Search Engine Optimization: A Review about Concepts, Techniques, and Algorithms

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Abstract—**The availability of several websites requires substantial techniques to grasp the user's attention to their website. Search Engine is vital in providing the user with relevant site pages. Popular search engines, such as Google, use web crawlers and ranking algorithms, such as PageRank Algorithm, to rank the site pages based on content quality metrics and their online existence over the Internet and the WWW. Search Engine Optimization is a technique to optimize a webpage's appearance on the first page of Search Engine Results. Whenever a user searches for a relevant query on the search engine, they enter a specific keyword or phrase instead of writing a complete website address or URL, then accordingly, the search engine manipulates or processes that specific keyword and searches for the relevant site pages and displays a comprehensive list of the relevant site pages at the top of the SERPs. This review paper focuses on understanding the concepts, techniques, and algorithms used for search engine optimization of websites and web pages to improve the website's ranking by incorporating SEO best practices on search engines such as Google and Bing.**

Keywords— Search Engine, Online Presence, Web Page, PageRank, SEO, URL, WWW

INTRODUCTION

The amalgamation of technology and traditional marketing has led to the rise of emerging digital marketing trends. In a technical perspective, digital marketing is the use of information technologies to promote brand awareness via conducting marketing campaigns for products or services, primarily on the Internet and other digital mediums i.e., display advertisements.

Search Engine Optimization is the process of improving the traffic on webpages by increasing the online visibility of your websites in the search engine results pages. The overall SEO process helps search engines produce the highest ranking factor to a specific website to reach it on the top of SERPs regarding the search query, and the searched keyword must be associated with the user query [2][3][4]. If a website gets ranked at the top of search engine results, then there is a higher possibility that users would be visiting that website. In this case, websites uses resource-oriented and powerful optimization techniques.

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However, most search engines use multidimensional algorithms and SEO practices to produce quality results on a specific time duration, as it is a complicated task to crawl across thousands to billions of web pages. To help search engines retrieve the results faster, web developers always tend to use multiple SEO-driven tactics [4]. The sole perspective of this paper is to understand the concepts, techniques, and existing algorithms related to Search Engine Optimization (SEO), critically evaluate the existing procedures and literature available on the Internet and provide a comprehensive review of the concepts, techniques, strategies, and algorithms used in the search engine marketplace [5].

RELATED WORK

Elbarougy, R and *et al.,* proposed a technique of text summarization in the Arabic language. The concept was to reduce the original textual data and retrieve the essential data from the original text. The authors debated about the complicated morphological structure of the Arabic language, such as the extraction of nouns that can be used as a summarization feature to process the verbal and natural language processing abilities to solve the problem. The authors initiated a graph-based system that incorporates the Google's PageRank Algorithm for accurate and precise analysis of the problem and provides solutions to the problem [1]. Sharma, Dushyant and *et al.,* provided a detailed review about SEO techniques and best practices. The authors explained the brief concept, technologies, types, techniques, algorithms, and classification and working of Search Engines. Furthermore, the author debated the future essence and importance of the search engine optimization by peer-reviewing the current and contemporary research work and their implementation aspects applied in the respective industry domains [2]. Nadeem Asad, and *et al.,* proposed a new technique named 'All in Title Query Result Analysis' to rank your website without the involvement of off-page SEO techniques. The working procedure of this technique is to identify and examine the targeted low-competition keywords without using an off-page related SEO technique. The authors collected data from approximately 36 months using Google Analytics. The results were predicted and measured based on the approximation of the new technique developed for digital marketing professionals to successfully execute their digital marketing campaigns with optimal performance and cost metrics [3].

Ziakis, Christos, and *et al.,* discussed about the essential facts and figures to improve the Google Search Results that will eventually increase the targeted audiences website's ranking on the Search Engine Result Pages (SERPs). The authors reviewed

the past, present, and prevailing researches and extracted the facts and figures that affects the website ranking in the SERPs and provide prevalent ways to rank it on the first page of the search engines. Furthermore, the authors collected the academic research papers and performed SEO implementation tactics to predict the better analysis and examination of the SEO best practices [4]. Hingoro, Murtaza Ahmed, and Nawaz, Haque presented a comparison of various search engine ranking algorithms. The authors reviewed the existing research work and conducted a comprehensive analysis of the Google PageRank Algorithm, Bing Algorithm, and Youtube Search Algorithms and their analysis on the Search Engine Result Pages (SERPs). Furthermore, the authors highlighted the comparative analysis results and explained the merits and demerits of the search engine ranking algorithms [5]. Sharmas, Simple, and Verma, Seema optimized the website based on the best practices of SEO to improve the efficiency and performance metrics of the website on the SERPs. The authors implemented On-Page SEO and Off-Page techniques to perform website optimization.

