Search engine effectiveness using query classification: a study

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Abstract

Purpose – The purpose of this paper is to highlight the retrieval effectiveness of search engines taking into consideration both precision and relative recall.

Design/methodology/approach – The study is based on search engines that are selected on the basis of Alexa (Actionable Analytics for the web) Rank. Alexa listed top 500 sites, namely, search engines, portals, directories, social networking sites, networking tools, etc. But the scope of study is confined to only general search engines on the basis of language which was confined to English. Therefore only two general search engines are selected for the study . Alexa reports Google.com as the most visited website worldwide and Yahoo.com as the fourth most visited website globally. A total of 15 queries were selected randomly from PG students of Department of Library and Information Science during a period of eight days (from May 8 to May 15, 2014) which are classified manually into navigational, informational and transactional queries. However, queries are largely distributed on the two selected search engines to check their retrieval effectiveness as a training data set in order to define some characteristics of each type. Each query was submitted to the selected search engines which retrieved a large number of results but only the first 30 results were evaluated to limit the study in view of the fact that most of the users usually look up under the first hits of a query.

Findings – The study estimated the precision and relative recall of Google and Yahoo. Queries using concepts in the field of Library and Information Science were tested and were divided into navigational queries, informational queries and transactional queries. Results of the study showed that the mean precision of Google was high with (1.10) followed by Yahoo with (0.88). While as, mean relative recall of Google was high with (0.68) followed by Yahoo with (0.31), respectively.

Research limitations/implications – The study highlights the retrieval effectiveness of only two search engines.

Originality/value – The research work is authentic and does not contain any plagiarized work.

Keywords World wide web, Search engines, Precision and recall, Retrieval effectiveness, Web queries

Paper type Research paper

Introduction

In the present era internet has become an important resource which emerges as the basic tool to assist users in communication and dissemination of information. As the quantity of information increases on the internet it really becomes hard for a user to retrieve the relevant information. Therefore, a number of tools and techniques have been implemented to help users in order to retrieve the most relevant information they need via the internet (Brinkley and Burke, 1995). However, web search engines play a very significant role to handle a number of vibrant changes that occurs on the internet because everyday new pages are published and some old pages are removed, while the content of various pages is changed (Bar-Ilan, 2007). Nowadays there are so many search engines available on the web and each search engines has its own specialty, their own capability, characteristics, the way of searching and more (Kaur *et al.*, 2011). There exists a number

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of parameters which can distinguish search engines from one another and can help to identify easily which search engines is best among all and these parameters can be; "crawling, update occurrence, relevancy, interface, features, coverage of the web, ranking methods, delivery of advertising," etc. (Spink *et al.*, 2006; Chowdhary and Soboroff, 2002). The main problem lies with search engines are that they are continuously changing and developing their search mechanism, user interface and on the other hand emergence of new search engines can reveal that no specific search engines evaluation remain valid for any particular period of time (Oppenheim *et al.*, 2000). It is very significant to have an efficient and accurate information retrieval methodology because due to the plenty of information available on the web and its continuous growing mechanism it becomes difficult for user to attain precise information (Kraft, 2002). There are two main retrieval effectiveness measures which can help researchers to check the retrieval effectiveness of results which users get back and these measures are precision and recall. "Precision can be defined as the number of relevant documents retrieved by a search divided by the total number of documents retrieved by that search while as Recall can be defined as the number of relevant documents retrieved by a search divided by the total number of existing relevant documents" (which should have been retrieved) (Bitirim *et al.*, 2002). Queries are the fundamental means through which users can articulate their information need to an information retrieval system. Researchers nowadays make use of query logs provided by search engines which can help them to evaluate queries and accordingly distinguish various queries and put them in different categories (Pu, 2005). Bian *et al.* (2010) define that users search intention can be identified with the help of queries which they type and thus for information retrieval and web search queries play an important role in the ranking mechanism. Barr *et al.* (2008) reveal that query reformulation is very vital process and queries are thus regularly formulated in search engines. Therefore, it is essential for a user to formulate a query always in an appropriate way because queries are the fundamental part of information. It depends on the query formulation that whether a user achieves precise information or not. There are number of queries which have been categorized according to different researchers in various types, namely, navigational, informational, transactional, structured and unstructured, commercial and non-commercial, popular and unpopular, etc. Vakkari (2011) categorizes queries in three different types, namely, navigational, informational and transactional. On the one hand navigational queries are those where a user desires to reach a particular web page. While as, informational queries are those where a user is looking for detailed information about some particular topic. Transactional queries are basically those queries where a user wants something other than information, e.g., downloads, etc.

