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Novel Semantic Approach Based Ranking Algorithm Framework For Advancing Search Engines

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ABSTRACT
Now a days, many of the internet users require efficient search engines in order to get the facility of faster web page searching and processes of information retrieval. But the conventional web search engines facing primary challenges of retrieving accurate outcomes for given particular query taking lowest time for response. Conventional search engines also face the challenges of expanding conflicting queries depending on the semantic link of each keyword. Therefore, in this paper, we proposed a novel model for web page ranking using semantic web page retrieval approach for the classification of significant results of queries which are not clear by making use of semantic relations. Experiments are conducted, by evaluating the proposed model with different four scenarios of inputs developed. The results are compared with existing web page ranking mechanisms including the real time search engines. The comparisons of results demonstrated that, the proposed model is in better place.

Keywords: search engine, information retrieval, indexing, semantic ranking, LDA, RDF.

1. INTRODUCTION
In a traditional Information Retrieval System, the progression of the process is that the reports from the web are downloaded and transformed into an authentic structure such as index or metadata or index inverted. Then, at that point user can enter an search-question as input to the web-search

engines which is then compared with its index. Such kind of comparisons may be metadata comparison or full-text comparisons. Those compared and matched docs retrieved depending on the similarities of inquiry model. The retrieved records are then scored depending on the models used for ranking, out of which top docs are displayed to web-user. The web-user may tap on any record and read the contents. Furthermore, retrieved archives can likewise be summed up and transformed over into pieces that can coordinate the web-user in opening respective doc. The method clarified above can be summed up into 3 primary stages [1]: Crawling, Indexing, Retrieval and Ranking. These stages are illustrated in details in the block diagram given in Figure1.

The crawling is an interaction which intermittently visits the website pages and duplicates them with the goal that they can be indexed. It's anything but a bunch of URLs and goes through the website pages addressed by these URLs, by adding every hyperlink in page to the URL Lists. If any new hyperlinks, could be added indiscriminately to URLs list or numerous checks could be made prior to adding it to URLs list. Accordingly, this cycle proceeds recursively.

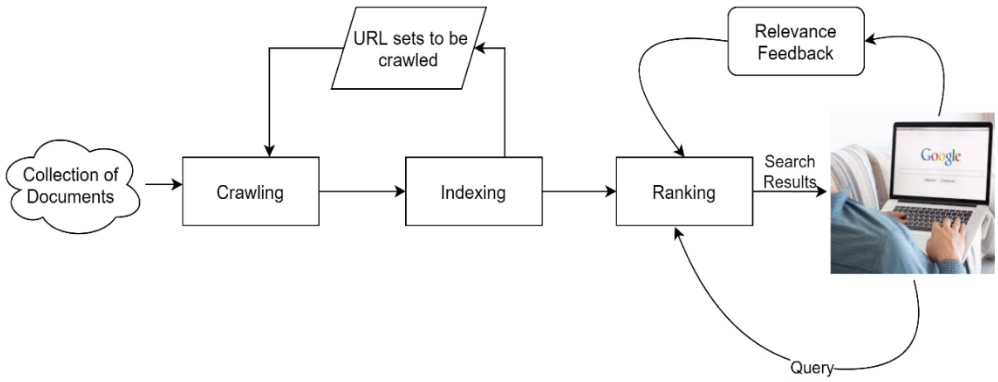

Figure 1 Block diagram illustrating Components of Information Retrieval System

In second stage, indexing, the pages which are crawled in initial step are changed over into an representational structure. Due to the index, we do not have to perform a full-text search each time an inquiry is terminated. Consequently, indexing makes search quicker and effective. There are a wide range of methods for indexing. The one of them is Suffix tree, in some cases alluded to as radix or Prefix tree. The suffix Tree is a kind of data structure having strings as keys. In this the tree node doesn't store the strings, which is unlike the binary tree, which stores the string values, except for the path of the node from root-node portrays the values. The indexing stage would be formed mainly through three phases such as tokenization, elimination of Stop-words and process of stemming.

