Roles of SEO in Increasing Page Speed and Reducing Energy Consumption

Simple Sharma
Department of Computer Science and Engineering,
FET, MRIIRS, Faridabad, Haryana, India

Supriya P. Panda
Department of Computer Science and Engineering,
FET, MRIIRS, Faridabad, Haryana, India

Abstract- The speed of a website is crucial. The process known as "Search Engine Optimization (SEO)" is used to boost a website's or piece of content's Google ranking. Google has provided a suite of tools for developers and webmasters throughout time to increase the speed at which webpages load. Google Lighthouse is one of these tools. Page speed has an impact on SEO. The fact that page speed directly affects rankings has become more widely known since Google's Algorithm Speed Update. Page speed can be significantly improved by optimizing one's code including deleting spaces, commas, and other unneeded characters. Additionally, eliminate formatting, unneeded code, and code comments. Google advises using UglifyJS and CSSNano. However, speed can also indirectly impact on rankings by raising the "bounce rate" and lowering "dwell time". Both society and the environment will benefit from this concept. From an environmental perspective, a successful technical SEO strategy aims to improve websitespeed by reducing the loading time and asset size, which consequently reduces energy consumption.

Keywords – On-page SEO, Off-page SEO , Page Speed, Private Blog Networks, Google ranks, HTML Meta Tags

I. INTRODUCTION

Search Engine Optimization (SEO) means optimizing a piece of online content so that on searching, Google like search engines show it near the top of the page. Therefore, SEO boosts a website's chances of showing up on the top page of search results [1]. Because SEO involves "organic" ranking, which implies one doesn't have to pay to be there, it differs significantly from paid advertising. In reality, Google is the origin of 75% of those searches [2]. The ultimate goal is to aid in search understanding so as to optimize content to rank higher on Google and attract more viewers to one's postings. An SEO must possess a variety of qualities in order to be effective, but one of the most crucial is a constant desire to develop. The website ranking increases when certain keywords are used, according to the assessed metrics of keywords, users, sessions, referrals, and Facebook likes, etc. [3]. Google Search Console, the Neil Patel SEO Analyzer, Google Keyword Planner, SEMrush, Longtail PRO, Screaming Frog, DeepCrawl, Woorank, Ahrefs, Open Site Explorer, etc. are a few of the frequently used SEO tools. The three Cs—Content, Code, and Credibility—are the fundamentals of SEO [4].

1.1   Two Common "SEO" Methods

"Black Hat SEO and White Hat SEO" are the two most often used SEO techniques. Black Hat SEO is used to describe unethical strategies and tactics employed to rank highly on search engine result pages for respective websites. The guidelines for search engines do not approve these strategies. The second technique, referred to as "White Hat SEO", refers to actions complying with search engine standards.

1.2   Meta Tags

The important Meta tags in SEO are:

1.   Title-Tag: Google shows 55-64 characters (better to keep it under 60 characters)
2.   Meta-Description-Tag: 160 characters
3.   Robots-Meta-Tag: It has four main values (follow, index, nofollow, noindex)

Google does not, however, factor keyword meta tags into its web search results. Because the meta tags are where people might dump frequently irrelevant phrases, Google ignores them. As a result, regular visitors would never see those keywords. Meta tags for keywords were frequently misused. Consequently, Google started to ignore the keywords meta tag.

1.3   *Extensible Markup Language (XML)*

A list of one's website's URLs is Extensible Markup Language (XML). It was developed to improve the search engines' usability. A solid XML sitemap gives the search engines information on the number of accessible pages on a specific website, how frequently updates are done, and the most recent modifications made. The search engines can effectively index the webpage with the help of this information.

1.4   *Core Elements of SEO: On-Page SEO and Off-Page SEO*

"On-page SEO" and "Off-page SEO" are both equally crucial strategies when it comes to overall SEO. On-page SEO is the process of optimizing individual web pages to raise a website's position in search results and earn organic visitors. It all boils down to including keywords in one's pages and content, publishing high-quality content frequently, ensuing that metatags and titles are crafted skillfully and contain adequate keywords, among other things. The top five on-page SEO elements are given in Table 1.

Off-page SEO refers to a form of optimization done outside of a website, such as creating backlinks. For this part of the equation,one need to develop connections and provide content that others want to share.
Although labor-intensive, it is essential for SEO performance. The methods used for On-Page vs. Off-Page SEO effort are displayed in Table-1.