Problem

Web information retrieval research area is the basic way through which information needs of user can be identified in the current scenario. Retrieval effectiveness of any search can be improved with the help of information retrieval research and latest techniques can also help researchers and users to find efficient achievements. On the one hand effectiveness can assist users to determine the capability of the search engine to locate the precise information. While as, efficiency can help them to check or to determine how rapidly this information is retrieved. The problem taken in hand evaluates the selected search engines on the basis of chosen parameters, namely, precision and relative recall, etc. Furthermore, the retrieval effectiveness of selected search engines on navigational queries submitted by selective users are also identified and compared with informational and transactional queries.

Objectives

(1) to identify different web queries and divide them manually into navigational, informational and transactional queries;

(2) to evaluate search engine efficiency and effectiveness based on different query intent; and

(3) to compare retrieval effectiveness of search engines in terms of precision and relative recall.

Methodology

Methodology is divided into two sections, namely, selection of search engines and selection of queries.

Selection of search engines: the search engines are selected on the basis of Alexa (Actionable Analytics for the web) Rank. Alexa listed top 500 sites, namely, search engines, portals, directories, social networking sites, networking tools, etc. But the scope of study is confined to only general search engines on the basis of language which was confined to English.

Selection of queries: a total of 15 queries were selected randomly from PG students of Department of Library and Information Science during a period of eight days which are classified manually into navigational, informational and transactional queries. However, queries are largely distributed on the selected two search engines to check their retrieval effectiveness. Queries that contain names of companies, institutions, universities, organizations, etc. were considered to be navigational queries. Example include in this category is "University of Phoenix." On the other hand transactional queries are related to actions such as download, upload, play music, save images, copy, etc. These actions are usually accompanied with images, songs, movies, software, file types such as ".ppt, .pdf," etc. Example include in this category is "Google Chrome download." As far as informational queries are concerned they usually contain queries related to search about topics where a user need a detailed information pertaining to his/her search topic. Queries that are not classified as navigational or transactional were considered or assumed to be informational. Example include in this category include is "Gender diversity and research."

Investigation of results

All queries were first categorized into three types and later each query was submitted to the selected search engines which retrieved a large number of results as output but only the first 30 results were evaluated to limit the study.

Scope

The scope of study revolves around the existing selected search engines, namely, Google and Yahoo, respectively. However, only 15 queries were collected randomly (from May 8 to May 15, 2014) from the PG students of Department of Library and Information Science, University of Kashmir.

Literature review

This section provides a brief overview of literature related to various aspects of web queries and their retrieval efficiency.

According to Buzzi *et al.* (n.d.) there are two important parameters which are considered as an essential and reasonable objective for each user, namely, usability of

search engines and accessibility of search engines which reveals that users always have a preference to follow a simple search interface while they pose or formulate any query to a search engine to acquire some information on the web. Therefore, in the present information retrieval systems it is very important to identify user's intention behind a web query (Calderon-Benavides *et al.*, 2010). While commenting upon the same Maabreh *et al.* (2012) and Calderon-Benavides *et al.* (2010) state that user's intention behind a web query is very complex task which cannot be identified easily. Hence, users can be satisfied only when one find out the intention behind the user's query. Kato *et al.* (2013) emphasize that when a user submits a rare or single-term queries, search engines should vigorously offer a query suggestions as per the current need of the user and thus search engines always offer enhanced assistance to the user while searching. According to, Oppenheim *et al.* (2000) retrieval effectiveness can be measured and compared while taking into consideration a number of aspects, namely, "interface design, result presentation and relevance of hits." Broder (2002), Rose and Levinson (2004), Slawski (2008), Tann and Sanderson (2009), Webber (2011), Bian *et al.* (2010), Gonzalez-Caro (2011), Kang (n.d.), Tamine-Lechani *et al.* (n.d.) and MacFarlane (2007) define that there exists a number of queries which fall in different categories and therefore a number of researchers classify queries according to different strategies and aspects. These queries can be of different types, namely, navigational, informational and transactional as per the need behind the query. Later Slawski (2008) describes that in navigational queries user want to attain a particular website or web page either by simple typing its URL or by typing the name of that website. In navigational queries users need is satisfied as soon as he/she reaches that particular website. While commenting upon the same Kim and Carvalho (n.d.) and Teevan *et al.* (2007) highlight that it has been revealed in many studies that navigational queries are very easy, frequent and short to type because they have much less instability as compared to informational and transactional queries. Another study by Mehrzadi (2011), Lu *et al.* (2010) and Tann and Sanderson (2009) reveal that in navigational queries users are looking for some prominent web pages including company name, brand name, institution name, organization name, celebrity name, etc. Maabreh *et al.* (2012) classify web queries in three different categories, namely, navigational, informational and transactional with the help of an automatic identification method where data mining can be used on the basis of some predefined conditions for each individual query type. While commenting upon the same, Lee *et al.* (2005) divide queries into navigational and informational type. However, Ashkan *et al.* (2008) distinguish queries as navigational/informational and commercial/non-commercial dimensions. Kim and Carvalho (n.d.) define that non-navigational queries are less stable while as navigational queries are significantly more stable. On the other hand, shorter queries are significantly more stable than longer queries and thus in navigational queries it is found that they show lower instability than average. Meanwhile, Yurekli *et al.* (2009) highlight that by using query expansion users take an advantage that they can add more terms to frame their query again. Google and Yahoo also provide this benefit to their users where users can make use of related queries or related searches in response to their query in order to refine their search again. Rose and Levinson (2004) emphasize that at a runtime search engines might associate goals with the help of two methods, namely, with the assistance of user interface user can easily recognize the goal unambiguously. On the other hand the system infers the goal automatically. According to Kato *et al.* (2013) query suggestion can also be used to improve or to enhance the given search query. Query suggestions can be used in different ways, namely, a user can use query

