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Effective tool for exploring web: An Evaluation of Search engines

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Abstract:

Evaluation of search engines is necessary to check the retrieval performance of search engines and to differentiate search engines from one another. The ability to retrieve and to rank the relevant result lists can be done by the process of evaluation and this process can take place in two ways viz; human based methods where one can evaluate search engines manually to calculate the significance of the returned results but this method is time consuming and expensive, while as the second is automatic method where one can make use of various techniques like retrieval measures can be used to assess the performance of search engines.

Keywords:

Search Engine, Retrieval Effectiveness, World Wide Web.

Introduction

The tremendous volume of information propelled the rapid growth of web search engines and thus most of the users prefer to use search engines as the vital information retrieval tool available in order to retrieve the information from the web. However, the user satisfaction is very important aspect in this context and from various previous studies it has been seen that users are not satisfied with the results provided by search engines **(Deka & Lahkar, 2010).** The people from every corner of world make use of search engines to retrieve the desired information from the web and thus search engines act as a significant gateway to the information available on the web and over the last few years have developed in their complexity and effectiveness **(McDonnell & Shiri, 2011).** Search engines are the resources which help their users to search any kind of information on the web in a simple and easy way **(Kaur, Bhatia & Singh, 2011).** A number of search engines exist nowadays but different search engines present different result lists due to the number of factors that distinguish one search engine from the other viz. "interface, features, coverage of the web, ranking methods, algorithm and indexing methods" etc **(Chowdhary & Soboroff, 2002); (Spink, Jansen, Kathuria & Koshman, 2006).** Therefore, search engines display different result lists when a user submits the same query to different search engines **(Kaur, Bhatia & Singh, 2011).** However, a number of tools exist which help users to search for the web pages related to their needs and these tools can facilitate users of search engine to look for the most relevant information via these searching tools. The web is enormously dynamic because everyday a large number of web pages are published and some irrelevant or old pages are eradicated from the web while sometimes the content of most of the web pages are modified. Hence, search engines in this context are able to handle these dynamic changes **(Bar-Ilan, 2002)** because they are considered as the most significant tools available for resource discovery on the web and have been growing in popularity since long **(Hassan & Zhang,**

2001). With the fast growth of the internet, web search engines have become more and more important as an information retrieval tool and with the help of these tools people from every part of the universe seek information to fulfill their information desire. As far as searching interface of these search engines are taken into consideration, the steps implicated are very similar among different search engines (**Zhu, Du, Meng, Wu & Sun, 2011**). Search engines always return the same results when the same query is submitted by different users and thus most of the users are not satisfied with the results returned by the search engines. Therefore, in order to find out the users long-term interests search engine track and record a user's search history (**Liu, Yu & Meng, 2004**). The process of retrieving information from the web takes place in various steps viz. first search engine crawl web pages at regular intervals and indexes them and creates its own database but it is not possible for any search engine to index the whole web. Search engines can index only a portion of web pages on the internet and thus it is better for a user to make use of multiple search engines to retrieve the broader range of information (**Zhang & Cheung, 2003**). However, users prefer to use single search engine rather than using multiple search engines because the results provided by single search engines also makes them feel satisfied even if they get only few related hits. However, some of the utility services show that the overlap among two or three search engines is the reason for different ranking positions of the matching hits provided by search engines. Further, a number of facts viz; "the search engines do not crawl the similar sites, neither do they head off to the same intensity, nor they harvest the identical documents" are responsible for the minimal overlap even among the largest search engines (**Jacso, 2005**). Search engines make use of different strategies like they make use of crawlers or spiders in order to perform the basic retrieval task and accept the query submitted by the user and then compare the query with all the records that exist in a database and finally present the creation of a retrieval set as output (**Dudek, Mastora & Landoni, 2007**). Furthermore, with the help of two steps search engines are constantly trying to provide most current information to their users. First search engines with the help of crawler can download a number of web pages for the purpose of including them in the search engine results and finally process the web pages to create the data structures used to service search requests (**Henzinger, Motwani & Silverstein, 2002**). As the amount of information is growing rapidly search engines are not able to provide the relevant results to their users and thus research done on search engines reveal that search engine with a dominant competence cannot search and retrieve systematically all the resources available on the web (**Moghaddam & Parirokh, 2006**).