The step tokenization is the way toward dividing sentences of reports into morphology-based units. Every morphology-based unit should be a word of substantial source language. The words which are incorrect, are amended by spell rectification.

Stop-words are the expressions of language that don't pass on significance of the specific situation yet further develop familiarity of sentence. Stop-words should be eliminated from query just as ordered document to really compared and matched with the idea of query with docs.

The process stemming is the cycle for decreasing words that are inflected to their base, stem, or root structures. This is normally adequate that connected words guide to a similar stem, regardless of whether this stem isn't in itself a legitimate root.

There are different types of algorithms to manage webpage ranking. In view of their page positioning methodology, the algorithms for website page ranking could be categorized as illustrated in Figure 2. Among these few of the algorithms discussed below, based on our importance for comparing later with proposed ranking approach in this paper.

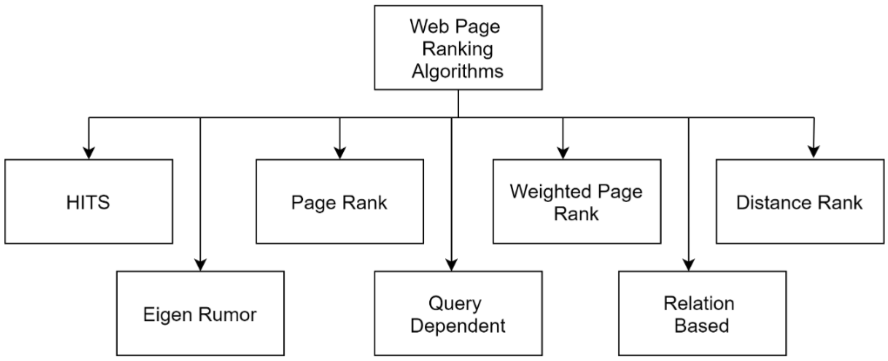

Figure 2: Various types of web page ranking algorithms

The Page rank algorithm is most significantly utilized for positioning the pages and furthermore utilized by Google. The working of algorithm relies upon the structure of the links of the pages. This algorithm idea depends on the count of significant connections pointing towards it then the connections to this webpage are likewise considered as the significant pages. In order to decide the rank score of the webpage, it considers the back line.

The HITS (Hyperlink Induced Topic Search) is next popular algorithm that is utilized for Page Rankings. In HITS, the underlying advance is the recovery of the most applicable pages to search-query. The set acquired by availing the top most returned webpages by utilizing text-based algorithms for search can be characterized as the root set. The expansion of the root set with all the site pages which connected to it and that are connected from it. The subgraph in focus, is being framed by the webpages in the base sets and all hyperlinks between those pages. Calculation of HITS is being obtained on this subgraph. The series of reiteration is performed by the algorithm, each comprising of two essential stages as illustrated in Figure3.

Authority update: Making update of "authority score" of every node equivalent to the summation of "scores of hubs" of each node pointing towards it. To such an extent that, the higher authority score is provided to node, by the pages being connected to it, that could be perceived as Hubs for information.

Hub update: Making update of the score of every hub that is equivalent to the summation of the "authority scores" of each node that it is highlighting. To such an extent that, higher hub core is allowed a hub, connected to nodes which are recognized as authorities regarding the subject.

The Algorithm Weighted Page Rank depends on page rank calculation in an adjusted manner, for example the rank score is chosen dependent on the standing of the pages and significance of both out-joins and in-joins are considered. The higher rank value to the webpage is given by a algorithm, furthermore do not separate the position of page among it's out-connect webpages equally. In view of the ubiquity each out-connect is given its individual position. The quantity of out-connections and number of in-connections chooses the prominence of the webpages.

