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Research Article

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Optimization Techniques: Increasing Web Performance

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Abstract The modern age of the digital world requires not only the solution to a critical problem but the given solution needs to be optimized and should reflect the efficiency of user-experience and business statistics. The websites are a great way for businesses to interact with customers. Even most of the digital businesses are only controlled through web-based systems. The optimal techniques need to be used for the optimization of websites to reduce loading time and enhance the user experience. The business globally is so competitive that the customer as a user has multiple options to select in a very short period. Search Engine Optimization needs to be considered while developing the websites and posting content on these systems. There are key metrics available to study the results generated from the optimization of web-based systems. These are helpful to understand the business metrics in association with customer responses.

Keywords web optimization, techniques, user experience, efficient rendering, response time

Introduction

In the current modern era, the world has reached a point where executing a plan with the help of technology is no longer a major problem. The concern therefore lies in making the systems more optimized. The world is in a race to make stuff easy to use and achieve the tasks for users in the fastest possible manner. This applies to a broad range of technological applications but the focus here would be to discuss the optimization of websites by applying useful techniques. The research explores the accumulation of different methods to improve web efficiencies with handling caching, asynchronous loading of pages and components, code optimization, assets compression, content optimization, and various server-side optimizations. The real-world scenarios would assist in achieving the effectiveness of these techniques while maintaining the industry standards.

The objective to achieve here is to reduce page loading time, faster execution of tasks, improved response time from server-side requests, and upgrade the overall experience of the user. The final results would be concerned about the essence of prioritizing website performance optimization in order to compete well globally and help the industry take a further step.

Search Engine Optimization is now the term to consider by almost every business with a website. For optimum results, factors like page speed, metadata description, back links, improved user experience, website URL, keywords, and accessibility controls need to keep in mind. The overall interest of the user with a targeted niche should be considered by the SEO experts while uploading content as well as the need to incorporate their suggestions to developers. So, SEO attracts the interest of researchers and companies themselves when it comes to the optimization of a website [5] [7]. On-page SEO specifically helps both the search engine and users by optimizing web pages and the integrated content within these. The optimization of this decides the ranking of the page on search engines like Google and helps to attract more organic users to business websites if they are built with on-page optimization. [2]

After reviewing the website optimization, it clearly reflects the importance of user experience and efficient web pages. So, there needs to a metrics to measure the efficiency of the results returned in response to user requests.

Companies are also reluctant to use these metrics for further improvements. These weblogs have been helpful for a diverse range of businesses to overcome weaknesses in their websites. Although, the lack of industry standards and the difficulty in handling big data are still associated these are still useful measures to get study results after applying the performance optimization techniques [3].

Literature Review

The user experience has become the main concern in the world of digital evolution and Web Performance Optimization is the target of the industry to penetrate into the solutions. According to Tuominen [10], the quality of response time can be verified by optimization of an organization's website. The load times and the size of web resources are the major contributing factors. The businesses nowadays are prioritizing the optimized results in order to seek a competitive edge in the online market.

The different areas to consider [1] while optimizing the web performance for user are, optimization of pipeline processing, client and server side optimization, runtime optimization, components optimization and overall optimized requesting handling. Other than that, there are other technical factors like Search Engine Optimization which falls under the content-based optimization but play a vital role in the broader perspective when it comes to optimized results against the user's request.

Impact Factors

The optimization of the web-based platform is directly related to various factors as better to worse optimization decides the statistics of these factors.

Revenue

The income from a website can be generated from multiple ways including, products selling, service fee, adsense and more. The traffic on a website is directly linked with its revenue. The optimized websites can attract more potential customers or visitors to it as compared to a normal one. The business growth is related to the number of potential users of a website.

User Traffic

The unique visitors of a website potentially decide its ranking. The hierarchy distribution of most effective visitors has the organic visitors on top level. The figure demonstrates how different sort of traffic affects the authenticity of a website to the search engine. The more organic traffic would bring success to rank the website for a search engine. The hierarchy demonstrates the complete picture of traffic type from in terms of search engine rakings.

Figure 1: Hierarchy of Search Engine Ranking in Order

Customer Turnover

It is the churn rate which means that the customer separate the ways from the company [4]. The customer turnover can be managed by attracting more potential customers through targeted campaigns and suitable content. The improvement in user experience can also attract more customers.