Problem:

Search engines are considered as the best information retrieval tool in order to retrieve information from the web. Nowadays people from every corner of world make use of search engines but due to enormous volume of information available on the web it is difficult to identify and retrieve useful and relevant information from the web. Therefore it is very much essential to evaluate these search engines on the basis of various parameters to help users in order to make use of these searching tools in a better way and more efficiently.

The problem taken in hand evaluates the search engines on the basis of different parameters like features, coverage, interface, ranking method, categorization, multi language support etc.

Scope:

The scope of study is confined to general search engines on the basis of language which was confined to English.

Objectives:

1. To evaluate the performance of search engines on the basis on various parameters.
2. To check the retrieval effectiveness of search engines in terms of coverage, interface, ranking methods etc.

Methodology:

The search engines were evaluated on the basis of features and general search engines were taken into consideration. Deep scan of web was done in order to evaluate search engines on the basis of their features as well as review of literature was done to evaluate the search engines and to check the retrieval effectiveness of search engines and on the basis of different parameters like coverage, interface, ranking method, categorization etc. search engines were evaluated.

Review of Literature:

Search engines can be evaluated with the help of some methods which are very essential for the process of evaluation and therefore, **Azimzadeh, Badie and Esnaashari (2016)** discuss that search engines can be evaluated with the help of some automatic methods viz; "methods based on user's feedbacks" (which is very effective if a search engine which is to be evaluated is being used by a number of people on everyday basis), "methods based on consensus" (which is effective only if a search engine under evaluation performs better in comparison to all other search engines, "methods based on rank aggregation" (this method is used for those search engines which have high level of overlaps among results) and "methods based on known item searches" (this method can be used in case of navigational queries because methods which use navigational queries are more accurate and easy to execute).In view of **Xie (2004)** interface design, system performance and collection coverage are the important components for users that help them to evaluate online information retrieval systems. **Li and Shang (2000); Shang and Li (2002)** highlight that a number of retrieval measures exist nowadays which can be used to evaluate the performance of search engines including; precision, coverage, response time, recall and interface etc. **Vaughan (2004)** presents two newly methods viz; "the quality of result ranking" and "the ability to retrieve top ranked pages" for evaluating the retrieval performance of search engines and found that these two measures are more effective in evaluating web search engines and are capable to differentiate search engine performances. **Lopez-Pellicer, Florczyk, Bejar, Muro-Medrano and Zarazaga-Soria (2011)** have performed an automated evaluation of three search engines viz; Google, Yahoo and Bing using their application programming interfaces and reveal that the discovery of geographic web services in search engines does not require the use of advanced search operators. While evaluating the performance of

search engines viz; Google, Bing and Parsijoo on Persian navigational queries **Mahmoudi, Badie, Zahedi and Azimzade (2014)** state that the performance of a Persian search engine "Parsijoo" is much better when Persian navigational queries are given as input in comparison to general search engines like, Google and Bing which performs better when general English queries are given as input. Therefore, "Parsijoo" is better search engine for those users who type their queries in a specific Persian language to attain better results. **Lewandowski (2008)** also evaluates the performance of five major search engines viz; Google, Yahoo, MSN, Ask.com, and Seekport while taking into consideration not only the results but also the result descriptions provided by the search engines and reveal that the performance of Google and Yahoo is comparatively betterthan other search engines. However, among all search engines Googledelivers significantly more relevant result descriptions than any other search engine. **Hammo (2009)** reveals that two leading international search engines viz; Google and Yahoo can retrieve documents in multi-languages. However, for diacritic queries (diacritics are normally utilized in religious scripts and are used in Arabic text where users can make use of short vowels) and diacritic-less queries (means a text without short vowels or signs), Google retrieved diverse results and most of the retrieved documents are a combination of diacritic and diacritic-less queries. On the other hand Yahoo pays no heed to the diacritics in most of the cases and thus returns almost the same results for diacritic and diacritic-less queries. While evaluating search engines viz; Google, Yahoo and Teoma, **Lewandowski (2004)** exploit date restricted queries and thus it has been seen that search engines perform to fail as far as date restricted searches are concerned. The performance of Google was not good with individual queries but better in terms of overall up-to-datedness rate in comparison to other search engines.

