AN EVALUATION OF TURKISH RETRIEVAL PERFORMANCE OF POPULAR SEARCH ENGINES FOR INTERNET AND IMAGE SEARCH BY USING COMMON LISTS

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ABSTRACT

In this paper, Internet search and image search performances of the popular search engines Google, Yahoo, Yandex, and Bing were investigated by using twenty four Turkish queries from eight categories. These queries were run on each search engine for each of four consecutive weeks and mean weighted precision ratios of the engines were calculated by using common lists. This was done for Internet search and image search separately. For both Internet search and image search, Yahoo was the best search engine based on the average of mean weighted precision ratios, followed by Bing, Google, and Yandex, respectively. Internet search performances of Google and Yandex were better than their image search performances. On the other hand, image search performances of Bing and Yahoo were better except for the fourth week.

KEYWORDS

Search engine, information retrieval, performance evaluation, Turkish

1 INTRODUCTION

With a huge increase of information on the Internet, it has become difficult for the Internet users to satisfy their information necessity without search engines. For this reason, search engines play a significant role in Internet users' lives; therefore, search engine performances are important. Hence, the evaluation studies on search engine performances are valuable works.

There are various studies on search engine evaluations such as follows: Demirci et al. investigated the performance of popular international search engines (Google, Yahoo, MSN, AlltheWeb, and Ask) and also compared them with the Turkish search engine Arabul on Turkish document retrieval [1]. Çakır et al. investigated the performance of four image search engines (Google, Yahoo, Ask, and Msn) based on seven topics determined from the categories of the top searched terms [2]. Edosomwan and Edosomwan evaluated the information retrieval performance of seven search engines (Yahoo, Google, Gigablast, AlltheWeb, Zworks, AltaVista, and Bing) in terms of precision and response time [3]. Tawileh et al. investigated the performance of five popular search engines (Araby, Ayna, Google, MSN, and Yahoo) in Arabic language to reveal their success on satisfying the information need for the Arab Internet users [4]. Ali and Beg reviewed Web search system evaluation studies and discussed them in eight categories [5]. In Garoufallou's study [6], four international search engines (Google, AltaVista, Yahoo, and Exalead) and four Greek search engines (Google.gr, In.gr, Robby.gr, and Find.gr) were comparatively evaluated.

There were more than 36 million Internet users in Turkey in the middle of 2012 [7]. Thus, the importance of Turkish retrieval performance of search engines has increased more. In this study, by using Turkish queries on the search engines Google, Bing, Yandex, and Yahoo, image search and Internet search performances of each search engine have been evaluated by using common lists for four consecutive weeks.

Importance of this study is to give an idea about the search engines to the users and also to motivate the search engine providers and researchers for improving the search engines.

This paper is organized as follows: Section 2 describes the methodology, Section 3 discusses the experimental results which include Internet search and image search performances of the search engines, and the last section concludes the paper.

Table 1. The queries in eight categories

Category	Query No	Query
Spor (Sport)	Q1	basketbol (basketball)
	Q2	karate (karate)
	Q3	forma (uniform)
Yaşam - Güncel (Life - Actual)	Q4	istanbul trafik (İstanbul traffic)
	Q5	marmara depremi (Marmara earthquake)
	Q6	piramitler (pyramids)
Teknoloji - Otomobil (Technology - Car)	Q7	tekerlek (wheel)
	Q8	cep telefonu (cellular phone)
	Q9	uzay mekiği (space shuttle)
Ekonomi (Economy)	Q10	altın (gold)
	Q11	dolar (dollar)
	Q12	imkb başkanı (chairman of İstanbul Stock Exchange)
Sağlık (Health)	Q13	burun estetiği (rhinoplasty)
	Q14	tansiyon aleti (sphygmomanometer)
	Q15	sigara zararları (harms of smoking)
Magazin - Eğlence (Magazine - Entertainment)	Q16	halay (is a traditional Turkish folk dance)
	Q17	kış modası (winter fashion)
	Q18	rumeli konseri (rumeli concert)
Siyaset (Politics)	Q19	mustafa kemal atatürk (is the first president of Turkey)
	Q20	çankaya köşkü (Çankaya palace)
	Q21	oy pusulası (ballot paper)
Kültür - Sanat (Arts - Culture)	Q22	şarap mahzeni (wine cellar)
	Q23	adile naşit (is a Turkish actress)
	Q24	altın portakal (is a name of a film award in Turkey)