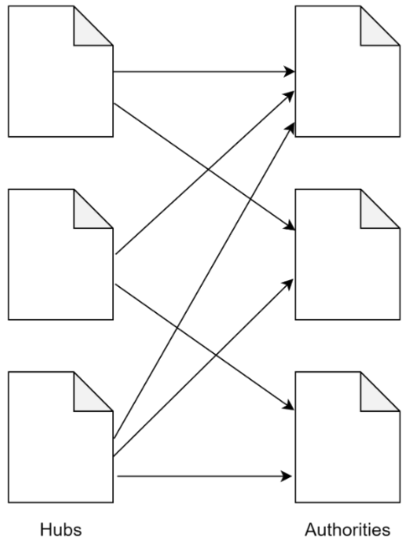

Figure 3. Diagrammatic allIlustration of Hubs and Authority

The algorithm Distance Rank depends on the algorithm Reinforcement learning. One of the segments in this Distance Rank is discipline factor that can be characterized as "the distance between the webpages". Based on the briefest logarithmic distance between two webpages, the positioning of the pages is created. The benefits of the algorithm are that it discovers excellent quality webpages rapidly with the utilization of distance-based arrangements.

The idea of semantic search [2]is to solve the demeritsand challenges associated with conventional search based onkeywords. Semantic search depends on the fact of retrieving data using tags along with adding the benefit oflinking these tags and understand the meaning behind and addmultiple tags which improve the search results [3]. An ontology-based methodology provided to have representation of the relationships and vocabularies between semantic entities. Ontology describes theelements that exist in any field or area to represent semantic based relations [4][5]. In this paper, we developed a novel model for web page ranking using semantic web page retrieval approach for the classification of significant results of queries which are not clear by making use of semantic relations.

2. RELATED WORKS

Some of the research works done in the area of information retrieval and web page ranking are discussed. In any case, the fast expansion in the amount of data has made it hard to give the applicable data by utilizing the contents of webpage and links among webpages. The work in [6] manages the correlation and analysis of algorithms for ranking of webpage by making use of various arguments. There are search engines trying to enhance the accuracy of retrieving the information. A large portion of the standard search techniques are very famous; however, their outcomes are now and then inaccurate that have a lower accuracy and high review. They need to obtain the implications of terms and articulations utilized in webpages and their links. The challenge lies in the presence of words which have numerous implications in normal languages [7].

Current intelligent search frameworks, such as SWSE, Swoogle, Falcons and so on, are developed dependent on the semantic way to deal with the conventional issues. Swoogle is a framework which depends on semantic crawling and ordering of web pages [8]. The most important downside of this framework is that it's restricted to predefined ontology files and not a search engine to be used for general purpose.[9]. A conventional web search engine can't expand a little, conflicting query dependent on the importance of every keyword and their semantic relationship. The work in the paper [10] proposes a web search engine model which gathers the advantages of both based on keyword and framework based on semantic ontology.

The importance of a web page is determined via web crawlers utilizing page ranking approaches. At the outset, Google presented Page Rank Algorithm which was set as standard algorithm in light of the fact that no other algorithm implied for positioning webpages was in presence. Later various components like weights or count of visits of a web page was fused in standard page rank approaches by various researchers. This work [11] incorporates a point-by-point review of different varieties of page rank calculation. The work also covers review on Search Engine Optimization just as Recommendation framework as these methodologies additionally assume a significant part in setting the exact Page Rank of a Web Page. The work in the paper [12] presents a approach of making use of ML algorithms depending on knowledge of experts to categorize web pages to three predetermined classes as per the degree of web content ordering to the SEO recommendations. Both standard SEO and ASEO have an essential worry with deciding the primary factors utilized in ranking approaches. The point of these two fields of enquiry is to provide more apparent the attributes that articles present and that, thus, fill in as rules for ranking [13].

Now a days, there is a big community of SEO specialists and organizations which devote their efforts to analyze and discuss Google's significance ranking approach. Through web blogs [14–17], books [18] andonline distributions [19–21], they suggest developers and website admins as to how they can upgrade their sites so they are effectively indexed and can possess the maximum rankings in the outcome pages. Different researchers work on different approaches deal with quality ranking in website as done by authors in [22], using algorithmic fuzzy programming.

