Evaluation of Borneo's Biodiversity Information System

Novianti Puspitasari
dept. of informatics engineering
universitas mulawarman
Samarinda, Indonesia
miechan.novianti@gmail.com

Edy Budiman
dept. of informatics engineering
universitas mulawarman
Samarinda, Indonesia
edy.budiman@fkti.unmul.ac.id

***Abstract*— Biodiversity information is very important for scientific studies/research, education, and decision making, in the management of natural resources, biodiversity information is needed to maintain the sustainability of species utilization, exploration of biological potential and species monitoring along with ecology, policy making, and for the development of biotechnological innovations. The paper analyzes the performance of Borneo's Biodiversity Information System in terms of the resources of software development used (Key Performance Indicators web), measuring each resource (scripts and contents web), testing, and the results are evaluated to determine system performance and recommendations for optimization solutions.**

Keywords—biodiversity, performance, Borneo, resource, web

I. INTRODUCTION

Indonesia, predicated as one of the mega biodiversity countries [1], [2], both in terms of ecosystem diversity, species diversity and genetic diversity requires a large responsibility for the preservation and utilization of the community. The biggest challenge in managing biodiversity is to maintain a balance between the preservation of (ecological) functions and the sustainability of benefits (economical) [3]. This challenge is not easy to deal with. This is because most biodiversity is a resource across administrative boundaries and is managed by various parties/sectors. However, it seems that until now it has not been able to answer precisely the questions such as: how big is the diversity of our biological resources? What is the distribution of our biological resource potential? Where is the location? Do these types of biological resources still have sustainable capabilities? and so forth. At present, the most urgent is where are the critical areas of biodiversity that need to be addressed immediately? Because of every year, many species who enter the Red List due to increasingly rare and endangered are increasing.

Researchers from overseas as well as other Indonesians have done a lot of research on Indonesia's biodiversity potential [3]. However, most of the research results are still stored in the form of papers/books. There is the very little amount of data stored in digital form. With a large number of percentages of non-digital documents, data and information on biodiversity are difficult to access. This condition will cause information and knowledge cannot be disseminated properly, the consequences will threaten the sustainability of living natural resources.

Decreasing the quality and amount of biodiversity and its impact on physical and socio-economic conditions is an indication of the urgent need for integrated planning and management in Indonesia. In addition, better protection and monitoring, more extensive research and studies of biodiversity resources and resources, as well as more intensive community development initiatives and work to empower and improve are needed. One of the factors that led to this was the absence of an integrated information system between the relevant agencies at the central and regional levels. This information system is needed as a reference for the central and regional governments so that the formulation of policies and development programs for Natural Resources and the Environment is more comprehensive, synergistic (inter-sectoral), fast and appropriate.

Biodiversity information is very important for scientific studies/research, education, and decision making [4], [5], [6]. In the management of natural resources, biodiversity information is needed to maintain the sustainability of species utilization, exploration of biological potential and species monitoring along with ecology, policy making, and for the development of biotechnological innovations [7],[8],[9]. Given the importance of bodily information, it is necessary to develop a computer-based technology that can manage biodiversity data, information, and knowledge well and efficiently so that it can be used for exploration, analysis, synthesis, and interpretation of biodiversity wealth potential [10], [11].0

Borneo's Biodiversity Information System (BBIS) [12], as one of the Bioinformatics resources portal provides information, data management, and biodiversity knowledge that is expected to be able to provide optimal performance in its services, it requires fast data and information access. Given that there are so much data content and complexity, with very large software resources, it will cause web portal performance to slow down.

Many factors affect the performance of a system, one of which is the use of large resources in software development. In addition, the data factor that continues to grow will cause the system state to be stress, overload, finally making a high load time (page loading speed) when accessing data [13].

Evaluation of the performance of a system is needed in an effort to maintain the stability and reliability of the system. will ensure that the software operates optimally efficiently and is easy to use. Continuous performance evaluation is a part that must be considered by every developer or administrator so that the system continues to run in accordance with the benchmarks of performance and achievement of targets that have been set.