Table-1: Techniques of "On-Page" Vs. "Off-Page SEO" work

On-Page Factors	Off-Page Techniques
• "On-Page SEO" Factor-1: Keyword Research	• Blog Post • Article Post • Forum Posting
• "On-Page SEO" Factor-2:URL Optimization	• "Yahoo Answer "
• "On-Page SEO" Factor-3: Meta Tags	• "Blog Comment "
• "On-Page SEO" Factor-4: Header Tags	• Submitting to directories • Submission of Press Release • Submitting to deep-link directories • Listing in local directories

The rest of the paper is organized as follows. Background terms are explained in section II. Comparison of Desktop vs Mobile is explained in section III. Battery consumption of mobile browsers is presented in section IV. Concluding remarks are given in section V.

II. BACKGROUND TERMS

Over the years, Google has offered a variety of tools to track performance and disclose. Some of the developers are quite skilled at using these technologies, but others have trouble keeping up with the abundance of tools and data. Some of the terms are explained below.

2.1 Core Web Vitals –

A successful web user's experience depends on a variety of quality signals, and Google has launched a programme called Web Vitals to provide standardised recommendations for these signals.Owners of websites shouldn't need to be performance specialists to grasp the calibre of the customer experience they are providing.

The most important indicators are the Core Web Vitals, and the Web Vitals project aims to clear up the clutter and let sites concentrate on these. The subset of Web Vitals known as Core Web Vitals pertain to all web pages, should be measured by all site owners, and will be surfaced in all Google tools. Each of the Core Web Vitals represents a unique aspect of the user experience, is field-measurable, and captures the practical application of a key user-centric result. The metrics that make up the Core Web Vitals will evolve over time. The user experience has three main components, loading, interactivity, and visual stability, which are the focus of the current 2020 strategy. The three metrics that constitute the Core Web Vitals are as Largest-Contentful-Paint (LCP), First-Input-Delay (FID), and Cumulative-Layout- Shift (CLS).

2.2   Page Speed –

Google prioritizes page speed and usability through the development of Core Web Vitals. Google may penalize one's website or make it harder to outrank rivals if it takes longer for the site or if some elements to load. Once more, this data will be provided by the Google Search Console, saving the user the trouble of looking for a tool to determine the page speed. "Page speed" has always been a crucial part of SEO work, and as more companies move their operations online, optimization becomes more important than ever [7].

Page speed is the duration from the browser's request for a page until the browser has finished processing and rendering the content. The rate at which a user can access content on a website is known as page speed. The pages that load quicker are more effective and provide a better on-page user experience, so it is crucial. When ranking websites, Google takes page speed into account as well. Table 2 lists several elements that have an impact on or relate to page speed. Many factors that affect or relate to page speed as outlined in Table-2.

Table-2: Factors Affecting Page Speed

Factors Affecting "Page Speed"
"Page-Size and Browser"
"Images, Video, and Heavy Files"
"Excess Code and Javascript"
"Load Time"
"Time-to-First-Byte" (TTFB)
"Round-Trip-Time" (RTT)
"Last-Contentful-Paint" (LCP)

Page speed is also important to users' experience. Page speed also has an impact on user's experience. Time taken to load a page is related to average time spent on the page and bounce rates. Lesser average time and higher bounce rate will result in slow loading page. Longer load times have been seen to have a negative impact on conversions. Users' impressions are influenced by page speed, and if the website loads slowly, one has already lost them. People's opinions of a website, the brand, and its products can be negatively impacted by a drop in page performance of as low as 500 milliseconds [8]. The speed of the page could jeopardise one's objectives and ultimately reduce money.

2.2.1   Bounce Rate

Bounce rate is the percentage of website visitors that depart without clicking a link, completing a form, or making a transaction. For all 17-industries, bounce rates are lower on desktop than on mobile as shown in Fig.1.
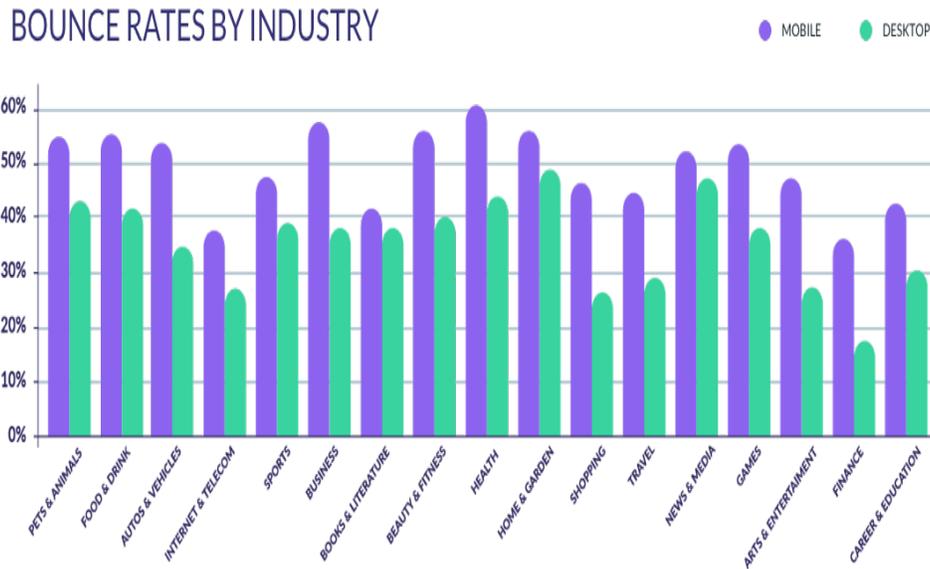