2 METHODOLOGY

Firstly, four popular search engines, namely, Google, Yahoo, Yandex, and Bing were selected. The reasons to select these search engines were as follows: Google, Yahoo, and Bing were the top three most frequently used search engines in the world wide [8] and Google, Yahoo, and Yandex were in the top three most frequently used search engines in Turkey [9]. Second one was that all search engines had both Internet Search (IS) and Image Search (ImS) features.

The following Web addresses were used for the IS of four search engines: http://www.google.com.tr address was used for Google; "http://tr.yahoo.com" address was used for Yahoo; "http://www.yandex.com.tr" address was used for Yandex; and "http://www.bing.com" address was used for Bing.

For the ImS of four search engines, the following Web addresses were used: from "http://www.google.com.tr", "Görseller" (Images) link was used for Google; from

"http://www.bing.com", "Resimler" (Images) link was used for Bing; from "http://www.yandex.com.tr", "Görsel" (Image) link was used for Yandex; and "http://images.search.yahoo.com" address was used for Yahoo.

Eight categories were determined by using some of the popular Turkish portals which were HABERTURK (http://www.haberturk.com), ntvmsnbc (http://www.ntvmsnbc.com), CNNTURK (http://cnnturk.com), Anadolu Agency (http://www.aa.com.tr), Doğan News Agency (http://www.dha.com.tr), and Mynet (http://www.mynet.com). Afterwards, three queries per category were selected as shown in table 1.

The twenty four queries given in table 1 were run on each search engine for each of four consecutive weeks from 11th of February to 10th of March 2013 and first twenty URLs (Uniform Resource Locators) were collected. (Note that for every week, the query runs were started on

Fridays and finished as soon as possible). This was done for ImS and IS separately. Then, Mean Weighted Precision (MWP) ratios were calculated by using Common Lists (CLs) as described below.

For IS of four search engines at each week:

Since the number of search engines is four, four CLs were created per query. First CL (CL_1) contains the URLs which only appeared in one search engine. Second CL (CL_2) contains the URLs which only appeared in two search engines. Third CL (CL_3) contains the URLs which only appeared in three search engines. Fourth CL (CL_4) contains the URLs which only appeared in four search engines. Afterwards, Common List Scores (CLSs) were determined for each CL with the following formula:

$$CLS_{CL_{no}} = no * 1/n \qquad (1)$$

n: number of search engines;

no: CL number. (For example: for the first CL, the value is one; for the second, the value is two; etc.).

For every pair of search engine and query, Weighted Precision (WP) ratio was calculated by using the following formula:

$$WP\ ratio_{Q\#}^{SE} = \frac{\sum_{i=1}^{cut-off}\left(PVofURL_i * CLS_{CLC_{URL_i}}\right)}{cut-off} * 100 \quad (2)$$

SE: search engine name;

Q#: query number;

cut-off: the value is twenty since the first twenty URLs retrieved were considered;

$PVofURL_i$: precision value of URL_i (For every URL_i , $PVofURL_i$ is assumed as one since CLS for the URL_i determines the relevancy level);

CLC_{URL_i}: Common List Category (CLC) for i^{th} URL. Determination of the category is as follows:

$$CLC_{URL_i} = \begin{cases} if\ URL_i\ is\ in\ CL_1,\ the\ category\ is\ CL_1 \\ if\ URL_i\ is\ in\ CL_2,\ the\ category\ is\ CL_2 \\ \vdots \\ if\ URL_i\ is\ in\ CL_n,\ the\ category\ is\ CL_n \end{cases} \quad (3)$$

After that, MWP ratios were calculated for each search engine with the following formula:

$$MWP\ ratio^{SE} = (\sum_{i=1}^{NoOfQ} WP\ ratio_{Q_i})/NoOfQ \quad (4)$$

SE: search engine name;

NoOfQ: number of queries (The value is twenty four).

