Comparative Evaluation of Actual and Predictive Rankings from Major Search Engine Results

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Abstract: ***Evaluation of search engines relies on analysis of search results for selected test queries. From these results, basically conclusions can be drawn in terms of relevance of the results for users. In practice however, evaluation can be determined by analyzing the results of major search engines. This paper presents and analyzes the predicted relevance system, which allows predicting a rank of search results according to relevancy for given query based on number of features found and score generated for the retrieved search results of major search engines. Given a set of retrieved search results, our proposed system finds out scores for search results and moves down non-relevant one having less number of score. Score computed directly correlates with actual relevancy judgment. The use of its relevance in actual evaluation scenarios is illustrated on web page results retrieved from major search engines for different queries. Predicted relevancy of retrieved ranking results of Google search engine improved from 88% to 99%, Ask improved from 90% to 99%, Bing improved from 93% to 98%, Gigablast improved from 89% to 98% while Yahoo improved from 93% to 100%.***

Keywords*:* ***Predict, relevancy, ranking, search engine.***

I. INTRODUCTION

The evolution in WWW leads to increase in number of internet users globally. Internet users reached the mark of the first billion in 2005, second billion in 2010, third billion in 2014 and 5.4 billion in 2023[1]. As a result of this active number of website has increased consistently. To access specific information from huge number of websites, searching online has become a part of daily activity. As a result of evolution in search engines, 91% of people use search engine to find information most of the time when they use internet [3]. Search engines locate information from huge data by using keyword based search. It becomes a difficult task for search engine to display only the most relevant pages from a large set of websites for the submitted search query. Most of the users never look beyond the first page of returning results[4]. First page search results of Google collect 91.5 percent of all traffic from the average search [5]. Even top placement in search engine results is now one of the strongest contributors to commercial websites success [6]. It becomes extremely tough competition among all the competing websites to get top position in the search results. Top position can be achieved by improving quality of website but it requires more money, time and other resources. The second option is to optimize the website using search engine optimization techniques(SEO). It can be preferred rather than Internet advertisement because of its lower cost [7]. SEO is the cost effective process and most important website promotion technique among all[8]. SEO is the process which improves the quality and volume of web pages via natural search results [9]. Business information can be published quickly on search engine result and it gets high ranking by using SEO technologies [10]. If the search engine optimizers optimize the website using ethical techniques, the top ranking results are contained in the relevant pages. The use of SEO techniques in unethical way misguides the search engine, manipulates the search engine ranking algorithm and bad sites get undeserved high ranking in search result. It lowers the quality of search engine. All White hat and black hat SEO techniques with on-site optimization and off-site optimization techniques in detail have been explained and these form as a "guide" of whole existing SEO techniques[11]. Some of the SEO techniques can still be found by inspecting the HTML code within the page source [12]. HTML source code of top result pages returned by major search engines were analyzed to understand the important features. Reverse engineering is a way through which the secret behind the ranking algorithm has been performed and important features were discovered. "SEO Guide" system is designed and developed to find out ranking terms (features) used in top result pages[13]. We developed a Prediction system which uses score computation algorithm[38] to move irrelevant results downwards. It has been designed and developed to assign score to each feature and according to that total score is computed for each page. Once all scores are calculated, the set of pages are sorted by descending order according to their total

score. This assigned a predicted ranking rank (k) to each page. Subsequently, predicted rankings and real positions are compared for all test pages .

This paper explores mainly the comparison of relevancy of predicted ranking and original ranking of major search engines for retrieved results using test queries. The novelty of the devised system lies in finding features and measuring the unique score to each page which can be used to rank and compare websites.