suggestion when the original query is rare query (single-term query) and also when a query suggestions are instantly recognizable and finally query suggestions can also be applied when a user clicks on several URLs in the first search result page. Deka and Lahkar (2010) divulge that in comparison to other search engines including (Yahoo and Bing), Google has extensively higher rate of performance in retrieving web resources. Brin and Page (1998) reveal that a number of techniques are implemented in current search engines to improve their quality of results and thus Google provides high-quality search results by adopting a number of techniques, namely, "page rank, anchor text, and proximity information." Search engines rank websites in their search engines results by using an algorithm which is known as page rank and thus it helps to determine the significance of a particular website by counting the number and quality of links to a page. On the other hand while linking to another document or location on the web, hyperlinks display certain visible characters and words and these words facilitate to determine the ranking that the page will receive by search engines, namely, Google, Yahoo and Bing. In proximity information user looks for those documents where two or more separately matching term occurrences are within a specified distance and that distance can be a number of intermediary words. Kumar and Prakash (2009) reveal that as far as quality of information is concerned search engines including Google and Yahoo displays diversity in their search ability, user interface and quality of information. On the same note, Lopez-Pellicer *et al.* (2011) perform an automated evaluation of three search engines, namely, Google, Yahoo and Bing using their application programming interfaces and reveals that the discovery of geographic web services in search engines does not require the use of advanced search operators and finally identifies Yahoo! as the best performer.

Findings

Table I reveals that queries are classified as per their query intent.

Estimation of precision and recall

According to Clarke and Willet (1997 as cited in Shafi and Rather, 2005) fraction of a search output that is relevant for a particular query can be called as precision and therefore it requires expertise and knowledge for its calculation about its relevant and non-relevant hits which are included in a document set.

Precision of search engines

(1) "Web pages matched to the subject matter of the search query is grouped as "more relevant" and given a score of 2.

(2) Web pages not familiarly associated to the subject matter but includes some relevant ideas to the subject matter of the search query is grouped as "less relevant" and given a score of 1.

Sl. no.	Query intent	Occurrences	%
1.	Navigational	5	33.33
2.	Informational	5	33.33
3.	Transactional	5	33.33
	Total no. of queries	15	100

Table I.
Query classification

(3) Web page not correlated to the subject matter of the search query is grouped as "irrelevant" and given a score of 0.

(4) For those pages where a message emerges "Links can't be accessed" for a particular URL then that page is grouped as "site can't be accessed" and given a score of 0.5."

The formula for estimation of precision of selected search engines for each of the search queries can be used as:

$$\text{Precision} = \frac{\text{Sum of the scores of sites retrieved by a search engine}}{\text{Total number of sites selected for evaluation}}$$

Precision of Google

Google, being one of the most popular search engines on the internet, was selected as one of the search engines for comparison. This study would measure the relevance of the websites retrieved for each search query. It was specified that the search query must appear in the "title of the web page." Since the number of search results retrieved was large, only the first 30 sites were selected for analysis.