Fig. 1:Bounce Rates lower on Desktop vs Mobile, Source: Preficient

Except for Books & Literature, which stands out as an exception and is best explained by mobile reading devices, every industry had a larger average time on site for desktop than mobile. According to the study, pages with longer load times experience higher bounce rates *as shown in Fig.2*[10].
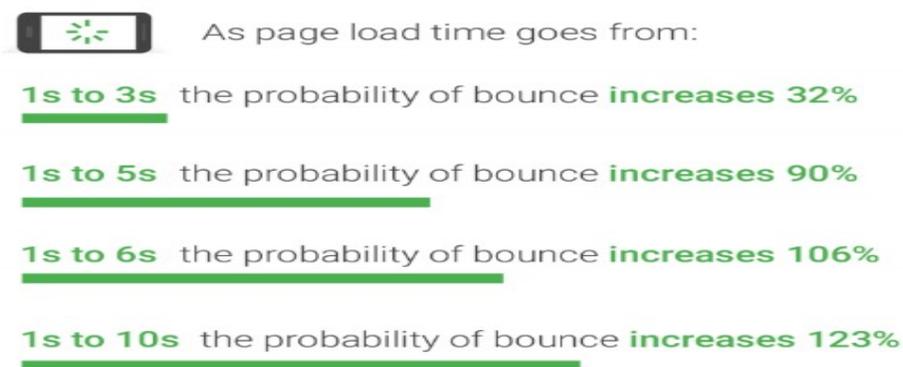

Fig. 2: Load time and Bounce rate, Source: Google/SOASTA Research, 2017

As can be shown, pages that take more than five seconds to load will lose 90% of visitors. For every additional second, the probability that a user will leave the page before it loads rises exponentially.

2.2.2   Metrics to Measure Page Speed

To gauge page speed, various metrics can be used. The following are a few of the four more typical examples:

 1) Time-to-First Byte (TTFB),
 2) Fully-Loaded-Page (FLP),
 3) First-Meaningful-Paint/First-Contextual-Paint (FMP/FCP)
 4) Cumulative-Layout-Shift (CLS).

- **"Time-to-First-Byte (TTFB)":** This metric measures the amount of time it takes for a page to start loading. TTFB is active when a white screen occasionally occurs shortly before a web page fully loaded.

- **"Fully-Loaded-Page":** This evaluation looks at the duration for the entire intended page to load. The most accurate approach to gauge page speed is in this manner.

- **"First-Meaningful-Paint/First-Contextual-Paint":** This refers to the length of time required to load enough resources on a webpage to allow for actual reading of the content. This measure is important because it gives users a better understanding of how visitors use and interact with the website.

- **"Cumulative-Layout-Shift (CLS)"** is also a new metric launched in May 2020 and measures the stability of the layout as it is being loaded.