The paper analyzes the performance of Borneo's Biodiversity Information System in terms of the resources of software development used (Key Performance Indicators web), measuring each resource, testing, and the results are evaluated to determine system performance and recommendations for optimization solutions. In particular, the resource to be evaluated focuses on the indicators key performance for speed, which include; script/query

(JavaScript/CSS), and content (image/URL/size), compression performance. These resources affect the performance of a bioinformatics web portal.

II. Related Work

A. Borneo's Biodiversity Information System (BBIS)

Borneo's Biodiversity Information System (BBIS)[12] was developed using a Model View Controller (MVC) design pattern and eloquent Object Relationship Mapping (ORM) based on a LARAVEL framework and open source.

The discussion in this paper is a follow-up study from the author who previously discussed, i.e. Database: Taxonomy of plants Nomenclature for Borneo biodiversity information system [14], Ethnobotany database: Exploring diversity medicinal plants of Dayak tribe Borneo [15], Borneo biodiversity: Exploring endemic tree species and wood characteristics [16], Biodiversity information system: Tropical rainforest Borneo and traditional knowledge ethnic of Dayak [17], and Eloquent object-relational mapping models for biodiversity information system[18-20].

The studies related to the problem of network availability at the research location as one of the supporting factors in the implementation of bioinformatics system development, the author has also discussed this issue in several papers such as; Measuring quality of service for mobile internet services [21], Broadband quality of service experience measuring mobile networks from consumer perceived [22], User Perceptions of Mobile Internet Services Performance in Borneo [23], Performance rate for implementation of mobile learning in networks [24], Mobile Networks for Mobile Learning Tools [25-27].

Borneo's web portal Biodiversity Information System can be accessed online at site URL:http://borneodiversity.org/ [12], where the system provides plant information and data services packaged in tree data modules, wood data modules, medicinal plant data modules, the bamboo data module, and reference module. Until now the system has recorded data of about 1482 species of trees and endemic, wood data and characteristics of 86 species, as many as 233 species of plants have medicinal properties, and bamboo data as many as 80 species. these data are presented in the form of images with high priority resolution. then the web page interface is presented in “Fig. 1”.

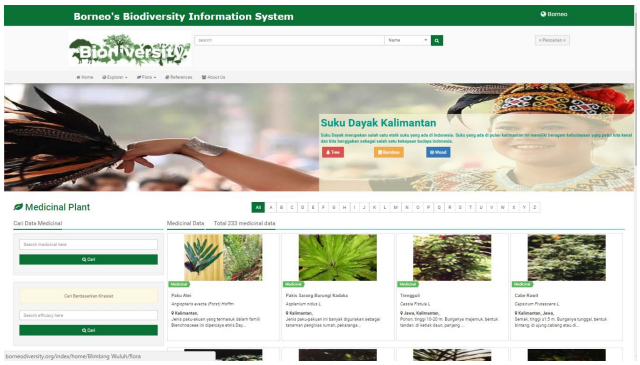

Fig. 1. Screenshot of the Borneo biodiversity information system webpage

III. Methodology

A web page consists of different resources such as HTML scripts, JavaScript, CSS, and various content such as images. Each of these factors makes a request to show what is seen on the web browser screen. Usually, the more requests sent, the slower the loading time of the website pages.

In this section, we discuss each part of this performance indicator and explain the method used to determine the performance of each resource contained in the Borneo biodiversity information system.

A. Scripts (JS/CSS)) Performance Variables

The scripts (JS/CSS) are the most important things for every modern website in order to function not only at the highest level but also in all parts. However, there must be poor performance. The issue arises because the web script page is first loaded before the actual web content (articles, text, image, etc.). The more script code on your web (especially those around the header), the longer it takes the browser to display content to visitors. This is because the browser must load all script until it is complete before displaying the actual content. the need recommends delaying retrieving script code until the main content is loaded.