The same calculations described above for IS were also done for ImS of four search engines at each week. Note that in MWP ratio calculation, we were inspired from the revised precision in the study of Li et al. [10].

3 EXPERIMENT RESULTS

Internet search and image search performances of the search engines are described below.

3.1 Internet Search Performances of the Engines

For each of four consecutive weeks, 24 queries were run on four search engines separately. Then, 7670 links were collected and examined. Bing retrieved less than 20 documents for 2 queries at the first, second, and last week. All search engines displayed dead links in some of their retrieval outputs for the first and second week. Furthermore, all search engines retrieved repeated links for some queries at each week.

As it is seen in figure 1 and table 2, at the first week, Google had its best performance with 40.21% MWP ratio. For the second and third week, the ratio of Google decreased between 1.93% and 4.17%. Even though Google's ratio was increased by 3.31% for the last week, it could not have better ratio than the first week. Yahoo had the MWP ratios 38.18% and 37.55% for the first and second week, respectively. Its ratio decreased by 6.35% at the third week. However, Yahoo got its highest MWP ratio

(51.81%) at the fourth week with a huge increment (20.61%). Bing's first and second week MWP ratios were 34.01% and 33.85%, respectively. Bing's ratio decreased by 3.02% for week three. However, at week four, it had its best MWP ratio with 21.24% excessive increment. Yandex had the MWP ratios 33.75% for the first week and 34.01% for the second week. Its ratio decreased by 1.87% at week three while increased by 2.35% at the fourth week and got its highest ratio.

Table 2. Weekly MWP ratios for IS of the search engines

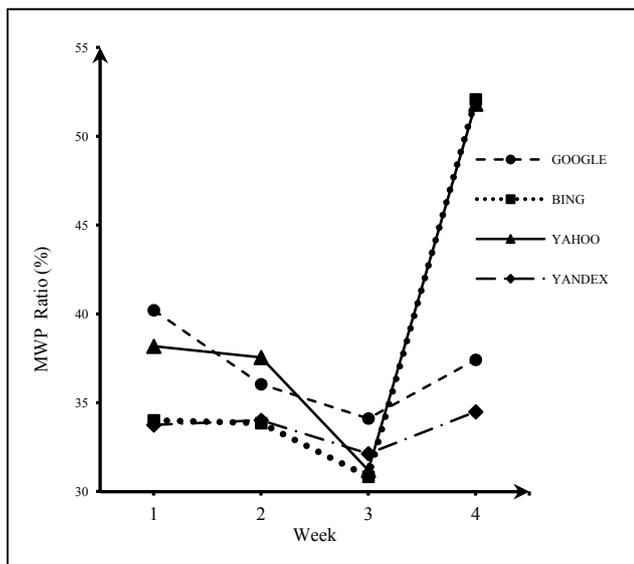|	MWP Ratio (%)			
Week	Google	Bing	Yahoo	Yandex
1	40.21	34.01	38.18	33.75
2	36.04	33.85	37.55	34.01
3	34.11	30.83	31.20	32.14
4	37.42	52.07	51.81	34.49
Average	36.95	37.69	39.68	33.60

Figure 1. Weekly MWP ratios for IS of the search engines

As shown in figure 1 and table 2, for the first week, Google was the leading search engine with 40.21% MWP ratio and Yahoo was the second leading search engine with 38.18% MWP ratio, while Bing and Yandex were the least search engines with the MPW ratios 34.01% and 33.75%, respectively. Yahoo had the MPW ratio 37.55% and Google's MWP ratio decreased by 4.17%; therefore, Yahoo was the leading search engine for the second week. On the other hand,

Yandex and Bing were the least search engines with the MPW ratios 34.01% and 33.85%, respectively. Furthermore, at week three, all of the search engines declined between 1.87% and 6.35% and Google became the leading search engine for the third week. There was a 3.31% and 2.35% increment in Google's and Yandex's MWP ratios, respectively, but this could not make any differences, Google and Yandex were the least search engines at the last week. Even though Yahoo and Bing were the least search engines at week three, respectively, a huge increment (21.24% for Bing and 20.61% for Yahoo) made Bing and Yahoo as the leading search engines for the last week with the MWP ratios 52.07% and 51.81%, respectively.