Furthermore, the authors used the Google Analytics tool to analyze and predict the organic traffic and incoming traffic from referral sources with the help of the targeted keywords. The overall analysis and examination is highlighted in the tabular format and sessions [6] Gudivada, V.N and *et al.,* provided a review about understanding the concepts, techniques and tools of search engine optimization (SEO), the authors have enlisted and explained the computing practices of SEO and Search Engines, the analysis and examining of practices that are being performed during the SEO process, the techniques of SEO i.e. white hat practices, black hat practices, grey hat practices along with On-Page and Off-Page Strategies are presented with a affirmative manner to conclude the importance of Search Engine Optimization and its relevant practices [7]. Bhandri, and Bansal presented a review about the concepts of search engines along with their amalgamation of marketing tactics to promote brand awareness and maintain sustainability to engage their target audiences and boost their online presence across internet communities, forums, social media sites, and communal groups. Furthermore, the authors have collected and evaluated the statistical analysis and measurement of the big data from multiple digital campaigns, these measurements provides a clear and consistent manner of hypothetical testing that focuses on the entire workflow of search engine optimization as a tool for digital marketing [8]. Nately, N conducted a study and analysis of digital marketing techniques using SEO strategies and evaluated the major outcomes that presented a comprehensive flow of digital marketing campaigns, the author discussed about the functional procedure of SEO, and also experimental analyzed and evaluated different types of digital marketing strategies that constitutes of Search Engine Marketing (SEM), Social Media Marketing (SMM), Content Marketing, Pay Per Click (PPC), Affiliate Marketing, and Email Marketing, the challenges and risk factors were also determined [9]. The authors Kumar, L and Kumar, N' measured the emerging ratio of internet

marketing via SEO techniques to maintain the effectiveness of their website in conjunction with search engines i.e., Google, Bing, Microsoft Edge, Mozilla Firefox etc. The techniques and terminologies related to SEO Strategies comprise of On-Page SEO, and Off-Page SEO, the classification of both is critically evaluated, and recommendations have been mentioned in the paper [10].

Punil Patel discussed about the parameters of WWW and Data Mining Aspects in the context of web crawling and its associated factors possessed in the form of web mining categories with the implementation of PageRank algorithm to induce link building and content development with the significant focus on Inbound Links and Outbound Links that helps website to rank on the top most of search engine results page [11]. Mr. Joshi Anuj and et al discussed about the Google Page Rank Algorithm and It's Updates. The PageRank Algorithm identifies and describes the popularity of webpages, websites or blogs depending on the link analysis in which ranking of web pages is determined by the algorithm that significantly impacts the overall of ranking factors with backlinks and relevancy of content and data along with keyword occurrence in the overall website [12]. Sharma Pratibha and et al conducted a study on various modern search engines and their methods that play a vital role in the comparative evaluation of the response rate, performance feedbacks, and other factors of Google, Yahoo, and Bing search engines [13]. Sakhsi and Saurab Charaya performed a study about search engine optimization factors that affect content or blogging. The techniques of SEO are highlighted by the authors, the novel approach of describing the overall workflow of Panda and Penguin Algorithms along with experimental results is reported by the authors [14]. In the research paper "A Comparative Study of Various Page Ranking Algorithms" Modi, Y. Hiral and et al presented a novel technique of web mining and clustering of data and information for search engine optimization aspects. The Page Rank Algorithm and the factors including domain authority and page authority impacting the ranking of particular websites or blogs on search engines [15]. Tsuei, Hung-Jia and et al., produced an intuitive approach to solve the problems of page ranking, website optimization, and computational modeling of data using SEO-driven hybrid models. In this approach, they introduced MCDM models for testing and evaluation of the decision making approach of DEMATEL, VIKOR, and INRM data-mining models and network techniques for the promotion and ranking of the website or site page on the topmost position on search engines [16].

ELEMENTS OF SEARCH ENGINE OPTIMIZATION (SEO)

The solid foundation of SEO is primarily dependent of its elements and tactics. The Figure 1.1 depicts the comparison of two elements of conducting Search Engine Optimization [2].