TABLE I. The Script Resources Tested

Resource (Assets)	Script File	Size (kB)
JavaScript	jquery.js	99.6
	bootstrap.js	17.3
	bootstrap-select.js	18.3
	owl.carousel.js	20.9
	mimity.js	1.5
CSS	bootstrap.css	26.1
	style.teal.flat.css	6.3
	bootstrap-select.css	2.0
	owl.carousel.css	1.4
	font-awesome.css	8.3
	chosen.css	3.1
	owl.theme.default.css	0. 719

JS and CSS scripts force the web browser to delay loading HTML pages, JS and CSS scripts on this webpage that do slowdown are not necessary on web pages, as for the script code to be tested are presented in TABLE I.

B. Content (Image/Size) Performance Variables

One of the resource assets that are very performance-consuming that the browser needs to download is web content (articles, text, image, etc.), causing the site to become very slow. The problem of image size scale, file size, and image quality greatly affect the browser when loading to display the user's browser screen. The image is responsible for the weight of a web page. The resource assets of content that will be tested and analyzed are presented in TABLE II.

TABLE II. THE CONTENTS RESOURCES TESTED

URL	Resource (Assets)	Type
http://borneodiversity.org/index	Serving scaled images	Images
	Optimize images	Images
	Combine images using CSS sprites	Images
	Specify image dimensions	Images
	Avoid a character set in the meta tag	Content
	Remove query strings from static resources	Content
	Minify HTML	Content
	Specify a character set early	Content
	Serve resources from a consistent URL	Content
	Minimize request size	Content
	Minimize redirects	Content

C. *Evaluation and Analysis Method for BBIS Performance*

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.

The analytical method uses the Automated Usability Testing Tools approach that is used to test the performance of a website. Performance is based on several general parameters, specifically in this study analyzing the performance of script resources and BBIS web content.

Testing these parameters are measured by using GTMetrix [28] tools to assess the BBIS web portal. GTMetrix is an automated software testing tool for measuring website performance. GTMetrix was built and developed by Gossamer Threads. This tool uses Google Page Speed and Yahoo YSlow as an analysis engine. This tool is intended to determine the performance of a website based on parameters such as page speed grade, YSlow class. Test results will be displayed with recommendations to be made. Based on detailed information on the GTMetrix site, the results of the assessment are given in the form of grades with scores in the form of numbers. This value is qualitatively marked with letters A, B, C, D, E, and F, while the scores are indicated quantitatively by numbers.

Refers to [29] evaluates how well a page follows common performance best practices and computes a score from 0-100 that estimates its performance headroom. The score is categorized as being Good, Medium, or Low. The calculation assumes that a developer wants to keep the same appearance and functionality of the page.

- Good: The page applies most performance best practices and there is little headroom for further optimization. The page scores 80 or above.
- Medium: The page is missing some common performance optimizations and there is medium headroom for optimization. The page scores between 60 and 79.
- Low: The page is not optimized and there is fairly large headroom for optimization. The page scores between 0 and 59.

IV. RESULTS AND DISCUSSION

Website access speed is characterized by fast loading time duration and web server reliability has a significant influence in providing convenience for users when accessing website content. The stability of web access depends very much on the performance of the web server and the size of the web page. The scope of the issues discussed is the performance of scripts and content. In general, a summary of the results of measurements of BBIS web page performance is presented in the TABLE III.

TABLE III. SUMMARY OF THE RESULTS OF BBIS HOMEPAGE PERFORMANCE CONTENT TYPE BY CONTENT SIZE AND REQUEST

Content Type	Content Size		Requests	
	Size	*Percent (%)*	*Requests*	*Percent (%)*
Image	8.00 MB	92.9	23	45.1
Script	248.62 KB	2.8	8	15.7
Other	170.62 KB	1.9	5	9.8
HTML	160.23 KB	1.8	8	15.7
CSS	47.93 KB	0.5	7	13.7
Total	8.61 MB	100	51	100

The results of the BBIS web page performance measurement presented on the TABLE III, explain that The main reason why it's so important to optimize images is because 92.9% of most websites are graphics dependent and therefore there are a lot of image files. Leaving these images uncompressed and in the wrong format can drastically slow down web page BBIS load times.