3. ALGORITHM AND FRAMEWORK PROPOSED

In this section, the proposed model for information retrieval and web page ranking system is discussed. The block diagram shown in Figure 4.

There are Two stages, first stage consists of crawling, pre-processing, keyword expansion, indexing, andranking processes of webpages, which occurs in background system. The second stage consists of Query Engine, Query Optimizer, overall a browsing and page retrieving processes, in which user can perform querying operationwith the background servers directly. The work in thispaper focus on Query optimization and cache table preparation in the foreground stage, Crawling, Pre-processing and web page Ranking in background stage.

In the crawling process, which is more critical process in background phase, the MapReduce [23] is used to handle huge data to enable divide & conquer and parallelization [24][25] on the input page. The initial part of the crawling process is defined in Algorithm-1, which takes website URL as input produces X, Y arrays as output. The algorithm focuses on TREE nodes of index page to objects and info nodes by making use of DOM-TREE. The looping in algorithm will filter out tags which are unused and having lower that 3 depths. The extracted nodes array is obtained from the nodes which pass process of filtration as useful nodes.

Then the pre-processing process is applied to parse the data from useful nodes and followed by cleaning of data (stemming process) in order to produce valid keywords. The MapReduce and Hadoop tools are used for the implementation of complete crawling process.The DOM-TREE sample containing special nodes, which are having common parent with useful data, is illustrated in Figure 5.

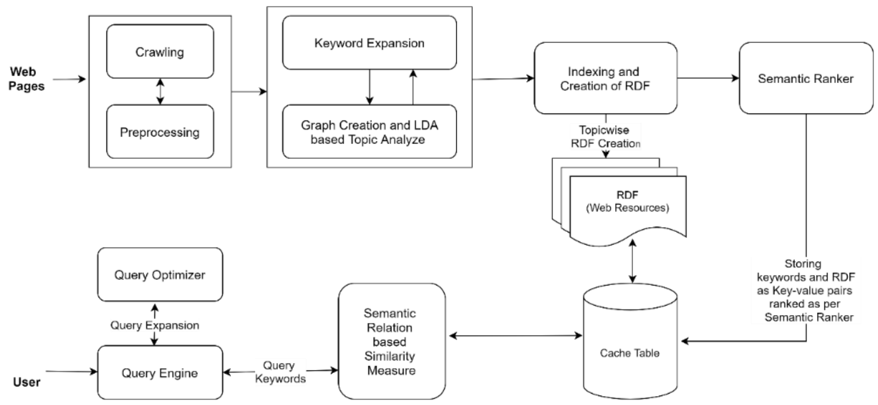

Figure 4 Proposed Model Architecture

Algorithm-1: Crawling

Input: Website address

Output: Array of DOM(X) and Extracted Nodes(Y)

X = NULL

Y = NULL

IP = Website address;

if IP == index or threaded page then

NThread << Website address;

X = objects DOM of entry page;

for k: X.len do

if depthTree (X[k]) >= 3 then

if X[k] == Linking Tag then

Crawling (X[k])

else

Y[k] = X[k]