II. REVIEW OF LITERATURE

The performance of search engine depends on ranking algorithm it uses. Each search engine uses its own algorithms for ranking and exact algorithm that compute ranking scores are kept secret by the search engines. Search engine optimizers analyzed the top search result pages to get secrets of search engines ranking process. It helps them to optimize the website specifically and website should have high chances of better ranking in search engine result. SEO is a cost effective process and most important web promotion technique among all website promotion techniques[8]. SEO helps to catch more traffic to the website and enhance its visibility on the internet. It is the reason that website owners try to improve their position on search engines by using SEO techniques. In SEO study papers [7,14,15,16,17] authors explained what SEO is, the different SEO techniques used and how they work. SEO techniques are basically defined to improve the website's ranking on search engines and making money[18,19,20,21,22]. In [23,10,24,25,26] authors explains different strategies, secretes, guidelines of SEO to move up the ranking of website and building traffic to the website. Websites are designed using SEO techniques so that website should be visible and get good ranking position. Page rank is the major parameter in search engine evaluation. Evaluations can be determined by analyzing the results of major search engines. Researchers perform the studies to decide which search engine is most capable of retrieving relevant information. Author [27,28,29,30,31,32,33] evaluated search engine performance relating to search engine parameters like relevance, precision, recall , degree of overlap, total clicks, click through rate, duplicate websites etc. This paper goes beyond this. In this paper predicted ranking is computed based on features (SEO techniques) found in web page for promoting websites in search engine result. The ranking position is predicted for each retrieved search results of major search engines for test queries. Original ranking and predicted ranking positions are compared. Search engines are evaluated with mean precision of predicted ranking.

III. SCOPE OF STUDY

The main aim of the study is to compare the predicted ranking of retrieved search results with original ranking of retrieved results of major search engines for selected queries. The present study is significant one because it examines the ranking position of relevant results after system implementation and discusses how the non relevant results move down and relevant results for given query get deserving position.

IV. METHODOLOGY

For this study, we have selected five search engines which are more popular namely Google, Yahoo, Bing, Ask and Gigablast. The criterion was the popularity of the search services. According to Search Engine Watch, a search industry news site, the major international search engines are Google, Yahoo, Bing and Ask[36]. These search engines use their own database. For this study, 10 different keyword queries from different areas are submitted by us to the selected five most popular search engines. All queries were English language with single word search keyword, two words search keyword and three words search keyword. A set of large number of resulting web pages on each topic were retrieved. We constructed a data set of HTML pages(source code)consisting of retrieved results return by major search engines. A system called "SEO Guide" has been designed and developed by us. This system reads top 100 result pages each from major seven search engines. System examines the HTML source code of search results and identifies the ranking terms used by major search engines. This helps to understand the search engine algorithm strategy. The prime goal of the system is to understand the features of search engines ranking algorithm. It help the webmaster to acquire a better ranking position in search engine result pages in ethical manner. This work also find out that search engine has more emphasis on some of the features also called as ranking factors[13]. From the study of all source pages of all search engines total 52 different features are selected and from these an optimal set of features are identified. Prediction system which is designed and developed in our previous work which find out the 10 optimal subset of features from observing retrieved search results. When search keyword match with the feature found in page then

according to criteria, some value is assigned to feature 'i' called 'f_i' and weight assigned to feature 'i' called 'w_i' When all the feature values computed then the total score for a page is computed by adding scores of all features and assigned Boolean values to a feature according to present or absent of feature in a page. Value 0 is assigned to each feature absent in a page and value 1 to each feature present in a page. Precise values for each feature are assigned according to its occurrence of frequency. Of course, there is no general rule to define precise value. Weights to each feature are assigned according to its importance which remained unchanged during the whole experiment. System computed score for each feature present in a page k and according to that total score is computed for each page. Total_score(k)= $\Sigma i=1$ to n (f_i . w_i) . Once all scores are computer, the web pages are re-ranked in descending order according to total score of page[38]. This paper analyzes Google results and proposes a novel approach to move down the top-ranking irrelevant Google search engine results. A 'feature Score computation' algorithm was presented here to compute scores based on features found in pages, and using the score, the pages are re-ranked to move down irrelevant results and uplift the relevant products. The accuracy of the corpus results' relevancy was 88%, and after applying the algorithm, it was improved to 99%. This work improved the ranking of relevant products efficiently. In this paper, we compare original results and predicted results, for comparison only top 20 pages retrieved by each search engine are taken. The reason behind selecting top 20 results is users are only interested in first few results[37]. For each query, the first 20 original results from each search engine were analyzed and the relevant and non- relevant results was marked. Subsequently, predicted ranking and real ranking of web pages are compared for relevancy of all test page[39].