A. *Performance Analysis of the scripts (JS/CSS)*

The script often triggers visual changes on the browser screen, it is directly through style manipulation, and sometimes the calculations will result in visual changes, such as searching or sorting a number of data. Long-running scripts or bad timing can be a common cause of performance problems and should try to minimize their impact as much as possible. Performance Analysis of the scripts (JS/CSS) homepage BBIS are presented in “Fig. 2”.

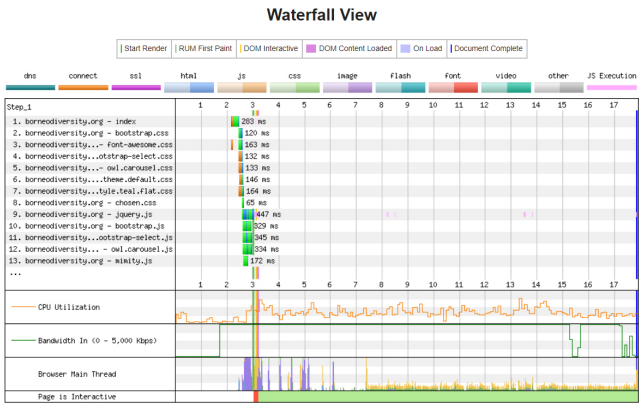

Fig. 2. Performance analysis of the scripts (JS/CSS) webpage BBIS

Based on "Fig. 2" can be explained in detail the results of the script performance measurement in TABLE IV. Where:

- Request Start is the time spent connecting to the server to make the request to the page. Technically speaking, this duration is a combination of the blocked time, DNS time, connect time and sending time of the request (rather than just connect time). During this time, the browser screen is still blank! Various causes could contribute to this, including a slow/problematic. Based on the results of the Request Start performance measurement, an average of 2,601s for JS, and 2,519s for CSS scripts.
- Time to First Byte (TTFB) is the total amount of time spent to receive the first byte of the response once it has been requested. It is the sum of "Redirect duration" + "Connection duration" + "Backend duration". Based on the results of script performance measurement, the Time to First Byte average was 137ms for JS, and 69ms for CSS scripts.

TABLE IV. THE SCRIPT PERFORMANCE MEASUREMENT RESULTS

Script File	Request Start(s)	Time to First Byte (ms)	Content Download (ms)	Bytes In (downloaded) (KB)	Bytes Out (uploaded) (KB)
jquery.js	2.579	64	383	99.6	0.9
bootstrap.js	2.595	131	198	17.3	0.9
bootstrap-select.js	2.596	153	192	18.3	0.9
owl.carousel.js	2.608	165	169	20.9	0.9
mimity.js	2.625	171	1	1.5	0.9
Average JS	**2.601**	**137**	**189**	**32**	**0.9**
bootstrap.css	2.457	62	58	26.1	0.9
style.teal.flat.css	2.548	66	9	6.3	0.9
bootstrap-select.css	2.524	64	1	2.0	0.9
owl.carousel.css	2.529	62	1	1.4	0.9
font-awesome.css	2.457	104	12	8.3	0.9
chosen.css	2.574	62	3	3.1	0.9
owl.theme.default.css	2.543	60	2	0.7	0.9
Average CSS	**2.519**	**69**	**12**	**7**	**0.9**

- Content Download or DOM content loaded time is the point at which the DOM is ready and there are no stylesheets blocking JavaScript execution, is the time spent executing JavaScript triggered by the DOM content loaded event. Based on the measurement results of Content Download performance, an average of 189ms for JS, and 12ms for CSS scripts.
- Bytes In/Out, This is the amount of data that the browser had to download or upload in order to load the page. It is also commonly referred to as the "Page Size". Based on the measurement results of Bytes In/Out performance, an average of 32 KB for JS, and 7 KB for CSS scripts. While for Byte Out, for JS and CSS both are on average 0.9 KB.