end

Return X, Y

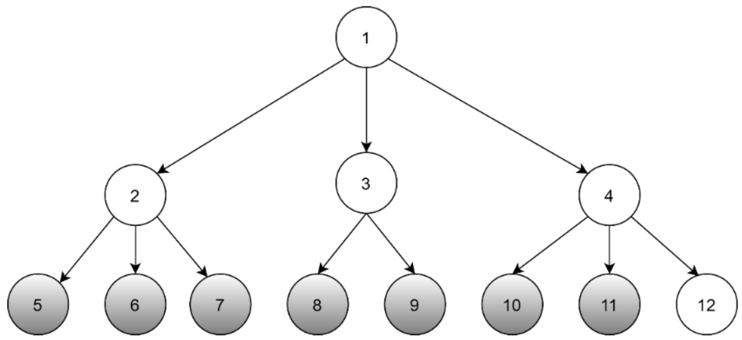

Figure 5 Example of DOM-TREE with special nodes and data

All nodes which are in grey colour are special adjacent nodes having distinct data regions. For instance, BODY, TABLE, IMAGE and DIV represented by the parent nodes 1,2,3 and 4. The child nodes of parent node TABLE are nodes 5, 6 and 7 which may represent TR tags, which are treated as initial data regions. Nodes 8,9,10 and 11 are treated as next data regions representing paragraph tags.

The next process is topic analysis and to obtain the maximum relevant keywords. The Latent Dirchilet Allocations (LDA) method [26] is used for topic analysing, and Fuzzy C-mean approach to gather respective keywords and primary keywords for subject wise memberships. And then the ontology graph is generated as per every cluster of topics, in order to manage representation of knowledge and reuses.

The results of crawling, pre-processing and topic analysis are arranged to store in the database. The indexing process converts stored ontology graphs in to XML based RDF (Resource Description Framework) data files. These docs and keywords as (key, Val) pairs are stored in database. To help with scalability purpose, the NoSQL [27] module is utilized for orientation of documents. The cache tables consist of keywords and respective ID of RDF.

The process of ranking is one of the primary goals of our work. In order to obtain the score of ranking for every document that make easier to retrieval of relative doc, the mathematical model (Eqn. 1) is proposed which combines the results such as keyword, position, RDF records, of crawling process and indexing processes.

$$\mathrm{Rank(j)} = \sum_{\mathrm{p,k}\,\varepsilon\,\mathrm{j}} \left(\mathrm{PGRank(j)}.\ \mathrm{CWt(p,j)}.\mathrm{LNWt(j,k)}\right) \quad (1)$$

where Rank(j) is the calculated j^{th} document's semantic rank, PGRank(j) is Google's page rank for j^{th} document, CWt(p,j) is content weight of keyword p in j^{th} page, and LNWt(j,k) is Link weights of pages j and k. The Algorithm-2 describes the steps in computing score of Ranking.

Algorithm-2 Generate Score of Ranking

Input:Search Query (SQ), WebPage (WP), Weights of Link for WebPage;

Output: Semantic Ranking Score of WebPage (Rank)

Step1: Enter Search Query SQ;

Step2: Compute M=Use wordnets with other keywords for Expansion ofSQ;

Step3: if all M belong toWP, then

x belongs toM;

Compute CWt(x, WP) for x on WP;

Obtain all WP links;

ComputeLNWt(WP, k) for WP;

Generate web page Rank (WP);

Return Rank (WP)

end

Meanwhile, the foreground stage is connected directly to the users.The query engine process that takes query from the users and divide into different words.The query optimizer process, that scans the keywords and optimize the user queries and find if any grammatic errors. The keywords of user query are expanded by making use of wordnet, and then the query engine will calculate the similarity score among tags expanded and cache table tags. The tags having maximum semantic score will be utilized for the retrieval of RDF docs.

4. EXPERIMENTATION AND RESULTS ANALYSIS

The experimentation environment was setup in the lab having 10 desktop systems arranged in master-slave architecture installed with programming languages such as PHP, web serverApache, database tools such as RDF scheme with NoSQL, with datasets of millions of webpages.

The various testing scenarios are prepared, in order to evaluate various queries. The four test scenarios are created as follows:

Scenario-1: In this scenario, we apply proposed techniques in the system with queries of single word.

Scenario-2: In this scenario, we apply proposed techniques by not applying the process expansion of keywords and semantic relations-based similarity score in the system with queries of single word.

Scenario-3: In this scenario, we apply proposed techniques in the system with queries of multiple words.