V. RESULTS AND DISCUSSION

To measure precision of search results the criteria is defined as follows. If contents of the web page are related to the given search keyword then the web page is considered as "more relevant" and score 1 is assigned. If content of the web page is not fully or partially related to search keyword then the page is considered as "less relevant or irrelevant" and score 0 is assigned. Using the above criteria the precision of search results of search engines for each of these queries is computed as follows:

$$\text{Precision} = \frac{\text{Sum of relevant sites retrieved by a search engine}}{\text{Total number of sites retrieved}}$$

This precision computation is done for top 10 queries, then 11 to 20 queries and so on. As a sample, comparative analysis of precision of top 10 original search results with predicted search result for Google search engines is shown in table I. Table I shows that original results of Google contained total 12 irrelevant sites in top 10 results of predefined queries. Mean precision computed is 0.88. After evaluating the system only 1 irrelevant site remained in total 100 results and the mean precision has improved from 0.88 to 0.99. It shows the improvement in original results relevancy. Fig. 1 demonstrates graphically the comparative analysis of precision of Google search results presented for all queries. Fig. I shows that for query Q2,Q3,Q4,Q7,Q8,Q9 all irrelevant sites are moved down and all top ten results contain relevant sites. For query Q1 precision has improved from 0.7 to 0.9 means in top 10 results only one site is irrelevant for query Q1.

Table I: Precision Results for Google search engine

Search Queries	Original Results			Predicted Results		
	Relevant	*Irrelevant or less relevant*	*Precision*	*Relevant*	*Irrelevant or less relevant*	*Precision*
Q1	7	3	0.7	9	1	0.9
Q2	8	2	0.8	10	0	1
Q3	8	2	0.8	10	0	1
Q4	9	1	0.9	10	0	1
Q5	10	0	1	10	0	1
Q6	10	0	1	10	0	1
Q7	9	1	0.9	10	0	1
Q8	9	1	0.9	10	0	1
Q9	8	2	0.8	10	0	1
Q10	10	0	1	10	0	1
Total	88(88%)	12(12%)	0.88*	99(99%)	1(1%)	0.99*

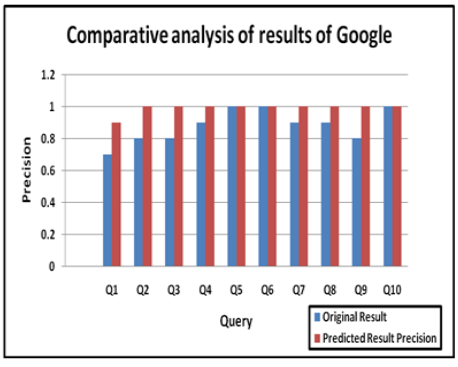

Fig. 1: Comparative precision analysis of results of Google

Table II shows comparative analysis of precision of original results and predicted results for each query of Ask search engines. In table II, original results of Ask contain 10 irrelevant sites in total 100 results. Mean precision computed is 0.90. After evaluating the system, in the predicted results, only 1 irrelevant site

remained in total 100 results and the mean precision has improved from 0.90 to 0.99. Hence relevancy has improved for search results of Ask. Graphical representation of comparative analysis of results of Ask search engine is depicted in Fig. 2. It shows that for queries Q1,Q2,Q4,Q5,Q6,Q7 all irrelevant sites in top 10 result list are moved down and all top ten results contain relevant sites. For query Q9 precision has improved from 0.8 to 0.9.

