Comparison between client-side and server-side rendering in the web development

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Abstract. Mandatory servers for universal applications that is accessible to number of users may be a deterrent for the corporation and excessive for small applications even though it could bring the compatibility advantages. Knowing that demand of web application increases to provide convenience and ease of use to the users, client side rendering comes to create software more fast and efficient. It has been done by redirecting the request towards an HTML file then the server will give messages without any content or a loading screen until the device takes all JavaScript to allow the browser compiling everything before displaying the content. Therefore, the purpose of this paper is to analyse the comparison between client side and server side method in the respect of technical aspects in term of first content paint, speed index, time to interactive, first meaningful paint, first idle CPU and estimated input latency that present better performance with 2.1s, 2.0s, 2.2s, 2.1s, 2.2s and 20ms respectively on server side. It also provide better result based on Google Audit with 100% performance, 48% accessibility, 93% best practice and 89% of search engine optimization (SEO).

1. Introduction

In 1988, Internet was upgraded to provide fast process and various integrated features [1], with starting from desktop application era and continue until web based application and mobile application created. Actually, web based application is kind of application that can be accessed from browser with desktop or mobile devices anywhere and anytime [2] [3]. The fast growth of software engineering provide tremendous benefits to the users as well as to the corporation especially to reduce time waste and cost of development in the current production. Many kind of business makes these technology as the fundamental requirement to build the system to support business function and process running well and perform better compare to the previous one, which primary used date from 1999. The evolution is extremely rapid, which better called as revolution, has been provided fast experience under good and reliable Internet connection through logic mechanism called as backend and application user interface called as frontend. In short, the client-side rendering manages routing dynamically without updating the page each time the user requests a different route but in the other hand, the server-side rendering can display the fully loaded page on the first for any website, while that the client side rendering first shows the blank page [5]. One kind of business that implemented client side rendering is e-commerce to provide optimized user experience to boot and efficient plan to support the communication and interaction [6] [7]. Apparently, software is just the tools to help the organization execute their business plan from start until finish with specific constraint of business limitation of budget and resources with high expectation of return in the end. Speaking about efficiency of software, there are many aspects to determine whether they can be called good or proper software in the context. In the early 2000, many software use server side rendering method which is the process totally run in the server side while the client only get respond as the received page. From that moment, server side concept has been evolved
with every process of rendering is not only running in server anymore but client will run as well the process, which called client side rendering. It proceed the process within the application layer while the algorithm run in server [8] to give less time to execute the application in order to satisfied the user.

2. Software architecture
In the process of developing software, the proper plan is not only analyse the problem and design the software but also select the correct architecture in the context of objective and the research scope. In this paper, the comparison focus on the application layer (service) as one of four layers of layered pattern in the software architecture besides presentation (UI), business logic (domain) and data access (persistence), which has function to compose capability to present the content interface visually and graphically in order to create the interaction between user and application through providing the middleware and the control. Commonly, the application layer has been run in the diagnostic mode or the user mode that can be customized accordingly. It is important to choose the right type of architectural patterns to optimize the utilization and to create reusable solution in order to anticipate the common problem occurred during implementation or in the given context. Besides the layered pattern, there are client-server, master-slave, pipe-filter, broker, peer-to-peer, event-bus, model-view-controller, blackboard and interpreter pattern [22]. In short, layered pattern can be utilized to organize programs that consist of several group of subtask, each of them is at specific level of abstraction that present the particular services for the upper layer. Practically, server side rendering is a software development method in web based application which handle requests from user in server, then server do some logic and algorithms as business needs. After requests were handled, server send response to user as the result from operation with almost of the rendering process called as multipage application because when user send request, it operated in server not in user device [8].

![Figure 1. Server side flow.](image)

There are many programming language that can run server side concept with one of them is PHP, which was the programming language developed at 1994 by Rasmus Lerdorf. PHP stand for personal home page, then in 1997, its meaning change to Hypertext Pre-processor [11]. Many developers utilized this type of script language due to its open source nature, platform independent, database connection oriented, module separated architecture, online documentation support, test cases driven, stability and compatibility for small organization and large organization within context of use [12]. Meanwhile, client side rendering is one kind of software development on web based application which handled every page in user’s browser. At beginning request, website only get a bundle of messages, which the browser will extract them to provide the waiting and loading process for user. For getting the respected data, most client side rendering using API (application programming interface) as the common tool provided by third party through command of ‘GET’ or ‘POST’ the data to provide the ability for the applications to transfer the data. It also presents highly flexible in term of integration that are not disruptive and widely available. Besides this mechanism, there are also webhooks or HTTP call backs, ISC (Integration Service Component) and orchestration as the other alternatives for the synchronization type of integration service management platform. Actually, almost client side rendering was called as single page application because this method do not need to load when changing user’s request pages with the creation of this application, developers prefer Java script language as the logic on the frontend [9].
Figure 2. Client side flow.

At first, user interact with the related application will create request. If the application are not use third party plugin, the algorithm will process it within client device automatically otherwise, API will handle the transferability from the server. With this concept, it will create the application process in term of time and resource decreased but faster through splitting the algorithm process between server and client device and also server’s response as data known as JSON. Commonly, the response was compressed in the bundle with small size packets, so the download process will faster due to its size. The last process in the extraction lead to the decompression of the downloaded bundle, which is run in client device that depends on the capability of the user device. There are many programming language that can execute the client side concept. Similarly, Java script is the programming language that spread widely in the developer eyes in the variety and diversity of web creation. Therefore, with AJAX, Java script obtained the success to build many dynamic and real-time performance, which Amazon, Gmail and Facebook implemented this type of mechanism [14].