User Experience

The interaction of user to a website is the last contributing factor and the most significant one. All other efforts would be useless if the website is not user friendly. The website can impact user experience if it's not optimized enough to handle large number of users at the same time. The loading time and performance issues within a website can impact the customer in a negative manner. But targeting the right audience at the right time can get benefits for the website.

Current Industry Situation

The current version of web is 2.0 as the concept was given by O'Reilly and MediaLive in a conference and it was based on the fact that most business were able to avoid the collapse having the facility of using web based systems [9]. It was therefore decided to take the user experience next level by diving into more depth of its implementation. The user now got the facility to participate while using the websites. Moreover, the personal websites got converted to blogging where one can post and actively receive the feedback from the readers. The major change was the addition of Search Engine Optimization where more personalized results can now be generated based on the search.

The earlier adoption of web 2.0 from most companies lead to the fact that most of these websites were not optimized and wasn't concerned about better user experience. The primary reason was the ignorance of user satisfaction either partially or completely and just considering faster execution factors. Therefore, most of the websites nowadays are slow in response with increase loading time specifically on low end devices like mobile phones and tablets. In recent times, the basic contributing factors for less optimized response are large size files, coding efficiencies, and server-side limitations which recommend the need of effective strategies.

Key Optimization Techniques

The objective is this to apply the suitable techniques for the optimization of a website. There are multiple contributing factors to this as,

Code Optimization

The performance of the system is directly affected by the efficiency of the code and a less optimized code can lead the system to collapse and would result in the excess consumption of time in loading.

The identification of redundant code cells and avoiding these can help but on a bigger perspective, the algorithms need to be optimized with the effective choice of data structure to make the overall system optimized.

Optimized Database Queries

The improper database design and inefficient database queries on top of that can lead to disastrous results with slow responses to front-end requests when database is handling the requests.

However, this can be solved with correct structure of database queries and thus reducing the number of queries by avoiding extra inefficient ways to respond a user.

Server-side Rendering

The rendering of content cannot be done on client-side and it specially affects the users of mobile phone and the slow internet can even lead to more inefficient results. This is because the client-side devices mostly don't have high processing power like server-side does [8].

Therefore, the server-side handling of resources is the proper way to render. The server-side can itself generate the required HTML page and return it, thereby reducing the efforts on user device.

Cache Handling

The common issue that occurs in the web optimization or makes hindrance is cache and it's the crucial part while making a system optimized. The problem to address here is that when repeated requests given to the system for same resources increases the load time for the user and affects the user experience.

The possible solution for this is to sort copies of repeated requests resources. So, it needs to avoid the server side request to frequently respond to each request. By sorting the frequent requests, load time can therefore be reduced. The figure 2 demonstrates the cache tree with its types.

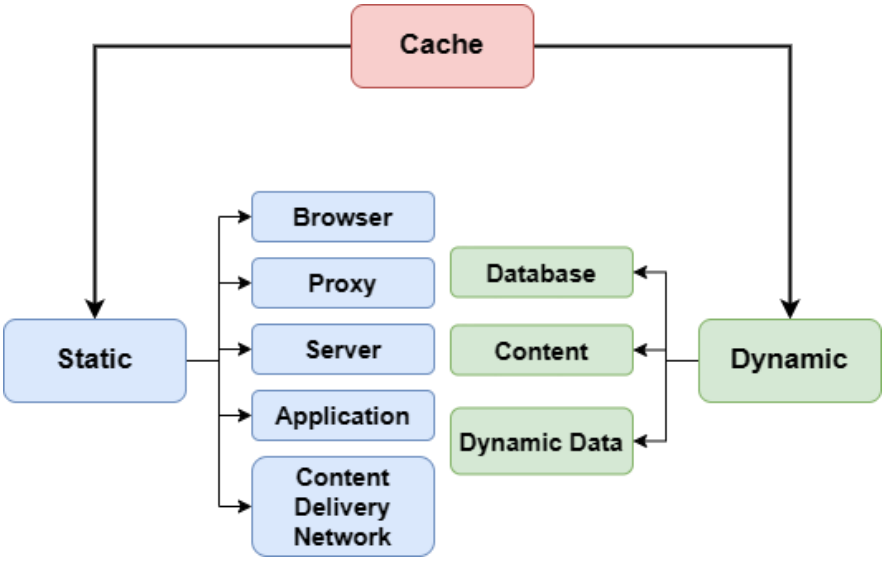

Figure 2: Cache with its types

Asynchronous Loading

The multiple content loading is a need of almost every website and resources need to be loaded quickly before the page is presented to the user. These can therefore cannot be loaded synchronously and make them wait in a queue would be problematic.