The average of MWP ratios of Yahoo was 39.68%, followed by Bing, Google, and Yandex with 37.69%, 36.95%, and 33.60%, respectively.

3.2 Images Search Performances of the Engines

For each of four consecutive weeks, 24 queries were run on the search engines (Google, Bing, Yandex, and Yahoo) and in total, 7680 links were collected and examined. No any repeated link was found in any retrieval output. For Google, Bing and Yandex, dead links were encountered for each week, only Yahoo displayed dead link(s) for the second, third and fourth week.

Figure 2 and table 3 indicated that, for the first week, Google had its lowest performance with 31.88% MWP ratio. However, for the continuous weeks, Google increased its performance steadily and had its highest MWP ratio with 34.32%. At the first week, Yandex had its lowest MWP ratio (26.09%) out of all four consecutive weeks. Yandex increased its MWP ratio by 2.04% for the second week. Even though Yandex faced with a decrease at week three, for the last week, Yandex increased its MWP ratio and got its highest ratio (29.11%) out of all four weeks. The MWP ratios for Bing demonstrated

that for the second week, Bing's MWP ratio decreased, but, then, increased consistently for the rest of the weeks. At week four, Bing had its highest MWP ratio (45.78%). Although Yahoo's MWP ratio decreased at week two and increased at week three and four, Yahoo got its highest MWP ratio (46.41%) at the first week.

Table 3. Weekly MWP ratios for ImS of the search engines

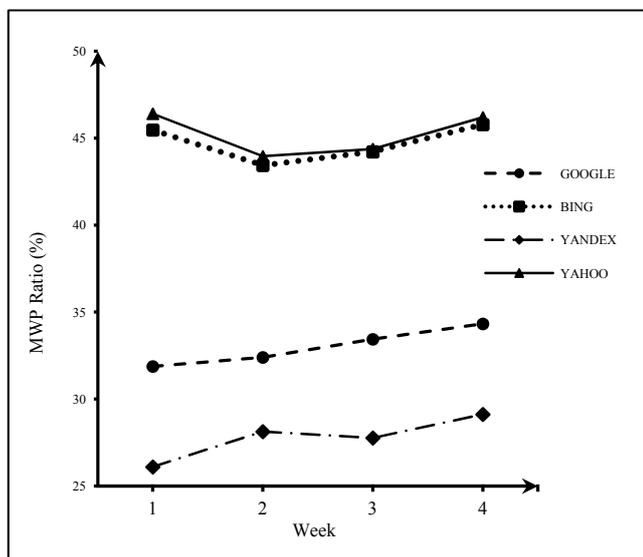|	MWP Ratio (%)			
Week	Google	Bing	Yahoo	Yandex
1	31.88	45.47	46.41	26.09
2	32.40	43.44	43.96	28.13
3	33.44	44.22	44.38	27.76
4	34.32	45.78	46.20	29.11
Average	33.01	44.73	45.24	27.77

Figure 2. Weekly MWP ratios for ImS of the search engines

As shown in figure 2 and table 3, Yahoo had the highest MWP ratios for all weeks. But, at week two, Yahoo had the greatest decrement (2.45%) compared to decrements of other search engines for the second, third, and fourth week. On the other hand, Yandex had the lowest MWP ratios for all weeks; however, at week two, it had the greatest increment (2.04%) compared to increments of other search engines for the second, third, and fourth week. Except Yahoo, other search engines got their best MWP ratios at week four. Only Google displayed a continuous increase for week two, three, and four. The MWP ratios of Yahoo and Bing acted in the same way for the coming weeks. For all four consecutive weeks, the differences between MWP ratios for Yahoo and Bing were 0.16%-0.94%, for Bing and Google were 10.78%-13.59%, and for Google and Yandex were 4.27%-5.79%.