Table II: Precision Results for Ask search engine

Search Queries	Original Results			Predicted Results		
	Relevant	*Irrelevant or less relevant*	*Precision*	*Relevant*	*Irrelevant or less relevant*	*Precision*
Q1	8	2	0.8	10	0	1
Q2	9	1	0.9	10	0	1
Q3	10	0	1	10	0	1
Q4	9	1	0.9	10	0	1
Q5	9	1	0.9	10	0	1
Q6	9	1	0.9	10	0	1
Q7	8	2	0.8	10	0	1
Q8	10	0	1	10	0	1
Q9	8	2	0.8	9	1	0.9
Q10	10	0	1	10	0	1
Total	90	10	0.90*	99	1	0.99*

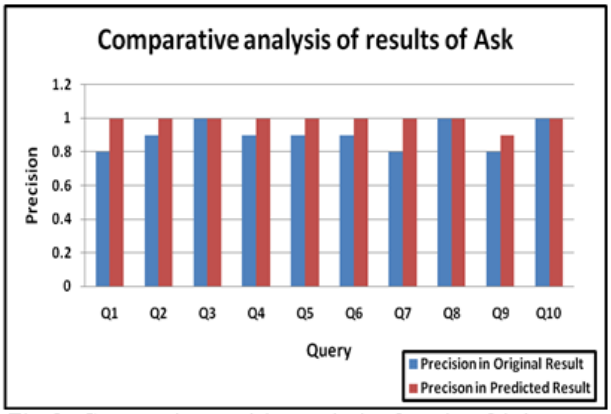

Fig. 2: Comparative precision analysis of results of Ask

Table III shows the comparative analysis of precision of original results and predicted results for each query of Bing search engines. It shows that original result contains 7 irrelevant sites remain in total 100 results. Mean precision computed is 0.93. After evaluating the system, it was found that only 2 irrelevant sites have remained in total 100 results and mean precision has improved from 0.93 to 0.98. Graphical representation of comparative analysis of search results of Bing search engine is depicted in Fig. 3. It shows that for queries Q2 to Q10 except Q1 and Q7 all irrelevant sites in top 10 result list are moved down and all top ten results contain relevant sites.

Table III: Precision Results for Bing search engine

Search Queries	Original Results			Predicted Results		
	Relevant	*Irrelevant or less relevant*	*Precision*	*Relevant*	*Irrelevant or less relevant*	*Precision*
Q1	9	1	0.9	9	1	0.9
Q2	9	1	0.9	10	0	1
Q3	10	0	1	10	0	1
Q4	8	2	0.8	10	0	1
Q5	10	0	1	10	0	1
Q6	10	0	1	10	0	1
Q7	9	1	0.9	9	1	0.9
Q8	9	1	0.9	10	0	1
Q9	9	1	0.9	10	0	1
Q10	10	0	1	10	0	1