B. *Performance Analysis of the Content*

The images created in programs like Photoshop and Illustrator look amazing but often the file sizes are very large. This is because the images are made in a format which makes them easier to manipulate in different ways. With file sizes upwards of a couple of megabytes per image, if put these files on the website it would be very slow to load.

Images hold data other than just the pixels we see on the screen. This data can add unnecessary size to the image which leads to longer load times as the user waits for the image to download. The results of performance measurement for BBIS web portal content from the indicator key parameters are presented in the "Fig. 3".

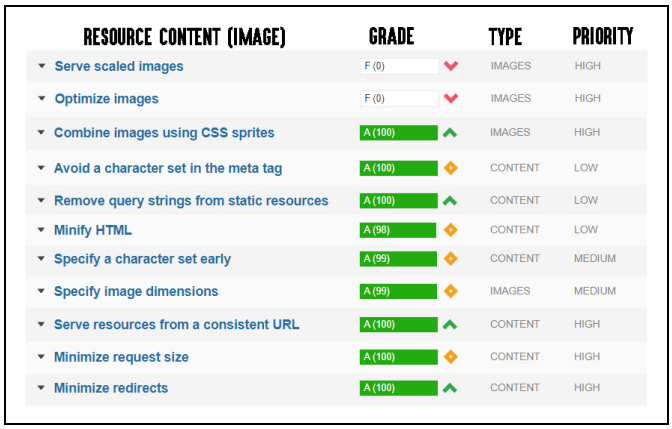

Fig. 3. Performance scores for resource content (image)

The "Fig. 3" explained that these arrows indicate performance relative to the BBIS sites that GTmetrix has analyzed [28], [29].

- The green arrow pointing up indicates that your result is better than average [28].
- The red arrow pointing down indicates that your result is worse than the average [29].
- The orange diamond icon indicates that your result is within +/- 5% of the average [28].

TABLE V. CONTENTS RESOURCES TESTED [28]

Resource (Assets)	Grade (Score)	Relative Score (%)	Category
Serving scaled images	F (0)	70	Low
Optimize images	F(0)	73	Low
Combine images using CSS sprites	A(100)	90	Good
Avoid a character set in the meta tag	A(100)	100	Good
Remove query strings from static resources	A(100)	88	Good
Minify HTML	A(98)	98	Good
Specify a character set early	A(99)	100	Good
Specify image dimensions	A(99)	98	Good
Serve resources from a consistent URL	A(100)	89	Good
Minimize request size	A(100)	96	Good
Minimize redirects	A(100)	90	Good

The "Fig. 3" can see which attributes of the BBIS site might require more attention. Specifically, can determine which recommendations/resources to handle. Based on "Fig. 3", the results show that there are two resources that score in the "low" category, i.e. the Serving scaled images and Optimize images get the value F (0), the average value expected / standard for this resource (Relative Score) for Serving scaled images are 70% and Optimize images 73%. For other the resources get a high score in the "Good" category.

C. Evaluation and Recommendations for Improvement

Many factors can reduce the speed of a web site's pages, including factors of resource use (JS/CSS) and the content of content in the website such as images, text (fonts), articles etc. The results of performance measurement of the script used on the BBIS website using the GTmetrix test tool show that the average load time (star request) is 2.601s (JS), and 2.519s (CSS), with Bytes In (downloaded) files averaging 32 KB for JS and 7 KB for CSS. The right explains that in the loading response time the website page is still in an ideal load time relative, which is about 3 seconds or less,. But this still needs to be the optimized by analyze the script file which sometimes passes the response time above 3s. The results of the tool analysis GT Metrix recommends reducing the size of resource files as presented in the TABLE VI.