The average of MWP ratios of Yahoo was 45.24%, followed by Bing, Google, and Yandex with 44.73%, 33.01%, and 27.77%, respectively.

3.3 Comparison of Internet and Image Search Performances

The MWP ratios for Google showed that IS ratios were 8.33%, 3.64%, 0.67%, and 3.10% higher than ImS ratios for four consecutive weeks. For the first three weeks, Bing's ImS MWP ratios were higher than its IS MWP ratios (between 9.59% and 13.39%). However, IS ratio was 6.29% higher than ImS ratio at the last week. For all weeks, Yandex's IS MWP ratios were higher than its ImS MWP ratios and the differences were between 4.38% and 7.66%. For the first three weeks, Yahoo's ImS MWP ratios were 8.23%, 6.41%, and 13.18% higher than its IS MWP ratios. But, IS ratio was 5.61% higher than ImS ratio at the last week.

4 CONCLUSION

It seems that all search engines could not completely overcome dead link problem for both IS and ImS and repeated link problem for IS.

For IS, Google had its highest MWP ratio at week one, while all others had their highest MWP ratios at week four. Furthermore, at the first and third week, Google; at the second week, Yahoo; and at the last week, Bing had higher ratio than the others. Only Yandex could not be the best at any week.

For ImS, Yahoo had its highest MWP ratio at week one, while all others had their own at week four. However, at all four consecutive weeks, Yahoo had higher ratio than other engines.

Based on the average of MWP ratios, Yahoo was the best search engine, followed by Bing,

Google, and Yandex, respectively, for IS as well as ImS.

IS performances of Google and Yandex were better than their ImS performances. On the other hand, ImS performances of Bing and Yahoo were better except for the last week.

5 REFERENCES

1. Demirci, R.G., Kişmir, V., Bitirim, Y.: An Evaluation of Popular Search Engines on Finding Turkish Documents. International Conference and Services (ICIW), pp. 61, IEEE Computer Society, Morne, Mauritius (2007).

2. Çakır, E., Bahçeci, H., Bitirim, Y.: An Evaluation of Major Image Search Engines on Various Query Topics. International Conference on Internet Monitoring and Protection (ICIMP), pp. 161--165, IEEE Computer Society, Bucharest, Romania (2008).

3. Edosomwan, J., Edosomwan, T.: Comparative Analysis of Some Search Engines. South African Journal of Science 106 (11/12), pp. 82--85, Academy of Science of South Africa, Pretoria, South Africa (2010).

4. Tawileh, W., Mandl, T., Griesbaum, J.: Search Results Presentation and Interface Design: A Comparative Evaluation Study of Five Web Search Engines in Arabic Language. Intelligent Systems Design and Applications (ISDA), pp. 592--597, Cairo, Egypt (2010).

5. Ali, R., Beg, S.M.: An Overview of Web Search Evaluation Methods. Computers & Electrical Engineering 37, pp. 835--848, Elsevier, Philadelphia, USA (2011).

6. Garoufallou, E.: Evaluating Search Engines: A Comparative Study between International and Greek Search Engines by Greek Librarians. Program: Electronic Library and Information Systems 46 (2), pp. 182--198 (2012).

7. Miniwatts Marketing Group: Internet Usage in Europe, http://www.internetworldstats.com/stats4.htm, (accessed 10 May 2013) (2012).

8. Statcounter: StatCounter Global Stats: Top 5 Search Engines from Jan 2012 to Jan 2013, http://gs.statcounter.com/#search_engine-ww-monthly-201201-201301-bar, (accessed 24 May 2013).

9. Statcounter: StatCounter Global Stats: Top 5 Search Engines in Turkey from Jan 2012 to Jan 2013, http://gs.statcounter.com/#search_engine-TR-monthly-201201-201301-bar, (accessed 24 May 2013).

10. Li, K.F., Wang, Y., Yu, W.: Personalised Search Engine Evaluation: Methodologies and Metrics. In: Lewandowski, D. (ed.) Web Search Engine Research (Library and Information Science), vol. 4, pp. 163--202. Emerald Group Publishing Limited, United Kingdom (2012).