Scenario-4: In this scenario, we apply proposed techniques by not applying the process expansion of keywords and semantic relations-based similarity score in the system with queries of multiple words.

The evaluation of above test scenarios is done using the metrics given in the equations (2), (3) and (4). The parameters used in the evaluation metrics include True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN). The Recall is computed as returned documents percentage which were rightly retrieved and treated as not part of the search query. The Precision is computes as returned documents percentage which were rightly retrieved and treated as very much related part of the search query. The F-score is computed from Recall and Precision.

$$\text{Recall} = \frac{\text{TP}}{\text{TP}+\text{FN}} \quad (2)$$

$$\text{Precision} = \frac{\text{TP}}{\text{TP+FP}} \quad (3)$$

$$\text{F} - \text{Score} = \frac{2*\text{Precision}*\text{Recall}}{\text{Precision+Recall}} \quad (4)$$

The results of experimentation using above four test scenarios are tabulated in Table-1. The Precision, Recall and F-Score values are computed for all four scenarios. The response time and the count of records fetched are recorded. The graphical analysis of system performance, response time and count of documents fetched for all four test scenarios are illustrated in Figure 6, Figure 7 and Figure 8 respectively. We can see that, when we single word, the number of documents fetched is maximum for scenario-2, and for multiple words, scenario-4 fetches maximum number of documents.

Table 1 Results of proposed system Performance

	Scenario-1	**Scenario-2**	**Scenario-3**	**Scenario-4**
Keywords as Input	1	1	4	4
Keywords Extended	10	0	15	0
TP	9820	7318	5718	4829
FP	412	520	112	324
FN	589	618	220	386
Recall	0.9439	0.9221	0.9629	0.9260
Precision	0.9597	0.9336	0.9808	0.9371
F-Score	0.9517	0.9278	0.9718	0.9315
Response Time (In seconds)	2.69	1.30	1.82	0.94
Count of Documents Fetched (RDF Files)	5810	11225	3292	7115