In total, 13.6 percent of the sites retrieved by Google for navigational queries were "less relevant" followed by "irrelevant" (12 percent). It was also observed that (2.6 percent) sites were "more relevant" and only a small percentage (1.8 percent) of results is categorized as "sites can't be accessed." The precision of the Google was calculated using the above formula. The overall precision of the Google for navigational queries was (0.65). In the case of search query (Q1.4) the precision was highest with (0.81) while as, the lowest precision was obtained for search query (Q1.5) with (0.61), respectively (Table II).

Table III illustrated the search results of Google for informational queries. It is evident from the table that (16.4 percent) of the sites are "more relevant" while as, (7 percent) of sites are "less relevant." It is also observed that (6 percent) of sites are "irrelevant" and only a small proportion of (0.6 percent) are "sites can't be accessed," respectively. However, the overall precision of the Google for informational queries is (1.33). The highest precision (1.38) is obtained for the search query (Q2.2) and query (Q2.3) each, respectively while as, lowest precision (1.4) was observed for query (Q 2.4).

Table IV revealed the search results of Google for transactional queries. It is evident from the table that (16.2 percent) of the sites are "more relevant" while as, (6.8 percent) of sites are "less relevant." It is also observed that (4.4 percent) of sites are "irrelevant" and only a small proportion of (2.2 percent) are "sites can't be accessed," respectively. However, the overall precision of the Google for transactional queries is (1.34).

Table II. Precision of Google for navigational queries

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q1.1	88,400,000	30	2	15	11	2	0.66
Q1.2	1,440,000	30	1	17	11	1	0.65
Q1.3	36,300,000	30	2	11	15	2	0.53
Q1.4	462,000,000	30	3	17	7	3	0.81
Q1.5	50,400,000	30	5	8	16	1	0.61
Total	638,540,000	150	13	68	60	9	0.65
%			2.6	13.6	12.0	1.8	

The highest precision (1.46) is obtained for the search query (Q3.2) while as, lowest precision (1.25) was observed for query (Q3.5). Meanwhile for query (Q3.3) and query (Q3.4) one of the results repeat twice therefore was considered as only 1 in number to avoid any sort of repetition.

However, findings are also in tune with the studies carried out by Deka and Lahkar (2010), Brin and Page (1998) and Bar-Ilan, 2007) establishing that Google provides high-quality search results and deliver significantly more relevant result descriptions than any other search engine and thus employ a number of techniques to improve search quality.

Precision of Yahoo

The other internet search engine taking into consideration is Yahoo which again is a popular and admired search engine. However, in order to evaluate the precision and recall of Yahoo the same set of search queries and same methodology is adopted.

The results of the study in case of navigational queries showed that (10.4 percent) of the sites were "less relevant" followed by "irrelevant" sites with (9.6 percent). It was also observed that (3.0 percent) sites were "more relevant" and only (1.6 percent) were "sites can't be accessed." The highest precision (0.75) was for search query (Q1.4) and the least precision (0.5) was observed for search query (Q1.3) and the overall precision of Yahoo was (0.57). However, for each query, number of result repeats and therefore in order to steer clear of duplication, if the same result repeats two times or more than two times, in that case only one result is taking into consideration. A total of 27 results are repeated by search engine "Yahoo" for navigational queries that were not taking into considered for estimation of precision (Table V).

From Table VI, it can be seen that (12.8 percent) of sites were "more relevant" followed by "less relevant" sites (7.2 percent) and "irrelevant sites" (6.8 percent). It can also be seen that only (0.2 percent) were "sites can't be accessed." The overall precision

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q2.1	7,510,000	30	14	7	9	0	1.16
Q2.2	782,000,000	30	17	7	5	1	1.38
Q2.3	25,800,000	30	17	7	5	1	1.38
Q2.4	35,500,000	30	18	6	6	0	1.4
Q2.5	70,200,000	30	16	8	5	1	1.35
Total	921,010,000	150	82	35	30	3	1.33
%			16.4	7	6	0.6	

Table III. Precision of Google for informational queries

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q3.1	468,000,000	30	15	7	5	3	1.28
Q3.2	8,270,000	30	18	8	4	0	1.46
Q3.3	12,200,000	30	16	7	3	3	1.35
Q3.4	186,000	30	17	7	5	0	1.36
Q3.5	863,000	30	15	5	5	5	1.25
Total	489,519,000	150	81	34	22	11	1.34
%			16.2	6.8	4.4	2.2	

Table IV. Precision of Google for transactional queries

of the Yahoo for informational queries was (1.09). For search query (Q2.2) the precision was highest with (1.36) and for query (Q2.1), (Q2.3) and (Q2.5) the precision was same with (1.03) each and lowest precision (1.01) was observed for search query (Q2.4). A total of 15 results are repeated by search engine "Yahoo" for informational queries that were not taking into considered for estimation of precision.