TABLE VI. MINIFY SCRIPT RESOURCES TO REDUCE THEIR SIZE

Script File	Minify Script for the following Resources to Reduce their Size
jquery.js	Could save 43.7KiB (51% reduction) after compression
bootstrap.js	Could save 3.3KiB (24% reduction) after compression
bootstrap-select.js	Could save 4.4KiB (29% reduction) after compression
owl.carousel.js	Could save 5.8KiB (34% reduction) after compression
mimity.js	Could save 294B (25% reduction) after compression
Minify JavaScript	**Resources to reduce their size by 58.4KiB (29% reduction)**
bootstrap.css	Could save 1.3KiB (7% reduction) after compression
style.teal.flat.css	Could save 273B (6% reduction) after compression.
bootstrap-select.css	Could save 230B (14% reduction) after compression
owl.carousel.css	Could save 193B (18% reduction) after compression
font-awesome.css	Could save 429B (6% reduction) after compression
chosen.css	Could save 416B (17% reduction) after compression
owl.theme.default.css	Could save 63B (14% reduction) after compression
Minify CSS	**Resources to reduce their size by 2.9KiB (8% reduction).**

The results of performance measurement on the use of content on the BBIS website are in a low category, which shows that the resource serving scaled images and Optimize images problems have a score of 0 (Grade F). Tool analysis results GT Metrix recommends reducing image size and resizing images as presented in the TABLE VII.

TABLE VII. SERVING SCALE AND OPTIMIZE IMAGE

Resource (Assets)	Resized in HTML or CSS from Image Scale
Serving scaled images	Serving scaled images could save 3.3MiB (77% reduction)
Optimize images	Optimize the following images to reduce their size by 965.0KiB (12% reduction).

- Serving appropriately-sized images can save many bytes of data and improve the performance of the BBIS webpage.
- Reduce file sizes based on where images will be displayed, Resize image files themeselves instead of via CSS, and Save files in appropriate format depending on usage

V. CONCLUSION

The design of a website is now not only about aesthetic beauty, but there are many other important factors that need attention. In addition to the interface design and ease of navigation, the flexibility of a website design for a variety of devices is now crucial. However, it should be noted that the use of large resources and high-resolution images will always require more byte memory and take longer to display on web pages, this will certainly have an impact on website visitors. A biodiversity information system web (bioinformatics portal) with bad UX can lose visitors because it needs to wait too long to get what they are looking for. And what they will do next will of course immediately close the website.

Borneo Biodiversity Information System as a large data and resource content as an object of evaluation in this paper, the results of the analysis have provided the author with experience on the behavior of the resources contained in the BBIS website [30-32]. And back to being the main problem found in web content management in this case related to the size, scale, and resolution of the image. The image content has a 92.9% share on the BBIS site. Therefore, there are many image files. Leaving these images uncompressed and in the wrong format can drastically slow down the BBIS web page load time. Leaving these images uncompressed and in the wrong format can drastically slow down web page's load time.

However, image optimization is both art and science, requiring careful evaluation of various parameters and a fine balance between content, format, quality and dimensions in order to produce significant performance improvements.

ACKNOWLEDGMENT

Thanks to Directorate General of Higher Education and Ministry of Research & Technology, Ministry of Research, Technology and Higher Education of the Republic of Indonesia for finance the Beginner Lecturer Research Scheme (PDP). Thank you to the Mulawarman University academic community, specifically for the Coordinator of the Informatics Engineering Study Program and the Department of Information and Communication Technology at the FKTI UNMUL.

REFERENCES

[1] Brooks, T.M., Mittermeier, R.A., da Fonseca, G.A., Gerlach, J., Hoffmann, M., Lamoreux, J.F., Mittermeier, C.G., Pilgrim, J.D. and Rodrigues, A.S., "Global biodiversity conservation priorities," science, vol. 313(5783), 2006, pp.58-61.

[2] Mittermeier RA, Gil PR, Hoffman M, Pilgrim J, Brooks T, Mittermeier CG, Lamoreux J, da Fonseca GAB, Seligmann PA, Ford H. Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Conservation International, New York, 2005.