A. *On-Page SEO*

In terms of SEO, the practices or activities that are performed on your site or page are known as On-Page SEO activities to improve rankings on the SERPs. The sole purpose of on-page

activities is to improve the quality standards of the website's pages to rank higher and get more traffic on search engines. The following are the factors that are used for implementing on-page SEO optimization and its relevant features [1].

✓ Meta Title
✓ Meta Descriptions
✓ Meta Tags
✓ URL Structure
✓ Keyword Placement
✓ Image Optimization

B. *Off-Page SEO*

Off-Page SEO refers to those activities or practices that are performed on external pages, social sites, forums to improve the website rankings and promote your brand on the SERPs [8]. In terms of SEO, Off-Page SEO is classified as a practice of link building comprising of the following activities that include:

✓ Blog Submission
✓ Guest Posting
✓ Social Bookmarking
✓ Press Release
✓ Article Submission
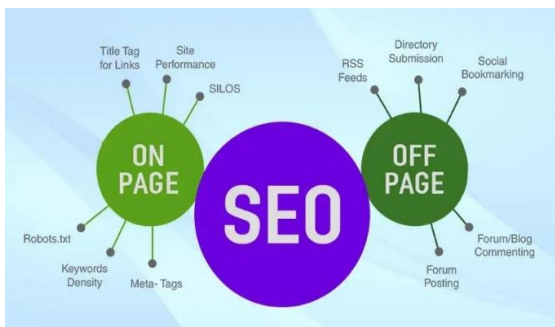✓ Building Links

Figure

Figure.1.1: Comparison of SEO Elements

The illustration above presents a skeptical representation of the comparison between on-page SEO and off-page SEO, the purpose of this evaluation study is to analyze and identify the differences in on-page SEO and off-page SEO. The sub-dimensions of on-page SEO constitutes of Content Marketing, Keyword & Image Optimization along with the technical SEO performance metrics that helps users to optimize their site audit, key parameters and site performance indicators. Significantly, the purpose of off-page SEO is to drive traffic from the referral sources to your site, these activities usually constitutes of building backlinks, guest postings, classified advertisements, blog commenting, and sharing of your posts on the social media platforms [5][6][7].

TECHNIQUES OF SEO

There are three major techniques of SEO that are depicted in the figure 1.2 [5].

C. *White Hat SEO*

White Hat SEO refers to the possible use of the search engine optimization strategies, algorithms, tactics and techniques that

merely focuses on reaching the target audience that is primarily contrary to the search engines and entirely follows search engines rules, regulations and policies.

D. *Black Hat SEO*

Black Hat SEO refers to the techniques that are not traced and approved by search engines to reduce the impact ratio of the search engine tactics. This technique is also known as Spamdexing.

E. *Gray Hat SEO*

The practice of using illegal procedures to increase and improve your site rankings is referred as Gray Hat SEO techniques. In simple terms, we can identify if the SEO optimizer may purchase or distribute links with other relevant websites to improve rankings on search engine, although it won't be acknowledged by the search engines on priority basis. Hence, this technique isn't considered to be a long-term practice for the ranking of your site or page.

Figure. 1.2: Illustration of SEO Techniques

The above figure depicts the diversity and expansion of SEO techniques into three broad categories, i.e., White Hat SEO, Black Hat SEO, and Gray Hat SEO [10]. The merits and demerits of the SEO techniques are evaluated and reviewed in the different sections of this paper, and the next sections focuses on these techniques and their impacts on the algorithms and modular approachability tools for SEO [16].

SEO ALGORITHMS

Page Ranking Factors are a greater challenge for SEO Analysts to find out the best possible search results using page ranking, content optimization, and link-building algorithms to perform search engine optimization of website and site pages etc. Nowadays, search engines are heavily reliant of web crawling & indexing algorithms that ultimately fetches and optimizes the overall search engine process and improves page ranking factor on the SERPs. Hence, there are several SEO algorithms, but we will discuss about 3 of the most popular Google Algorithms for SEO in the later sub-sections [5][10][11].