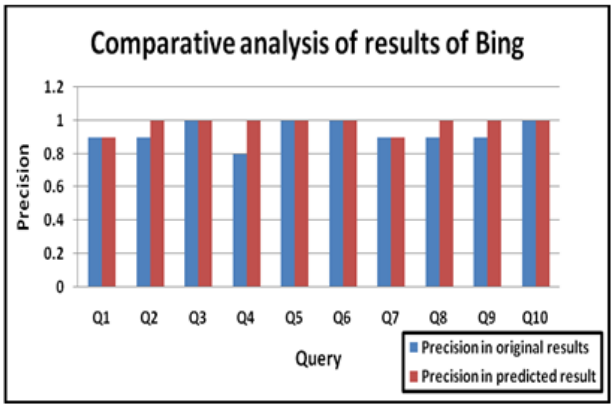

Fig. 3: Comparative precision analysis of results of Bing

Table IV shows precision computed for original and predicted results for each query results of Gigablast search engines. Table IV shows that original result contains 11 irrelevant sites in total 100 results. Mean precision computed is 0.89. After evaluating the system the top 10 results for each query are re-ranked and it is found that only 2 irrelevant sites have remained in total 100 results and mean precision has improved from 0.89 to 0.98. Fig. 4 shows graphically the comparative analysis of precision in original results and precision in predicted results of Gigablast search engine for each query. Fig. 4 shows that for queries Q1,Q3,Q4,Q7 the ranking of original results improved in predicted results. Predicted results contain all relevant sites in first search engine result page and the irrelevant sites in top 10 results list are moved down and only 2 irrelevant site remain in top 10 result list of query Q5 and Q9.

Table IV: Precision Results for Gigablast search engine

Search Queries	Original Results			Predicted Results		
	Relevant	*Irrelevant or less relevant*	*Precision*	*Relevant*	*Irrelevant or less relevant*	*Precision*
Q1	9	1	0.9	10	0	1
Q2	10	0	1	10	0	1
Q3	8	2	0.8	10	0	1
Q4	8	2	0.8	10	0	1
Q5	8	2	0.8	9	1	0.9
Q6	10	0	1	10	0	1
Q7	9	1	0.9	10	0	1
Q8	10	0	1	10	0	1
Q9	7	3	0.7	9	1	0.9
Q10	10	0	1	10	0	1
Total	89	11	0.89	98	2	0.98

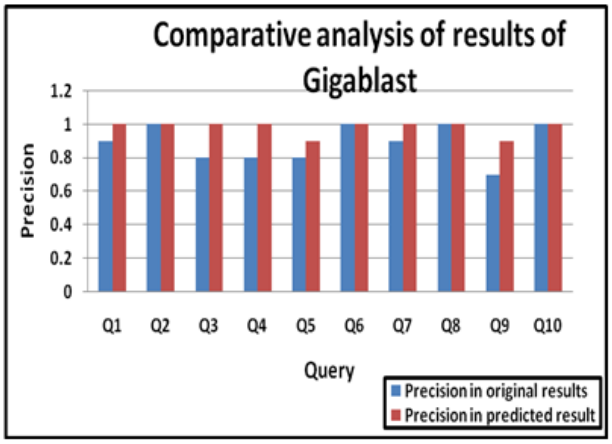

Fig. 4: Comparative precision analysis of results of Gigablast

Table V shows precision computed for original results and predicted results for each query results of Yahoo search engines. Table V shows that original result contains 7 irrelevant sites in total 100 results. Mean precision computed is 0.93. After evaluating the system the top 10 results for each query are re-ranked and it is found that not a single irrelevant site remains in total 100 results and mean precision improved has from 0.93 to 1. Fig. 5 depicts the graphical representation of comparative analysis of precision in original results and precision in predicted results of Yahoo search engine for each query.

Fig. 5 shows that for queries all predicted results contained relevant sites. The precision score for queries Q1,Q4,Q5,Q8,Q9 is improved from 0.9 to 1 and for Q7 improved from 0.8 to 1. Now all top 10 results for each query has contained relevant sites. It has been observed that now Yahoo contained 100% relevant sites in top 10 result list of each query.

Table V: Precision Results for Yahoo search engine

Search Queries	Original Results			Predicted Results		
	Relevant	*Irrelevant or less relevant*	*Precision*	*Relevant*	*Irrelevant or less relevant*	*Precision*
Q1	9	1	0.9	10	0	1
Q2	10	0	1	10	0	1
Q3	10	0	1	10	0	1
Q4	9	1	0.9	10	0	1
Q5	9	1	0.9	10	0	1
Q6	10	0	1	10	0	1
Q7	8	2	0.8	10	0	1
Q8	9	1	0.9	10	0	1
Q9	9	1	0.9	10	0	1
Q10	10	0	1	10	0	1
Total	93	7	0.93*	100	0	1*