[3] V. Rintelen, K., Arida, E. and Häuser, C., "A review of biodiversity-related issues and challenges in megadiverse Indonesia and other Southeast Asian countries," Research Ideas and Outcomes, vol 3, 2017, p.e20860.

[4] Canhos DAL, Sousa-Baena MS, de Souza S, Maia LC, Stehmann JR, Canhos VP, et al. (2015) The Importance of Biodiversity E-infrastructures for Megadiverse Countries. PLoS Biol 13(7): e1002204. https://doi.org/10.1371/journal.pbio.1002204

[5] Martinez-Harms, M. J., Bryan, B. A., Balvanera, P., Law, E. A., Rhodes, J. R., Possingham, H. P., & Wilson, K. A. Making decisions for managing ecosystem services. Biological Conservation, vol. 184, 2015, pp. 229-238. https://doi.org/10.1016/j.biocon.2015.01.024.

[6] Barbosa, F.A.R., Scarano, F.R., Sabará, M.G. and Esteves, F.A., "Brazilian LTER: ecosystem and biodiversity information in support of decision-making," Environmental Monitoring and Assessment, vol. 90(1-3), 2004, pp.121-133. https://doi.org/10.1023/B:EMAS.0000003571.10570.02.

[7] Dudley, N., Baldock, D., Nasi, R. and Stolton, S., Measuring biodiversity and sustainable management in forests and agricultural landscapes. Philosophical Transactions of the Royal Society of London B: Biological Sciences, vol. 360(1454), 2005, pp.457-470.

[8] Convention on Biological Diversity: available at: https://www.cbd.int/gbo1/chap-02.shtml

[9] Perfecto, I. and Vandermeer, J., "Biodiversity conservation in tropical agroecosystems: a new conservation paradigm" Annals of the New York Academy of Sciences, vol. 1134(1), 2008, pp.173-200.

[10] Hardisty, A. and Roberts, D., "A decadal view of biodiversity informatics: challenges and priorities. BMC ecology", vol. 13(1),2013, p.16. https://dx.doi.org/10.1186%2F1472-6785-13-16.

[11] Canhos, V.P., de Souza, S., De Giovanni, R. and Canhos, D.A.L., Global Biodiversity Informatics: setting the scene for a "new world" of ecological forecasting. Biodiversity Informatics, vol. 1, 2004.

[12] BBIS: Borneo's Biodiversity Information System available at: http://borneodiversity.org/index.

[13] J. Manhas, "A Study of Factors Affecting Websites Page Loading Speed for Efficient Web Performance", published in International Journal of Computer Sciences and Engineering (IJCSE) 1, vol.1(3), Nov. 2013, pp. 32-35.

[14] E. Budiman and S. N. Alam, "Database: Taxonomy of plants Nomenclature for borneo biodiversity information system," *2017 Second International Conference on Informatics and Computing (ICIC)*, Jayapura, 2017, pp. 1-6.
doi: 10.1109/IAC.2017.8280642.

[15] Haeruddin., Johan, H., Hairah, U., and Budiman, E. Ethnobotany database: Exploring diversity medicinal plants of dayak tribe borneo. In International Conference on Electrical Engineering, Computer Science and Informatics (EECSI), Institute of Advanced Engineering and Science, 2017, pp. 120–125.
doi: 10.1109/EECSI.2017.8239094.

[16] U. Hairah, A. Tejawati, E. Budiman and F. Agus, "Borneo biodiversity: Exploring endemic tree species and wood characteristics," *2017 3rd International Conference on Science in Information Technology (ICSITech)*, Bandung, 2017, pp. 435-440. doi: 10.1109/ICSITech.2017.8257152.