Data Analysis and Interpretation

1. **Search Engine: Software**

Search engines make use of their own customized software to examine their databases and work according to similar principles which means that terms exist in other web sites which are identical to user query are also presented in the result list provided by search engine displayed to the user. However, algorithms are also used to determine the ranking of these web sites because algorithms can scrutinize the position and occurrence of the term used by a user against the matching list of those web sites. The result provided by different search engines varies from one another because of the variation among the work of algorithms between search engines. It has been revealed that the content overlap between search engines remain comparatively low and thus users frequently experience different results while running the same search across different search engines**.** Search engine now make use of monolingual search that is coupled with machine translation software to help users where they can translate web pages available in any language into English in the following steps, first query is accepted from users in a specified language and an integrated translation mechanism is used to translate them into an accepted language but only once web pages are retrieved. However, Google which has developed an innovative technique for web page translation with the help of automatic learning feature that translates a text simply by investigating web pages that already exist in multiple languages.

2. Search Engine: Interface

Searching is one of the important mechanism through which users can get online information in a simple and easy way. However, search engine like Google provides relevant information to its users because of its easy search interface as compared to any other search engine. Furthermore, nowadays almost all systems follow two vital levels of searching viz. basic and advanced search. However, the basic retrieval features which are included in these systems are;"Boolean operators, phrase searching, match of exact words/phrases, field specific searches, limit field searches, save search, search history, truncation, wildcard, rules of preference with nested queries, proximity search, range searching, use of thesaurus or permuted index for searching, subject search and stemming". Information searching strategies can be of three types "top-down, bottom-up, and mixed" where in top-down approach users search for general information and then slowly search for specific information. On the other hand in bottom-up approach users search for specific information by make use of higher number of search terms in their subsequent query as compared to their previous prior query. While as in mixed approach users look for both specific as well as general information. Search engines have their own database content and a search interface and both these features are correlated with the help of search software. Moreover, databases of www pages differ extensively like large databases can be seen in robot keyword search engines while as the small databases are held by the manually-accumulated subject directory search engines. However, the size of these robot keyword search engines can be determined in three ways, "number of retrieved pages, number of unique URLs and number of URLs". Different search engines have different features but it has been revealed that most of the search engines have similar interfaces and a submit button e.g, tabs for searching web, images, audio, video etc. Search engines use an effective browsing mechanism known as conceptual matching which is originated for a user to observe a document list organized in a predefined sequence according to a suggestion to decide which documents are worthy of examination. However, in order to examine the results provided by the search engines from the top rank and to observe the conceptual matching to estimate the theoretical proximity of an unobserved webpage to a query or a web pages that a user had already in mind can be estimated with the help of this browsing mechanism.

3. Search Engine: Coverage

Coverage is one of the important factors that can affect retrieval effectiveness of any search engine. However, coverage of any single search engines refers to the total number of different single search engines that are associated with it and to which a meta-search engine directs its queries. It has been seen that if a meta-search engine covers a large number of single search engines it is possible that its performance will be better in terms of retrieval effectiveness and it will be able to retrieve precise results. Moreover, "the coverage of a search engine can be determined as the total number of pages returned by the search engine". Clustering approach can be used for search engines with largest databases and thus search engines like Google, Yahoo, MSN and Ask contains an enormous data and to deal with the large amount of data, a service known as "Teoma" search service have been incorporated which has a suitable system to assist users to retrieve the documents that are

most relevant to them while as, "Teoma" search service is based on the popular clustering software known as "Vivisimo".