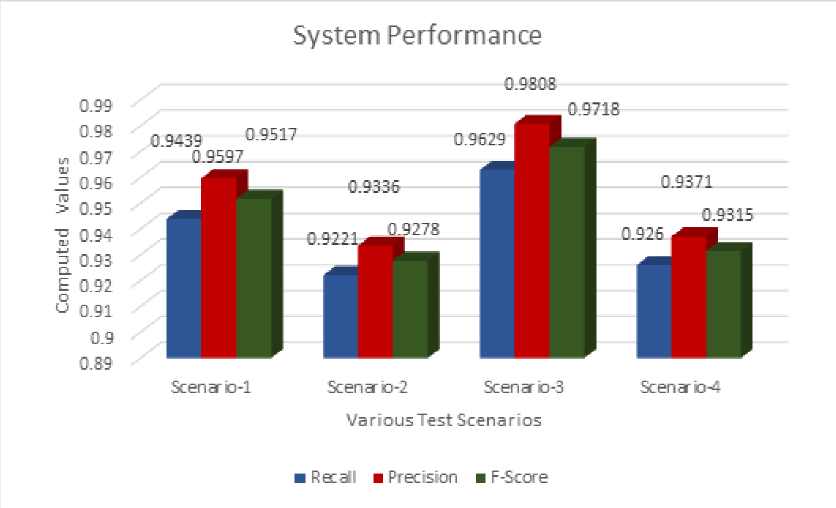

Figure 6 Graphical analysis of System Performance for four test scenarios

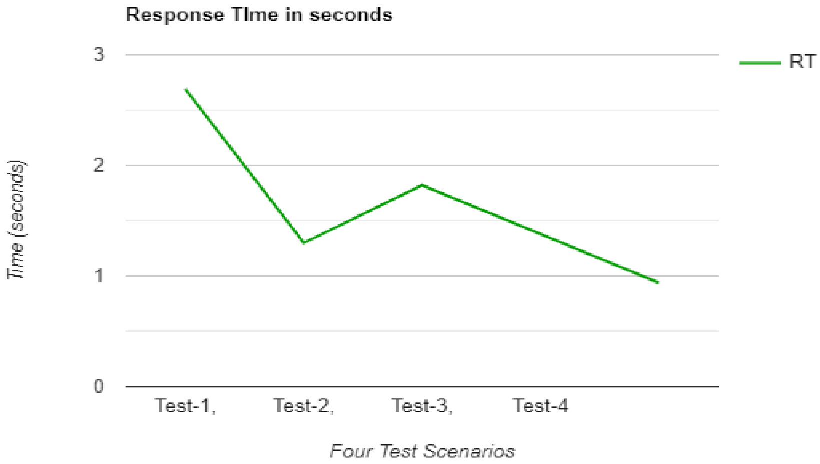

Figure 7 Graphical analysis of Response Time of four test scenarios

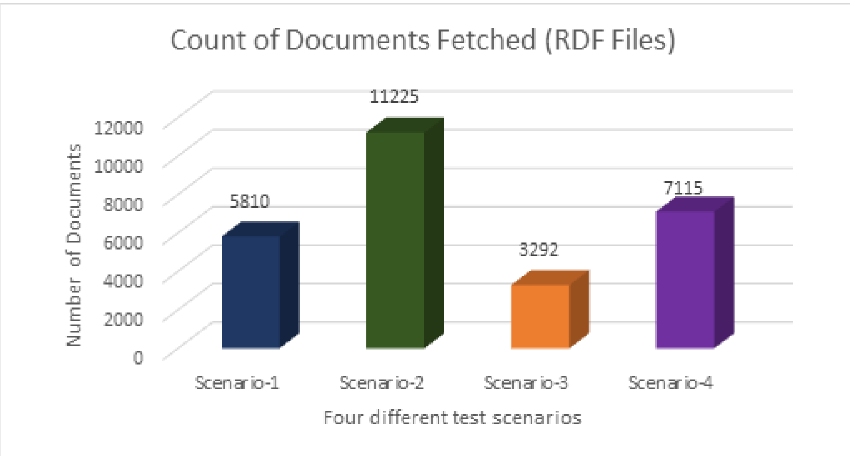

Figure 8 Graphical analysis of Number of documents fetched in four test scenarios

The proposed ranking approach is compared with various existing ranking approaches and tabulated the comparisons with merits and demerits of each approach based on various parameters such as types of ranking, facts, performance, mining approaches and limitations in Table 2.

Table 2 Proposed Ranking Approach compared with existing approaches

Ranking Approach	Proposed Ranking Approach	Distance Ranking	Hits Ranking	Weighted Page Rank
Ranking Types	Text	Text	Image	Text
Facts	Webpage Meta data and Backlink	Backlinks	Content of Image	Links visited
Performance	Medium speed	Medium Speed	Slower	Faster
Mining Approach	Content and Web Structure	Web Structure	Content of Web	Content and web Structure
Limitation	Works with webpage rank	Works weakly with Bigdata	Problems in speed	No Efficiency

The proposed system is also compared with some of the realtime systems in respective fields. There are various factors such as semantic support, bigdata handling, performance etc, using which we can enable comparison of our system with existing related systems. The two test scenarios of proposed system, scenario-2 with single word and scenario-4 with multiple words, are compared with Falcon, Swoogle and Google systems data for Precision, Recall, F-measure, number of documents fetched and response time. The Table 3 gives the results of comparisons. The graphical analysis of these comparisons for both the scenarios are illustrated in Figure 9 and Figure 10 respectively.