F. *Google Panda*

Google Panda is an algorithm used by Google for search engine optimization (SEO) that targets websites and blogs with content that is either duplicated or plagiarized beyond a certain limit. The algorithm focuses on the content level, removing or replacing any redundant, plagiarized, poorly structured, or

grammatically incorrect content that does not convey the intended meaning of the query [9].
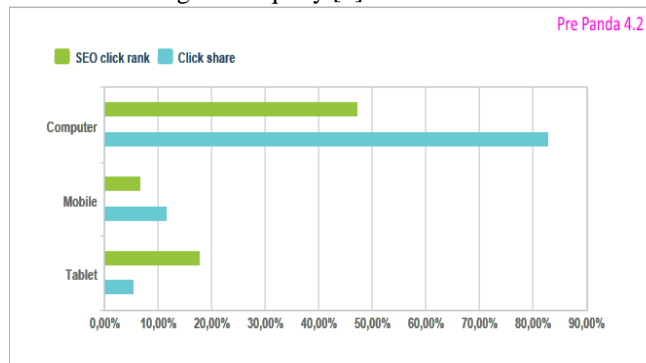

Figure 1.3: SERPs Metrics of Google Panda Update

While the Google Panda Algorithm does not immediately affect website content, websites or blogs can be penalized with the Panda Penalty in rare cases, even if they have high-quality content. This can occur due to the sharing of links to the website on sites that have been penalized by Google [8].

G. *Google Penguin*

Google Penguin is a link-building algorithm that primarily focuses on the backlinks of websites or blogs. In its early stages, the algorithm was known as the Web Spam Algorithm Update and was designed to remove spam from search engine results, as shown in Figure 1.4 [12].
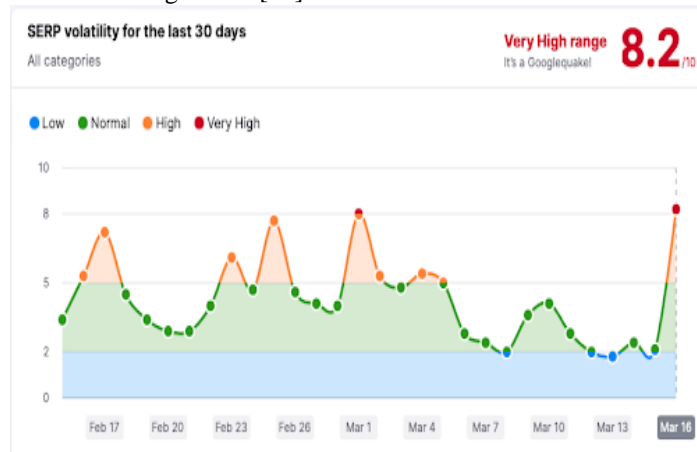

Figure 1.4: SERPs Metrics of Google Penguin Update

The Google Penguin Algorithm checks the quality of the backlinks of websites or blogs by examining the page rank of the pages on which the links are created. Websites or blogs with poor-quality backlinks continue to rank lower in search engine results pages (SERPs) [3].

H. *PageRank*

Page Rank is an algorithm that constitutes a numerical weight assigned to a webpage based on relevancy and performance metrics. This algorithm uses inbound links and information to prioritize the overall ranking score for all the pages on the website[1]. Furthermore, the entire amount of inbound links acquired from quality webpages proceeds towards the measurement of the popularity and regulation of the site, as shown in Figure 1.5 [5].
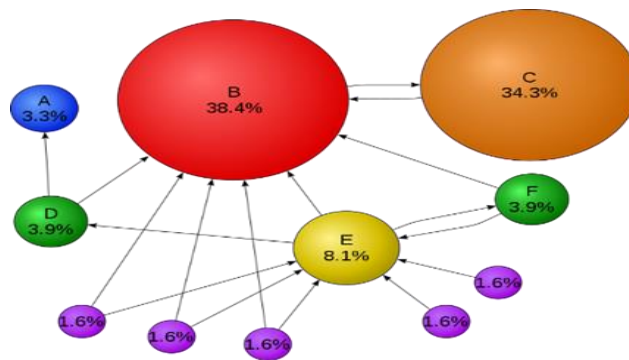

Figure 1.5: Graphical Representation of PageRank

This is based on the accordance of quantity and quality of both internal and external links. The site pages which consumes higher rank are considered to be the most essential and it has likely more possibilities on search engine's ranking list. According to Google, the working procedure of PageRank starts with counting of the numbers and quality metrics of links to a page to regulate a predicted estimate of how to determine your website. The underlying assumption is that most conservative and essential websites are possible enough to receive more links from relevant websites[13][14].

CONCLUSION

This paper comprehensively reviews the concepts, techniques, and the most popular algorithms used for link building, website performance optimization, data analysis, and content mining to acquire predictive & improved SERPs. Furthermore, the results provided in this paper are acquired from various sources that explain and govern the importance of SEO best practices that significantly imply the progression and advancement of SEO in the forthcoming years.

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