4. Search Engine: Ranking Methods

It has been revealed that web search engines have developed different indexing and query ranking methods. One of the vital methods utilized by Google is ranking algorithm that takes into consideration some additional parameters like anchor text which is considered the clickable part of hypertext link. However, the main function of anchor text is that it provides a compressed description of the web page it links to, and also explains the web page in another language. Furthermore, the ranking algorithm are performing better but their performance does not depend entirely on each page because users are considered the best evaluators to decide the best ranked web page and thus decide the quality of algorithms of different search engines. Meanwhile, algorithmic search component of search engines is the key function of web search relevance ranking and such methods are employed to bias the ranking of the advertisements displayed in search results.

5. Search Engine: Categorization

A number of factors are responsible that can classify one search engine from the other viz. "programming language in which it is executed, storage which means how it stores inverted files, databases, file structures etc, ability of searching like use of Boolean operators and stemming, fuzzy search etc, ranking method, different file types like html, pdf etc, online indexing opportunities and building incremental indexes, software update. Hence, search engines should be updated regularly because outdated search engines can create problem at the time of customizing it to the requirements of the current website. Thus, these features are very much helpful to categorize different search engines and consider the performance of these search engines with different loads of data. This can help researchers to investigate the indexing time versus the amount of data, as well as the amount of resources utilized during the process of indexing. Web search engines develop the structure of documents in a number of ways, "compute textual comparison with respect to each document element like title, subtitle etc and on the other hand incorporate matches of different structural elements into a single textual relevance score" and it can help to classify one search engine from the other. Furthermore, overall quality of a document can also provide information of textual relevance which means that search engines by using automatic document classifiers can identify precise document fields like adult content, commercial sites, etc. While as, in order to detect spam pages some specialized techniques are used by search engines and such techniques can help to eliminate those web pages that are less relevant to the users. Search engines also use search control to assist users as it provides both quick control over a search and more user-favoured retrieval results. This process takes place either by restraining the number of hits or setting a search time for each single search engine. Furthermore, it has been revealed that result sorting is vital process because users rarely view those pages that are irrelevant to them or those result that are low-ended. Thus, web pages can be sorted with the help of some potential criteria which includes viz; "relevance, web page title, URL, search engine source, and query response speed".

6. Multiple Language Support

Search engines provide an option for searching only in the given language, filtering and with display limitation of the number of retrieved web pages and other audio/video functions viz. image, map, news release etc with the help of multiple language support feature. However, usability of search engines will be affected by the poor visibility of a feature e.g; it is very difficult to identify any web page, if a feature is implanted at extremely deep level within an interface. Therefore, visibility of a feature in a search engine interface is significant and thus demotes to its level, position, and form within the interface. The level of a feature in a search engine is defined as "the number of clicks/selections from the main interface of a search engine down to the screen that contains that feature". Search engine retrieves a number of results and thus language of a document in which it is accessible is very much important because it decides whether it is helpful for a user to understand or not. Therefore, when ranking results search engines consider language factor and the results available in English language are displayed first for that user whose desire is to retrieve those documents that are available in English language. Hence, the results that are available in language different from the language of its interface obtain a lower ranking which reveal that if a result set for some particular query is same in English as well as in German version of Google search engine, its ranking will be different. However, in order to deal with this issue user can make use of target language of the search engine's interface e.g, if a German user is looking for a document that is available is English language he/she can use "the.co.uk" interface that will help him/her to achieve higher ranking for the desired document. Nonetheless, while using this interface documents available in other language will not be eliminated but will be ranked below the documents in the target language of the interface.

7. Web-Page Ranking

Page relevance is an important feature which can be used by the search engines for page's relevance particularly those web pages listed by the search engines. However, web search relevance ranking is not able to estimate relevance of a page to a query. Web search engines are integrated with a number of standards and algorithms but had to become accustomed and enlarge them to fit their requirements. It has been revealed in previous studies that early search engines like Lycos, AltaVista focused on the scalability issues of running web search engines with the help of traditional relevance ranking algorithms but current search engines like Google developed web-specific relevance features viz; hyperlinks to acquire imperative growth in terms of the quality of results. Furthermore, with the assistance of relevance ranking search results are sorted according to algorithms that determine how much relevant or related a particular document is to a particular query and therefore search engines help its users in sorting the overabundance of information on the web. Moreover, the measures used by ranking algorithms are based on document characteristics but varies from one search engine to another in terms of following factors, "number and frequency of matching terms, location of terms within the document, link structure". Textual relevance can be measured with the help of different features that are incorporated in modern web search engines. However, a number of features are integrated in search engines

