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A Virtuous Way for Information Retrieval Using Semantic Perceptive Density Approach (SPDA)

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Abstract: The increasing growth of content volume in the internet makes the content management process challengeable to the various web search engines which in turn need increasing developments in information retrieval process. This study comprises the advantages of two methodologies namely ontology determination and synonym determination which paves a way for building up an effective web search mechanism. Further researchers developed an approach for the retrieval of information consisting of both the semantic perspective density approach and lexical resources. Those two approaches provide us with the catalog of the type of things or categories for the queries thrown on to the search engine. Retrieved documents are displayed to user based on document ranking process. Display starts with top ranked document.

Key words: Query expansion, ontology determination, synonym determination, annotation, score calculation, lexical resources, document ranking, semantic perspective density

INTRODUCTION

Advancements in the field of web mining help people to search the web quickly and carry out so many complicated tasks. The process of retrieving information from web is called Information Retrieval (IR). There are so many IR techniques available, maximum of them make use of users search information to retrieve information from web so called information need. All classical method follows the above said procedure. A query that is sent by the user is reformulated that modifies the retrieval performance. The process of reformulating a query is named as Query Expansion (QE). It search user inputs and expands the search to match additional documents. This method involves the following approaches such as finding out:

- The synonyms of words
- The various morphological forms of the words presented in the query
- Spotting spelling mistakes
- Automated correction of spelling errors
- Re-write the terms as if in the original query

Due to vast research taken in information retrieval field make researchers to think differently to retrieve information, their contributions make a novel method for web search. They not only focus on the user search information also understand the searcher intent and the contextual meaning of terms as if it appears in the searchable data space to provide more relevant results. Such way of searching information is called Semantic web search which allows the searcher to find, share and combine information more easily. In present scenario, the content distributed worldwide is increased by leaps and bounds. Even universal search engine senses the content management as a difficult task. While retrieving a data through a search engine, the user expects to retrieve the accurate results regarding their concern without getting deviated. Hence, the traditional techniques of web search have to be enhanced with some additional effective and temporal methodologies. As far as the semantic web search is taking into consideration for making the semantic web search more efficient, the proposed system derived an approach called Axiomatic web approach.

Semantic perspective density approach supports for the set of reasonable retrieved constraints. The concept deals with the combination of ontology and semantic determination methodologies. A method of knowledge representation as a set of concepts and relationship between those concepts with a domain is said to be ontology. It describes the entities present in a domain.

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The ontology determination works on the basis of the parameters such as instances, concepts, attributes and relations about the given concern from the user. By using any one of the method, the information retrieval method can be made more precise. One way is to match the keywords with appropriate meaning that can been identified by using the information available in lexicographic database, this method is effective in the case of document, another way is to seek user to choose an apt word from several optional words with same meaning it is suggested in the case of queries. The efficacy rate of semantic web search can be further improved by using the lexical resources. A database holding one or multiple dictionaries is called Lexical Resource (LR). The utilization of lexical resources in the system plies us with the maximum relevant data regarding the processed query. It helps the search process to retrieve data with its root equivalent.

Information retrieval is the process of searching up of documents relevant to the user's query (Langville and Meyer, 2006). The traditional information retrieval concept is completely depends on the Vector Space Model which calculates the direction and distance of the user query to produce the result. The traditional system is now augmented with the concept of semantic indexing and gathering methods. Information retrieval methodology is boosted with two concepts namely ontology and semantic determination. This fulfills the user needs by providing relevant data. The ontology based methodology adds a semantic layer to the search engine. User's standpoint can be determined from the given query by means of ontology. This may in turn lead to a better search experience for the user as well as more relevant results being returned from a search. In spite of acquiring efficacy results from the search engine, it needs detailed syntactic specification which is provided by the concept of semantic determination (Riad *et al*., 2010). A mechanism called query capture similarity measure (Smeaton and Quigley, 1996) applied for determining the pre-computes word-word semantic distances which makes the relevant results more accurate. The semantic portal approach (SEAL) demonstrates a method for collecting and maintaining the information from the web in a portal using the semantic description of user query (Guha *et al*., 2003). The process introduced a methodology for semantic-based browsing. The conceit semantic search was explained in the research work (Doan *et al*., 2003) hich comprises the building methodologies of supporting technologies and improves the traditional searching algorithms. Since, the web search based on semantics is more efficient, an approach called ontology matching (Staab *et al*., 2003) has been developed in which ontology denotes the semantics of the user query. Data integration was also embedded with this conceit. In order to improve the search procedures over large repositories a vector based model was demonstrated (Castells *et al*., 2007) which composed of a semi-automatic annotation and a retrieval system for the adept way of information retrieval. The research work by Barnaghi *et al*. (2007) provided a combined methodology of the process such as semantic web, information retrieval and information extraction in order to formulate a semantic-enhanced searching algorithm.