The choice of hosting provider frequently has a significant impact on whether it has a good TTFB. As shown in Fig.3, the investigation revealed that the average TTFB speed was 1.28 seconds on desktop and 2.59 seconds on mobile. The ideal time according to Google is less than 1.3 seconds. For desktop computers, this is being done on average, but mobile devices still need to catch up.
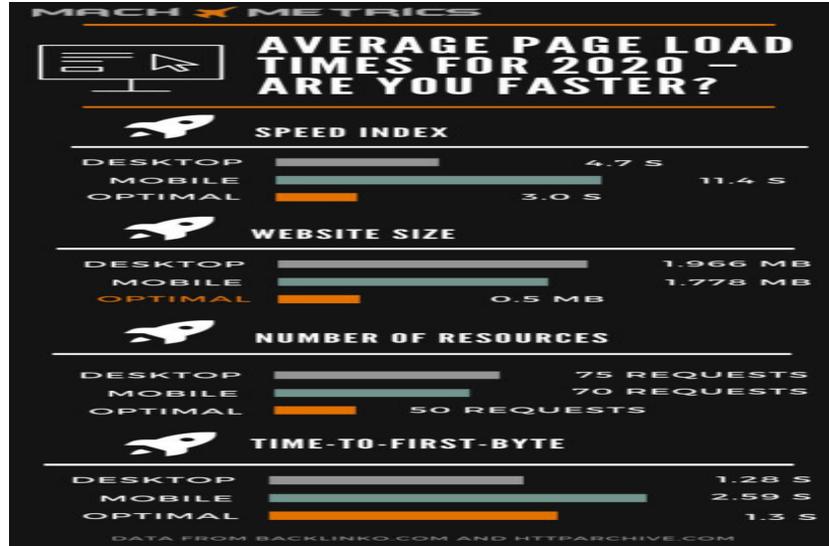

Fig. 3: Average Page Load DEsktop vs Mobile, Source: Mach Metrics

2.2.3   Factors for Good Page Speed

What is a good page speed for SEO?
Three seconds or less is the ideal site loading time. The graph in Fig.4 also includes industry comparisons to examine how one's site compares to the competition and suggestions on how to enhance mobile page speed SEO.

What is a good image size for SEO?
The max-image-preview: big setting or the use of Accelerated Mobile Pages (AMP) are required for huge images, as stated by Google in its Advanced SEO page. Large images must also be at least 1200 pixels wide.

How to Achieve 100% Google Page Speed?
- Identify any areas of weakness.
- Image compression.
- Minify or reduce the size of JavaScript, CSS, and HTML code.
- Get rid of render-blocking components.
- Quicken your mobile connection.
- Minimize or prevent page redirection.
- Speed up server responses.
- Use a content delivery network, please.

2.2.4   Page Rank

One of the methods used by Google to estimate the relevance or importance of a web page is page rank. Google started using page speed as a ranking factor for mobile search results in July 2018. Since Google's Algorithm Speed Update, the fact that page speed is a direct ranking factor has become prevalent. Speed, however, can also have an indirect impact on rankings by raising the bounce rate and lowering dwell time. "Users want to get answers to their inquiries quickly, and evidence shows that users truly care about how quickly their pages load," according to a corporate announcement [11]. The major Google Ranking factors are:

- Content Quality and Structure
- Quality and Relevant Backlinks
- Page Speed
- Image alt-text
- Mobile Friendliness
- User Experience
- Content Freshness
- Domain Age, URL, and Authority
- Page-Element-Distributions (What proportion of the content on the website is made up of things like graphics, HTML, JavaScript, and CSS?)

III. DESKTOP VS. MOBILE

In 2022, mobile internet usage passed desktop as the majority with 81% of website visits coming from mobile devices. Projections for the next few years expect the mobile market share to increase as mobile devices become more powerful and more prevalent. Mobile is still the Top Priority [Fig.4].
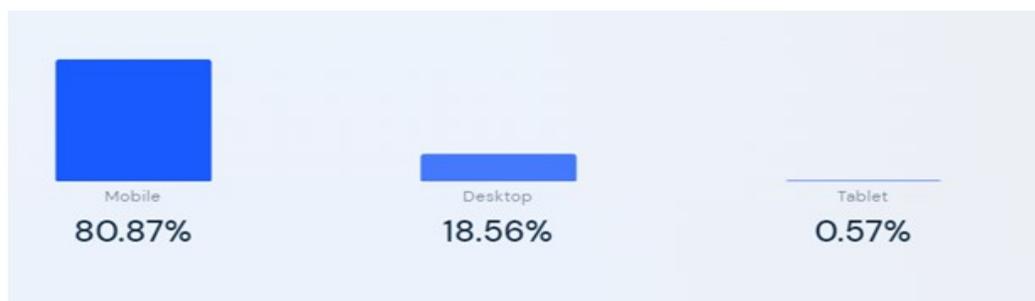

Fig. 4: Desktop vs Mobile Internet Usage, Source: https://www.similarweb.com/platforms/india