[17] Dengen, N., Budiman, E., Widians, J.A., Wati, M., Hairah, U., and Ugiarto, M., Biodiversity information system: Tropical rainforest borneo and traditional knowledge ethnic of dayak. Journal of Telecommunication, Electronic and Computer Engineering, vol. 10. No. 1-9, 2018, pp. 59-64

[18] E. Budiman, M. Jamil, U. Hairah, H. Jati and Rosmasari, "Eloquent object relational mapping models for biodiversity information system," *2017 4th International Conference on Computer Applications and Information Processing Technology (CAIPT)*, Kuta Bali, 2017, pp. 1-5.
doi: 10.1109/CAIPT.2017.8320662.

[19] Haeruddin, H. Johan, U. Hairah and E. Budiman, "Ethnobotany database: Exploring diversity medicinal plants of Dayak tribe Borneo," *2017 4th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)*, Yogyakarta, 2017, pp. 1-6.
doi: 10.1109/EECSI.2017.8239094

[20] E. Budiman, Hairah. U, Haeruddin, A. Tejawati, S. Darmawan, and S. Wahyuni, "Biodiversity Information System of Medicinal Plants from Tropical Rainforest Borneo Based on Traditional Knowledge Ethnic of Dayak", Advanced Science Letters, Vol. 24 (11), Nov. 2018, pp. 8668-8673(6). American Scientific Publishers

[21] E. Budiman and O. Wicaksono, "Measuring quality of service for mobile internet services," *2016 2nd International Conference on Science in Information Technology (ICSITech)*, Balikpapan, 2016, pp. 300-305.
doi: 10.1109/ICSITech.2016.7852652.

[22] E. Budiman, D. Moeis and R. Soekarta, "Broadband quality of service experience measuring mobile networks from consumer perceived," *2017 3rd International Conference on Science in Information Technology (ICSITech)*, Bandung, 2017, pp. 423-428. doi: 10.1109/ICSITech.2017.8257150.

[23] E. Budiman and S. N. Alam, "User perceptions of mobile internet services performance in borneo," *2017 Second International Conference on Informatics and Computing (ICIC)*, Jayapura, 2017, pp. 1-6. doi: 10.1109/IAC.2017.8280643.

[24] E. Budiman, U. Haryaka, J. R. Watulingas and F. Alameka, "Performance rate for implementation of mobile learning in network," *2017 4th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)*, Yogyakarta, 2017, pp. 1-6. doi: 10.1109/EECSI.2017.8239187.

[25] Budiman, E., Hairah, U., and Saudek, A., Mobile Networks for Mobile Learning Tools, Journal of Telecommunication, Electronic and Computer Engineering, vol. 10 (1-4), 2018, pp. 47-52.

[26] Budiman, E., Haeruddin, Hairah, U., and Alameka, F., "Mobile learning: Visualizing contents media of data structures course in mobile networks", Journal of Telecommunication, Electronic and Computer Engineering, vol. 10 (1-9), 2018, pp. 81-86.

[27] M. Taruk, E. Budiman, Haviluddin and H. J. Setyadi, "Comparison of TCP variants in Long Term Evolution (LTE)," *2017 5th International Conference on Electrical, Electronics and Information Engineering (ICEEIE)*, Malang, 2017, pp. 131-134.
doi: 10.1109/ICEEIE.2017.8328776.

[28] https://gtmetrix.com

[29] PageSpeed Insights: google developers available at : https://developers.google.com/speed/docs/insights/about.

[30] E. Budiman, Haeruddin and A. Tejawati, "Efficiency and Reliability Performance's of the Bioinformatics Resource Portal," 2018 5th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI), Malang, 2018, pp. 493-498.

[31] E. Budiman, M. Wati, J. A. Widians, N. Puspitasari, M. B. Firdaus and F. Alameka, "ISO/IEC 9126 Quality Model for Evaluation of Student Academic Portal," 2018 5th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI), Malang, 2018, pp. 499-504.

[32] E. Budiman, N. Puspitasari, S. N. Alam, M. A. Akbar, Haeruddin, F. Alameka, "Performance Analysis of the Resource Loading Time for Borneo Biodiversity Information System," 2018 The Third International Conference on Informatics and Computing (ICIC), Palembang, pp. 1-6.