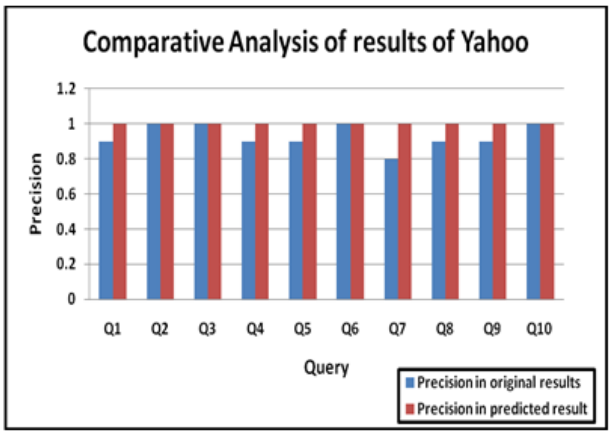

Fig. 5: Comparative precision analysis of results of Yahoo

VI. COMPARATIVE ANALYSIS OF SEARCH RESULTS OF SELECTED SEARCH ENGINES

Comparison of precision of various search engines for selected queries is analyzed. Table VI shows comparative evaluation of precision of original results of major search engines for all queries. Fig. 6 graphically shows precision measure for original results of major search engines for all queries.

Table VI: Comparative evaluation of original results

Queries	Google	Ask	Bing	Gigablast	Yahoo
Q1	0.7	0.8	0.9	0.9	0.9
Q2	0.8	0.9	0.9	1	1
Q3	0.8	1	1	0.8	1
Q4	0.9	0.9	0.8	0.8	0.9
Q5	1	0.9	1	0.8	0.9
Q6	1	0.9	1	1	1
Q7	0.9	0.8	0.9	0.9	0.8
Q8	0.9	1	0.9	1	0.9
Q9	0.8	0.8	0.9	0.7	0.9
Q10	1	1	1	1	1

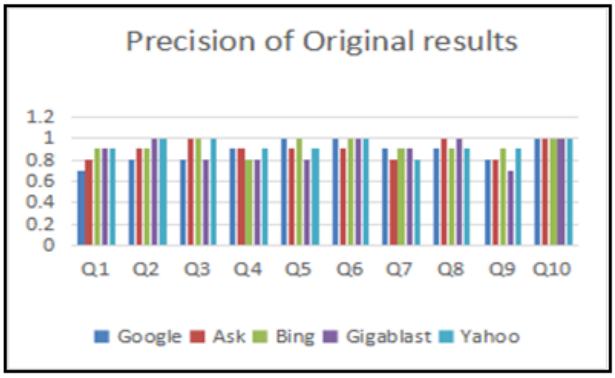

Fig. 6: Comparative evaluation

Bing and Yahoo seem to have the best documents retrieval performance in terms of relevant results retrieved. The results show that Bing and Yahoo returns 93% relevant documents while Google returns 88% and Ask returns 90% relevant documents in top 10 results. Table VII shows comparative evaluation of precision of predicted results for all search engines and queries with its graphical representation is shown in. Fig. 7.

Table VII: Comparative evaluation of predicted results

Queries	Google	Ask	Bing	Gigablast	Yahoo
Q1	0.9	1	0.9	1	1
Q2	1	1	1	1	1
Q3	1	1	1	1	1
Q4	1	1	1	1	1
Q5	1	1	1	0.9	1
Q6	1	1	1	1	1
Q7	1	1	0.9	1	1
Q8	1	1	1	1	1
Q9	1	0.9	1	0.9	1
Q10	1	1	1	1	1
Mean	0.99	0.99	0.98	0.98	1.00*

