE PAGE LOAD TIMING MEASUREMENTS FOR WOOD

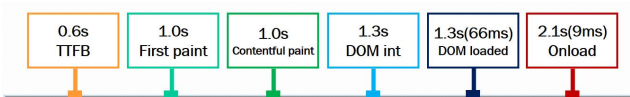| Characteristics of Page Load Timing Performance	Load Time(onload)
Time to First Byte (TTFB)	0.6s
First paint time	1.0s
First Contentful Paint	1.0s
DOM interactive time	1.3s
DOM content loaded time	1.3s (66ms)
Onload time	2.1s (9ms)

For the marker view, shown in "Fig. 4".

Fig. 4. The marker view of behaviour page loading timing for wood page

4) Page Load Timings for Medicinal plant page

The homepage for the BBIS system access on the site URL: http://borneodiversity.org/index/medicinal, the results of the Page load timing measurements, shown in TABLE V.

TABLE V.   THE PAGE LOAD TIMING MEASUREMENTS FOR MEDICINAL PLANT

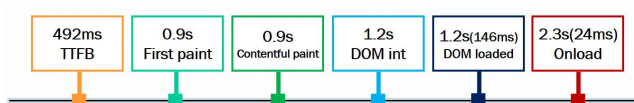| Characteristics of Page Load Timing Performance	Load Time(onload)
Time to First Byte (TTFB)	492ms
First paint time	0.9s
First Contentful Paint	0.9s
DOM interactive time	1.2s
DOM content loaded time	1.2s (146ms)
Onload time	2.3s (24ms)

For the marker view, shown in "Fig. 5".

Fig. 5.   The marker view of behaviour load-time medicinal plant page

5) Page Load *Timings* for bamboo page

The homepage for the BBIS system access on the site URL: http://borneodiversity.org/index/bamboo, the results of the Page load timing measurements, presented in TABLE VI.

TABLE VI.   THE PAGE LOAD TIMING MEASUREMENTS FOR BAMBOO

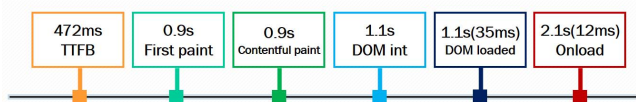| Characteristics of Page Load Timing Performance	Load Time(onload)
Time to First Byte (TTFB)	472ms
First paint time	0.9s
First Contentful Paint	0.9s
DOM interactive time	1.1s
DOM content loaded time	1.1s (35ms)
Onload time	2.1s (12ms)

For the marker view, shown in "Fig. 6".

Fig. 6.   The marker view of behaviour page loading timing for bamboo

C.   Analysis Results and Discussion

The measurement of resource loading time in Borneo Biodiversity Information System using key performance indicators with variable testing of loading time, number of page sizes, and number of requests.

Based on the analysis of measurement results it was concluded that the BBIS web page performance scoring general in the average Grade F (20%) of the Page-Speed from Google recommendations [20], and the average Grade D (69%) for YSLOW from Yahoo recommendations [20]. This shows that, there are several priority resources on BBIS systems that are less optimal, and resources are Serve scaled images, optimize images, and leverage browser caching), and for Minify JavaScript, add expires headers, use a CDN and use cookie-free domains, and Minify JAVASCRIPT and CSS, and make fewer HTTP requests [19-20].

Repair solutions are needed for to the optimization of resources according to [19] i.e. S*erve scaled images*: could save 3.3MiB (77% reduction). *ptimize images; Leverage browser caching; Minify JavaScript;* size by 58.4KiB (29% reduction). *Add Expires headers; ;Use a Content Delivery Network (CDN);Make fewer HTTP requests*: Use cookie-free *domains*: and *Minify JavaScript and CSS [19].*

The Response-time limits to keep the user's attention can wait for the load of the web page is 10s [21]. Whereas according to [22] the best load time a website page is less than 3 second, for an acceptable load time of less than 10s.

The testing for page loading time, the results of the measurement of the main page in each module (homepage, tree, wood, medicinal and bamboo) are generally still below the average page loading time of less than 3s or the average time of loading time is 2.48s. This explains that, the time load can be said "ACCEPTED" by referring to recommendations J Nielsen [21] for an acceptable time load of fewer than 10s. The average total page size is 6.39 Mb, with the average number is 50 requests.

V.   CONCLUSION

Borneo's Biodiversity information systems are one of the enterprise-scale systems that represent open-source plant-based taxonomy data, developed by the research team in a follow-up effort to manage the digital inventory of biodiversity data contained in the Rainforest of Borneo Island in terms of its monitoring can be preserved sustainability. The system has a large data content, with diverse types and characteristics of plants, of course, will affect system performance functionality in terms of data accessibility, Performance of Decision Tree [23], use of resources, level of efficiency and reliability issues [24-27].

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