The statistic from Backlink unfortunately presents a dismal picture of mobile internet usage. They discovered that the typical online page loads 87% more slowly on mobile devices than on desktop. Additionally, according to a study that analysed 5-million desktop and mobile pages, a desktop browser takes 38% less time to fully load a webpage as shown in Fig.5.[13].
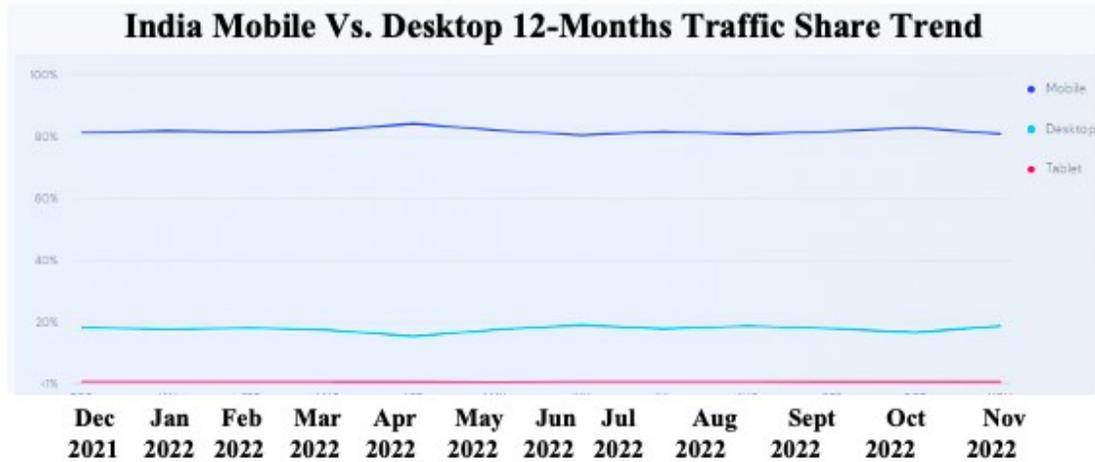

Fig. 5: Average time to fully load a webpage on Desktop vs Mobile, Source: https://www.similarweb.com/platforms/india/

IV. BATTERY CONSUMPTION OF MOBILE BROWSERS

The operation of mobile and desktop browsers varies. All portable electronics, including smartphones, tablets, and other gadgets, face a serious problem with battery life. Unfortunately, the battery life of these mobile devices is rather short; it often only lasts for one day or less of use. Recent years have seen a rise in the popularity and volume of mobile web browsing. In contrast to their desktop equivalents, the ecosystem of mobile browsers has grown from a handful of browsers (Chrome, Firefox, and Safari) to a plethora of browsers, each with unique characteristics (battery friendly, privacy preserving, lightweight, etc.) [14]. Our strategy is obviously battery-centric, but it also considers other metrics like CPU, bandwidth consumption, mobile website load and performance that have a direct impact on battery usage. The worst-case loading situation on mobile devices should always be taken into account before any other performance indicator when improving mobile website load and performance. They also have less reliable connections and slower processors. Due to these reasons, it's critical to assess your site's page load times from a worst-case mobile viewpoint in order to identify areas with genuine room for improvement.

Different from desktop browsers, mobile browsers parse and load pages differently. Simply put, desktop browsers are better at loading pages with a large number of tiny requests, whereas mobile browsers are better at loading pages with a smaller number of well-organized queries. Round Trip Requests refers to the quantity of elements that must be fetched from the server before a page may be loaded (RTRs). Minimizing RTRs is crucial to optimising and enhancing mobile page speed. Awareness is the first step in minimising RTRs. Many pages contain more over 100, one should aim for less than 50 RTRs per page.

V. CONCLUSION AND FUTURE SCOPE

The success of an online business is determined by page speed because Google has elevated it to a crucial ranking element. In order to keep one's business at the top, one must take website performance optimization action. Any online business is badly impacted by mediocre website performance. Users may become impatient with a slow-loading website and search for alternatives. Consequently, rivals' triumph. Lack of patience is currently the most common trait in online user behaviour, as "53% of mobile site visits are abandoned if pages take longer than 3 seconds to load." This paper discusses the significance of website loading times as well importance of website loading time, tools, tips-and -tricks, and technical implementations one can use for a faster website, increased traffic,

and higher search engine rankings. Page Speed is concerned with how quickly a certain page is downloaded from a website's hosting servers and shown on the requesting web browser. It utilises less energy as a result, which is advantageous for both the environment and society.

Page load speed further can be improved by Optimising images, Enable Gzip compression, Enable browser caching, Minify HTML, Minimize CSS and reduce Java Script, Remove Unused JavaScript, Implement a CDN (if applicable), Reduce HTTP requests, Reduce server response times. These suggestions if actioned in a right way will have immediate effect while others may take more time.

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