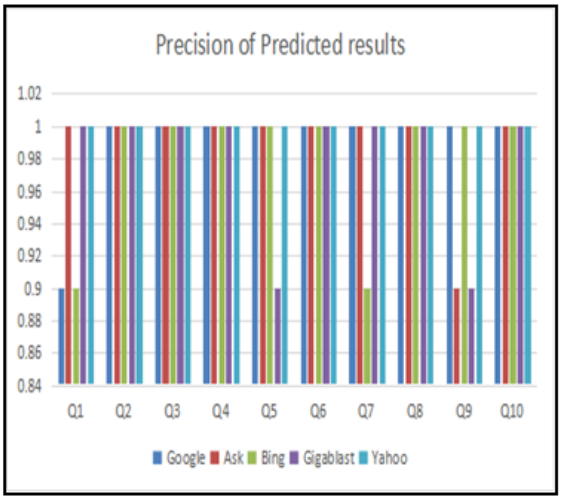

Fig. 7: Representation of predicted results

It has been observed that Yahoo seems to have the best documents retrieval performance in terms of relevant results retrieved. It returns all relevant sites in top 10 results for each query. It has been observed that results of Ask search engine returned 99% relevant documents while results of Bing and Gigablast search engine returned 98% relevant documents in top 10 results. Result also shows that Google search engine returns 99% relevant results. Comparative evaluation of mean precision of original and predicted results is shown in table VIII.

Table VIII: Comparative evaluation of mean precision

Search Engines	Mean Precision Before	Mean Precision After
Google	0.88	0.90
Ask	0.90	0.99
Bing	0.93	0.98
Gigablast	0.89	0.98
Yahoo	0.93	1.00

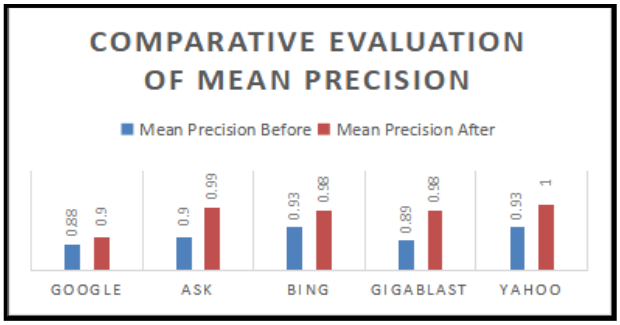

Fig. 8: Comparative Evaluation of mean precision

Relevancy of results retrieved by Google has improved from 88% to 99% while for Ask search

engine relevancy was improved from 90% to 99%. Bing search results relevancy has improved from 93% to 98% while Yahoo! Search engine gives 100% relevant results, its relevancy has improved from 93% to 100%. Previously Gigablast returned 89% relevant results but after system implementation relevancy has improved from 89% to 98%. Fig. 8 depicts graphically the comparative evaluation of mean precision score of original results and predicted results presented by major search engines. Original results of Google contain 12 and Ask contain 10 irrelevant results in total top 100 results for 10 different queries. After system evaluation, the predicted results contain 99 relevant results each in top 100 results. For Bing search engine previously, original results contain 7 irrelevant results in total top 100 results. But after the experiment evaluation the predicted result contains only 2 irrelevant sites. For search engine Gigablast mean precision has improved from 0.89 to 0.98. Means original results contain 11 irrelevant results in total top 100 results for 10 different queries. After system evaluation only 2 irrelevant results remain. Even for search engine Yahoo! Mean precision has improved from 0.93 to 1. Original results of Yahoo contain 7 irrelevant results in total top 100 results for 10 different queries. After system evaluation, the predicted results contain all relevant results in top result list of each of queries. Hence from this discussion it can be stated that the devised present predicted system performs better for given corpus.

VII. CONCLUSION

According to the analysis of original and predicted results , predicted relevancy of retrieved ranking results of Google has improved from 88% to 99%, Ask has improved from 90% to 99%, Bing the improved from 93% to 98%, Gigablast has improved from 89% to 98% while Yahoo has improved from 93% to 100%. The results indicate that the newly devised system generates improved results for each search engine for selected queries. Predicted results for all major search engines have contained maximum relevant sites in top search results and irrelevant sites are moved down.

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