Table VII showed that (11 percent) of the sites retrieved by Yahoo for transactional queries were "more relevant" followed by "less relevant" (7 percent). It was observed that (5.8 percent) sites were "irrelevant" and only a small portion (0.8 percent) categorized as "sites can't be accessed." The overall precision of the Yahoo for transactional queries was (0.98). In the case of search query (Q3.2) and query (Q3.5) the precision was highest with (1.08) while as, the lowest precision (0.83) was obtained for search query (Q3.1). However, for each query, number of result repeats and therefore in order to avoid duplication, if the

Table V.
Precision of Yahoo for navigational queries

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q1.1	45,400,000	30	2	9	5	5	0.51
Q1.2	483,000	30	3	10	12	1	0.55
Q1.3	41,200,000	30	2	11	10	0	0.5
Q1.4	167,000,000	30	5	12	10	1	0.75
Q1.5	40,200,000	30	3	10	11	1	0.55
Total	294,283,000	150	15	52	48	8	0.57
%			3.0	10.4	9.6	1.6	

Table VI.
Precision of Yahoo for informational queries

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q2.1	7,460,000	30	12	7	8	0	1.03
Q2.2	98,700,000	30	17	7	5	0	1.36
Q2.3	25,800,000	30	11	9	9	0	1.03
Q2.4	458,000,000	30	12	6	4	1	1.01
Q2.5	31,800,000	30	12	7	8	0	1.03
Total	621,760,000	150	64	36	34	1	1.09
%			12.8	7.2	6.8	0.2	

Table VII.
Precision of Yahoo for transactional queries

Search query	Total no. of sites retrieved	No. of sites evaluated	More relevant	Less relevant	Irrelevant	Site cannot be accessed	Precision
Q3.1	127,000,000	30	10	5	7	0	0.83
Q3.2	12,000,000	30	11	10	6	1	1.08
Q3.3	2,960,000	30	12	7	4	0	1.03
Q3.4	190,000	30	09	7	7	2	0.86
Q3.5	2,940,000	30	13	6	5	1	1.08
Total	145,090,000	150	55	35	29	4	0.98
%			11.0	7.0	5.8	0.8	

same result repeats two times or more than two times, in that case only one result is taking into consideration. A total of 27 results are repeated by search engine "Yahoo" for transactional queries that were not considered for estimation of precision.

Table VIII revealed that the mean precision of search engine Google was (1.10) while as, the mean precision of search engine Yahoo was (0.88), respectively.

The findings are in consistency with that of Kumar and Prakash (2009) and Xie (2004) commenting that Google is able to give better search results with more precision as compared to Yahoo.

Relative recall of Google and Yahoo

The formula for estimation of relative recall can be used as:

$$\text{Relative recall} = \frac{\text{Total number of sites retrieved by a search engine}}{\text{Sum of sites retrieved by both Google and Yahoo}}$$

The relative recall of Google and Yahoo for navigational queries was calculated and presented in Table IX. The overall relative recall of Google was (0.68) and Yahoo with (0.31). However, in case of Google, the search query (Q1.2) had the highest relative recall value of (0.74) followed by search query (Q1.4) with relative recall value of (0.73), respectively. While as, least relative recall (0.46) was obtained for search query (Q1.3). In case of Yahoo, the highest relative recall (0.53) was observed for search query (Q1.3) and lowest relative recall (0.25) was attained for search query (Q1.2).

Table X revealed the relative recall of Google and Yahoo for all five informational queries. It was calculated that the overall relative recall of Google and Yahoo was (0.59) and (0.40), respectively. The highest relative recall of Google was for search query (Q 2.2) with (0.88) while as the highest relative recall of Yahoo was for search query (Q2.4) with (0.92). However, the lowest recall of Google with (0.5) was observed for search query (Q2.3) and lowest recall of Yahoo with (0.5) was obtained for search query (Q2.3) each.

Table XI showed relative recall of Google and Yahoo for transactional queries. The overall relative recall calculated for both Google and Yahoo was (0.77) and (0.22), respectively. In case of Google, the highest relative recall of (0.80) was observed for the search query (Q3.3) followed by the search query (Q3.1) with (0.78) relative recall value.