Table 3 Proposed System compared with Realtime systems for scenario-2 and Scenario-4

	Proposed System		**Falcon System**		**Swoogle System**		**Google System**	
	Scenario-2	Scenario-4	Scenario-2	Scenario-4	Scenario-2	Scenario-4	Scenario-2	Scenario-4
Count of Retrieved data	11K	7K	5K	1K	20K	13k	20M	2M
Response Time Avg (seconds)	2.69	1.82	2.92	2.15	3.11	2.44	1.53	0.65
Recall	0.92	0.92	0.93	0.95	0.90	0.94	0.98	0.98
Precisio	0.93	0.94	0.94	0.95	0.95	0.96	0.93	0.95

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F-Measure	0.93	0.93	0.93	0.95	0.92	0.95	0.95	0.96

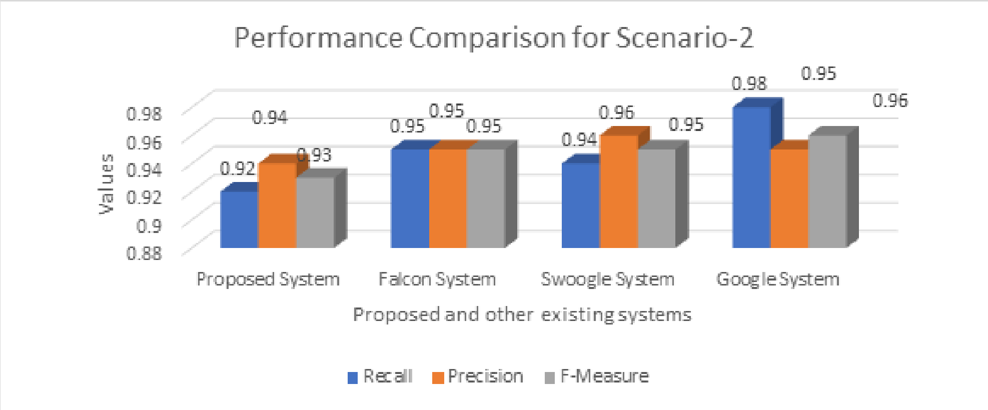

Figure 9 Graphical analysis of comparison of performance for scenario-2

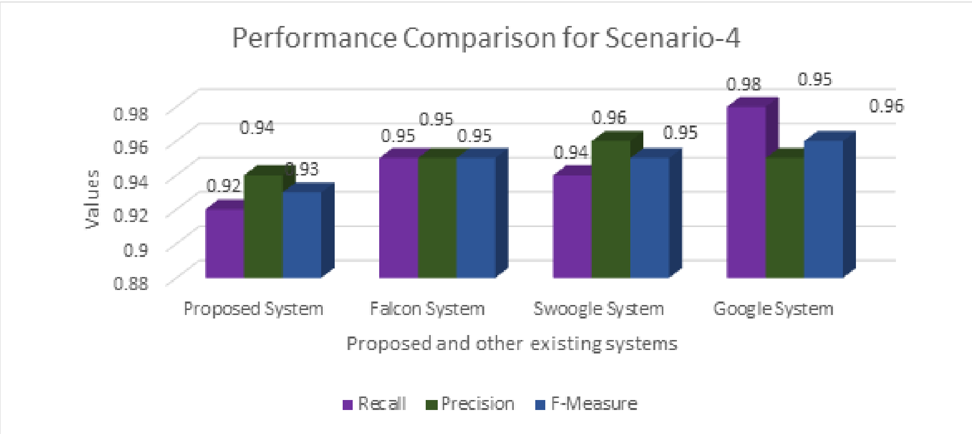

Figure 10 Graphical analysis of comparison of performance for scenario-4

5. CONCLUSION

The work done in the paper, initially introduces the need of web page ranking algorithms, illustrating various types of available ranking approaches. We gathered various related works done by researchers. Then proposed a model for web page ranking using semantic web page retrieval approach for the classification of significant results of unclear queries by making use of semantic relations. Experiments are conducted, by evaluating the proposed model with different four sets of test scenarios developed. The Precision, Recall and F-measure of proposed algorithm are computed and compared with existing web page ranking mechanisms. The analysis of results achieved proved that the proposed mechanism is comparatively better placed.

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