3. Methodology
This study use iterative incremental development methodology for the web application due to advantages offered such as gradual model improvement in feature addition, pattern identification within context and a cyclical testing phase that align with various type of project scope such as agile development, extreme programming and rational unified process. It is one of solution offered in the response of the waterfall methodology of software development life cycle as traditional concept that is not really flexible in the current implementation though it is easy to execute [15] [16]. This type of development is a discipline to develop systems based on the work production with several parts of the system that are developed at various times or levels and are integrated according to the completion phases. On the other hand, the other team plans to review parts of the system to improve it based on the user comments given that is discussed among the team in order to provide better insight of the modification in delivering the successive shipments. For this purpose, this research develops a web application that is called ‘Show Up’ with the objective of being a social media platform for influencers that provides a marketplace for marketing purposes that involves the supportive roles, endorsements and placement of products of people or organizations that have a level of expert knowledge or social influence in their respective fields. On the other hand, in Server side rendering have been used PHP, HTML and CSS [17] while the client side rendering have been used Java script, HTML and CSS because Java script can implement OOP [18]. For the website testing, it used Google Audit, which can look the score of performance, accessibility, best practice, search engine optimization and progressive web app.

4. Result and discussion
In the layered pattern (n-tier), the code is organized according to the framework designed by the developers so that the data enters the upper layer first then works in each layer systematically until it reaches the bottom layers which is usually a database for the application. Along the way, each layer has certain kind of tasks, such as verifying data consistency or reformatting values to maintain consistency. One example of popular structure in the layered pattern is the Model-View-Controller (MVC), which have the model layer to contain the business logic and information about the types of data in the database [17]. There is also the visualization layer, which is often CSS, JavaScript and HTML with embedded dynamic code and in the middle, it has a controller, which has several rules and methods to change the data that moves between views and models. The benefit of layered architecture is the disconnection of pattern where each layer can emphasize only on its function for bringing easy maintenance and testing
while different type of roles for the purpose of updating layers separately. The suitable layered architecture will have unconnected layer that will not be influenced by some changes in other layers to allow easier reorganization. This may also consist of the supplementary open layers like service layer, which commonly utilized to access shared services only in the business layer but can also be omitted for faster performance. Cutting tasks and specifying the other related layers is the primary challenge for the architects especially if the requirements match the pattern well, the layers will be easily disconnected and assigned to different programmers. For the result of comparison, this study provides some information to show the performance between client side and server side web application.

![Figure 3. Result from server side.](image1)

![Figure 4. Result from client side.](image2)

In general, a website is developed to provide responsive process based on user request, which commonly the developer prepare certain type of technique of design such as fluid grid layouts (relative-based grid), flexible images and media as well as media queries and screen resolution [4]. It is applied on the website structure to enable the viewed content presented smoothly on multiple type of the webpage dimension. Interestingly, server side have 100 percent of performance shown at image 1 while client side have question mark show at image 2 that might happen due to the device capability. At the accessibility score, client side show 51% score while server side have 48% while both of them have same score in the best practices. In term of search engine optimization (SEO), the server side show higher score compare to the client side, which provides tasks such as tracking backlinks, target audience, stability, keyword research, ranking monitoring and website analysis so that the developers get information about their competitors’ strategies and develop a plan on how to achieve the best rankings in the search compilation with minimal investment. To avoid errors in the design process of this application, the most important thing is to follow the specific requirements and design standards specified in the needs analysis. The system will be tested through various scenarios based on personality or fictional character to see the consequences and circumstances in each process [11] [12] [13]. Freedom of information in terms of availability and accessibility must take into account the background context, objectives and benefits to facilitate the understanding of the community and encourage citizen support [19]. Basically, the challenge of implementing certain procedure to have responsive web is related to the efforts for developing the commitment and the consistency within the team member.
Table 1. Server side and client side comparison.

| Point                     | Server Side | Client Side |
|---------------------------|-------------|-------------|
| First Content Paint       | 2.1 s       | 3.1 s       |
| Speed Index               | 2.0 s       | 3.2 s       |
| Time to Interactive       | 2.2 s       | 4.9 s       |
| First Meaningful Paint    | 2.1 s       | 3.1 s       |
| First Idle CPU            | 2.2 s       | 4.9 s       |
| Estimated Input Latency   | 20 ms       | 20 ms       |

In this test, the study implemented simple login page with the test case of wrong password input. Functionally, first paint is trigger when any render process has been identified within the browser, which could be something as simple or not very informative as changing the font size of letters while first meaningful paint related to the primary content to be appeared on the browser. As it can be seen in the table 1, server side present more responsive compare to the client side with 2.1 seconds. Meanwhile, speed index metric is an average of the amount of time taken for the visible parts of page to load in the browser window while time to interactive related to the time taken before visual element appears. Besides that, there are various type of measurement used as the standard in the industry such as TTFB (time to first byte), document load, page complete, number of resources and page size. Based on the table 1, it shown that speed index and first meaningful paint from server side are quicker compare to the client side with 2 seconds and 2.2 seconds respectively. On the other hand, first CPU idle related to the moment of the users have the control over the page with once again server side have better result compare to the client side with 2.2 seconds. Lastly, the estimated latency involves the probability of users have the total delay before a transfer of data have begun, which in this case have similar score.

5. Conclusion
In this research we know that client side rendering and server side rendering have plus minus each other. In server side rendering was proven that Search Engine Optimization was better than Client Side Rendering because SEO read content from server’s response as page not bundle. But in accessibility point, client side rendering was better than server side rendering because it does not loading when change the page, not like server side rendering which will give more time to load the page from server.

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