Search engine	Navigational queries	Informational queries	Transactional queries	Mean precision
Google	0.65	1.33	1.34	1.10
Yahoo	0.57	1.09	0.98	0.88

Table VIII. Mean precision of Google and Yahoo

	Google		Yahoo	
Search query	Total no of sites	Relative recall	Total no of sites	Relative recall
Q1.1	88,400,000	0.66	45,400,000	0.33
Q1.2	1,440,000	0.74	483,000	0.25
Q1.3	36,300,000	0.46	41,200,000	0.53
Q1.4	462,000,000	0.73	167,000,000	0.26
Q1.5	50,400,000	0.55	40,200,000	0.44
Total	638,540,000	0.68	294,283,000	0.31

Table IX. Relative recall for navigational queries

While as, the lowest relative recall (0.22) was achieved for search query (Q3.5). In case of Yahoo, search query (Q3.5) attained the highest relative recall (0.77) and the least relative recall (0.19) was observed for search query (Q3.3).

The mean relative recall of Google and Yahoo was (0.68) and (0.31), respectively as seen in Table XII. Google had the highest precision (1.10) as well as the highest relative recall (0.68) as seen in Table VIII.

Conclusion

The internet and especially the world wide web, is rising at a marvelous rate and is extremely popular in educational institutions, homes, government organizations and offices alike. However, more and more searching tools have been emerged on the web and many other algorithms and searching techniques, have since been added to search engines to improve their search results in order to retrieve most relevant information in an effective and efficient way while avoiding any sort of irrelevant information. The study estimated the precision and relative recall of two most popular search engines, namely, Google and Yahoo. The results of the study showed that the precision of Google was high for transactional queries followed by informational and navigational queries and Yahoo had comparatively high precision for informational queries followed by transactional and navigational queries. Relative recall of Google

Table X.
Relative recall for informational queries

	Google		Yahoo	
Search query	Total no of sites	Relative recall	Total no of sites	Relative recall
Q2.1	7,510,000	0.50	7,460,000	0.49
Q2.2	782,000,000	0.88	98,700,000	0.11
Q2.3	25,800,000	0.5	25,800,000	0.5
Q2.4	35,500,000	0.07	458,000,000	0.92
Q2.5	70,200,000	0.68	31,800,000	0.31
Total	921,010,000	0.59	621,760,000	0.40

Table XI.
Relative recall for transactional queries

	Google		Yahoo	
Search query	Total no of sites	Relative recall	Total no of sites	Relative recall
Q3.1	468,000,000	0.78	127,000,000	0.21
Q3.2	8,270,000	0.40	12,000,000	0.59
Q3.3	12,200,000	0.80	2,960,000	0.19
Q3.4	186,000	0.49	190,000	0.50
Q3.5	863,000	0.22	2,940,000	0.77
Total	489,519,000	0.77	145,090,000	0.22

Table XII.
Mean relative recall of Google and Yahoo

Search engine	Navigational queries	Informational queries	Transactional queries	Mean relative recall
Google	0.68	0.59	0.77	0.68
Yahoo	0.31	0.40	0.22	0.31

was high for transactional queries while as Yahoo had higher relative recall for informational queries. However, results of the study showed that the mean precision of Google was high with (1.10) followed by Yahoo with (0.88). While as, mean relative recall of Google was high with (0.68) followed by Yahoo with (0.31), respectively. It was observed that Google and Yahoo showed diversity in their search capabilities, user interface and also in the quality of information. The study demonstrated that the Google was able to provide enhanced search results with more precision and more relative recall as compared to Yahoo which proves that why Google is the most widely used search engine for the internet till date.

The conclusion is limited by a number of factors. These include the fact that only few queries have been selected for this evaluation. Future research would need to include a larger and more diverse sample of queries with different levels of domain expertise and degrees of familiarity with information retrieval systems.

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Appendix. Search queries

(1) Navigational queries
- Q1.1: University of Phoenix
- Q1.2: ICMR
- Q1.3: PubMed
- Q1.4: Web of Science
- Q1.5: Springer

(2) Informational queries
- Q2.1: Gender diversity and research
- Q2.2: Women and research
- Q2.3: Research output
- Q2.4: Social media in present era
- Q2.5: Reference management software

(3) Transactional queries
Q3.1: Google Chrome download
Q3.2: Harvard citation style
Q3.3: Weather in Kashmir
Q3.4: Download Greenstone Software
Q3.5: Download Tekken3

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