like, matching functions which help to determine the term resemblance to the query and these matching functions are based on the frequency of occurrence of query terms while as, some features depends on the page structure, term position, graphical layout etc. On the other hand current search engines take out more complex and intricate query reformulations which allocate them to find out acronyms, detect phrases, etc. Search engine has become an important source for retrieving visual information and thus efficient tools are required to retrieve images from the Web. However, image retrieval from the web has to prevail over difficulties regarding speed, storage, computational cost, and retrieval quality. Relevance of retrieval output can be enhanced by applying content based image retrieval methods which are based on clustering and ranking. This approach is very helpful for both the text-based and visual content-based approaches to accomplish high speed and high precision retrieval. Query expansion information collected from users can be used by search engines as a factor for determining web page visibility. These factors can be categorized into two basic categories viz. "these factors are internal and are calculated by the webpage itself and thus include web page metadata structure and content of a web page, and these factors are external to the webpage and cannot be obtained from the webpage itself and thus include hyperlink cited status, query expansion". However, factors included in first group are controlled and influenced by webpage designers but factors included in the second group are not organized and supervised by the webpage designers. Web page developers follow some rules without someone striking these rules on them like they make use of anchor text of a link to present a concise description of the target page.

8. Search Engine Optimization

Search engine optimization is that process by which web page factors can be identified which impacts search engine accessibility so that search engine can attain highest promising visibility when it responds to a relevant query. However, it is a complex task because different search engines follow different indexing strategies and ranking algorithms. The main aim of this process is to accomplish better search engine accessibility for web pages and thus high visibility in a search engine result. Some web sites use certain techniques so that they will be indexed in a better way by search engines and those techniques takes place in a process known as search engine optimization. Further, search engines take many factors into consideration while indexing pages and those factors are; "article length, writer's expertise, title, topic, keywords, and quality of linking sites, or inbound links". Web page visibility of a search engine can be affected by query expansion and thus search engines observe, examine, and use users query expansion information as a factor for webpage visibility computation. However, multiple variables are responsible for the searching process like an initial query can be changed, modified, revised toward a more effective and well defined query. It has been seen that SEO is quickly growing into an advertising discipline that can be calculated using the metrics of cost-effectiveness that are applied to all advertising techniques. In order to determine the ranking for a given query, search engines evaluate the content of a document by using various techniques like text spam technique is used to modify the text in a method where search engine rates the page as being predominantly relevant, despite the fact that the

amendments do not boost perceived relevance to a human reader of a document. Furthermore, ranking can be improved in two ways viz; in the first method one has to focus on a small set of keywords to improve perceived relevance for that set of keywords. While as in the second method one has to increase the number of keywords for which the document is perceived relevant by a search engine. Search engines are associated with four different groups with different interests viz; users, search engine operators, web site providers and search engine optimizers. However, all these groups work together in the following ways in order to provide valid results to the users viz; web site providers generate valid results through the accurate indexation of their web sites. While as, users on the other hand expect appropriate search mechanism from search engine operators so that clear ranking lists are produced in respond to particular queries.

Conclusion

It has been revealed from the study that search engines are considered as the basic tools available nowadays used by millions of people from all over the world for searching, retrieving and accessing information. However, search is considered as a commodity through which users express their information desire and they always wish to get the high quality results back from these search engines. Moreover, search engines play an effective role not only in providing access to information and knowledge, but are also gradually taking an essential part in the creation of knowledge itself. A number of factors exist through which search engines can perform better in order to retrieve more relevant results to their users like its searching mechanism, interface, techniques, coverage, algorithm, indexing and ranking methods, type of query etc. However, queries or keywords given by the users to different search engines play an imperative role in this context, where users can frame a query in the right method to find relevant information while ignoring irrelevant one. Therefore, query formulation is very much important which help users to formulate their queries while searching for any sort of information. However, search engines frequently improve their technology by implementing new skills to arrange and organize information through the rising number of web pages in order to return quality results to web users.

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