The presented solution for this is that, the resources of the website need to be loaded simultaneously and independently from one another. So, the web page can be shown to user more quickly.

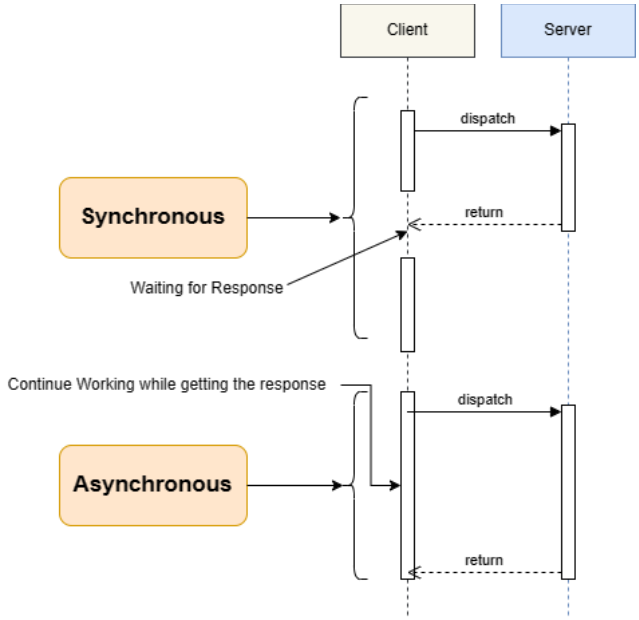

Figure 3: Synchronous and Asynchronous Tasks Handling

Assets Compression

The large files like HD images and videos can lead to slow loading time and can consume more resources of the user device including internet. This specifically has a direct impact on users with slow internet. Not only that but small files also effect badly when they are not handled properly with better controls.

The real time resource optimization and pre-fetching of repetitive used assets are the two possible solutions to address this problem. The real-time optimization of resources can be done from server-side upon immediate request of the user. Further, the assets can be cached to user device if it's more likely to being used frequently by the user [6].

Apart from these, there are other techniques as well like optimizing the content accordingly in an efficient manner without consuming too many resources. Also, load balancing can help in a situation of high traffic loads.

Use Cases

The use cases for the industry from the mentioned solutions can be:

- The websites can implement given caching technique to reduce load times and improve user experience like a website can cache content to ensure fast loading of content even during high traffic hours.
- The asynchronous loading of resources for the user can take the optimization to next step as it would not be possible to load these resources in a synchronous way.
- Website like social media and e-commerce can only be efficient if they are using the best possible algorithms and data structures and can succeed only with effective choice.
- The websites with large files like visual content based systems can manage the assets in an efficient manner to increase the user experience.
- The business platforms with complex structure of user profiles like Linkedin can use effective database queries to improve the speed of loading the content for their users.
- The large business can deal the user requests on server-side to reduce the extra load on their system while managing traffic load and keeping their revenue.

Future Developments

With the rise of AI, there are now numerous tools available for the Search Engine Optimization and other techniques to improve websites performance. The AI based algorithms like Support Vector Machine and K-Nearest Neighbor are used to assist in Search Engine Optimization [12]. However, these have only limited functionality till date and are predicted to boost the optimization industry in a serious manner. It's not feasible to exactly predict the future but the current statistics support that the optimization strategies would become easy to implement in future and will be helpful for the competitive individuals and companies in the digital market.

Findings with Benefits

The proposed solutions against the mentioned problems are going to help business to increase their platform efficiency. This applies to a range of business categories with the considerations of effective use cases. By applying techniques like, assets compression, code optimzation, cache handling, optimized databases, effective server side rendering and content optimization, the websites would be able to attract users. This comes from the user satisfaction within the platform and making them land from search engine results to these optimized websites.

Conclusion

As a cessation, the optimization of web-based systems is consuming the efforts of the industry in the modern era. The user experience directly affects the final revenue of the business and an optimized system can result significantly useful for the business to sustain them.

The solutions are presented against the problems being faced. Although, these listed solutions are only a few and need to consider other basic optimization techniques but this gives a comprehensive picture to the reader. The

impact factors like user traffic, revenue, and customer turnover and user experience are considered while presenting these solutions and use cases are the focal points for the industrial associations.

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