Documents are annotated and retrieved by ontology determination technique (Vallet *et al*., 2005). Annotation is the concept of making the retrieval functionalities based on the highlighted key terms. Annotation plays a vital position in the affirmed work to make the information retrieval process facile. Content management is the term that determines the collection, managing and publishing information and in which the concept of annotation clowns its part, since the contents in the internet are growing enormously. With the synonym determination the process holds up the search by considering the meaning of the particular word or query given to the process. The work of synonym determination is completely adapting the semantic similarity which embeds on the likeliness of the given query that provides us with adept and accurate results.

The semantic perspective density weight determination provides the system with the adage priority pattern results in ranking mechanism which makes the user with efficient browsing experience, since researchers band the two effective concepts namely ontology determination and synonym determination. The concept provides the predominant mechanism for ranking the information that is relevant to the concern (Sreenivas, 2009).

An effective ranking algorithm in a search engine can be designed significantly by figure outing the user intent. Probability ranking principle-based approach is a traditional mechanism for ranking process which makes the web search easier for the user. An approach named ontolook which is a prototype relation-based search engine was explained by Yufei *et al*. (2007) to carryover the semantic search with details about the location of display and the information to afford an effective searching. An algorithm by Mayfield and Finin (2003) suggested that the retrieved data is tightly enchained with an assumption.

In the proposed research the implementation of effectual methodologies made with the semantic perspective density weighted approach that combines the ontology determination and synonym determination for ranking the data retrieved makes the search more accomplished. The conceit of document ranking helps in

stemming up of the information retrieved related to the given query on the basis of query expansion process. The system affords an adequate approach for semantic web search.

RELATED WORKS

With the emerging growth of content volume in the internet there is a need of a technology for automatic retrieval of data according to the relevance of user query. For making the above scenario in practice a research work was proposed on the ontology based system for ranking the document (Shamsfard *et al*., 2006). The ontology based system deals with document annotation and query expansion. The system describes five features namely:

- Combination of conceptual, statistical and linguistic features of documents
- Query expansion with related concepts before comparison to documents
- Extracting the words and phrases for computing relevance degree
- Proceeding with weighted combinations by improving the spread activation algorithm
- Allowing variable document vector dimensions

In future research, document annotation and query expansion accomplish by applying ontology. Hui Fang and ChengXiang Zhai proposed semantic perspective density approach was a method for semantic term matching. The system allows semantically related items to make the process of information retrieval adept. Semantic similarity function is used by Hui and Zhai (2006) to adopt the primitive weighting function. The model demonstrates the term-based retrieval constraints. The limitation of this research is neglecting of similarity between query terms and further the expansion based query terms can be included.

In accordance with the conceit explained in the research work (Roger *et al*., 2001), there was a methodology called Smart Web Query (SWQ). The motive of the method proposal is to retrieve the web data on the basis of semantic retrieval process. The manner involves in composition of web query by getting the user information and by finding the semantic relevant about the query. The approach is actualized into an SWQ engine which may have its further enhancements on the basis of plug and play approach.

There is a term called lexical resources implemented for the re-examination of query expansion (Hui, 2008). This model involves in the comparison of the retrieval performance with the various similarity functions based on query expansion using short queries. Query expansion is the effective technique in order to improve the performance of information retrieval. This deals deals with the concept of semantic perspective density approaches for the significant improvement of system performance. They re-examine the limitations on using lexical resources with the semantic perspective density approach. The system can be implemented with the particular domain for future studies.

There is a study demonstration for document ranking at high precision rate (Mee-Sun and Se-Young, 1989). The approach accomplished with the conceit called Key Fact Network (KFN) which comprises nodes, edges and their relationships in the aspects of broader term, related term, used for and key fact term. As future expansion there is a chance of experiencing the KFN in automatic indexing.

Personnel Semantic Search Engine (PSSE) has been prospered for the consideration of semantic relationship between query terms and other significant concepts from the user (Riad *et al*., 2010). The main determinant of the proposal is to furnish a set of personalized results to the user. Researchers can reduce the processing time by parallel processing during data processing in future work.

There is an effort for semantic query expansion (Piotr, 2011). Semantic Modeling of Information (SMI) is used to morphologically demonstrate the user information needs based on information system. Two types of ontologies are debated in this approach namely domain ontology and automatic ontology. Domain ontology can be approximated by using fragments discovered from data whereas the automatic ontology is contrived by the information retrieval system. The research is propped on the accordance between the mental representation of user and the needs of information and the ontology based knowledge. The research work is compared with this SMI approach. Experimental result in study 4 witnesses the efficacy of the proposed method than SIM in terms of computing time, accuracy and memory usage.

Document clustering is a concept applied in the information retrieval mechanism for easy recognition of pertinence of data (Sridevi and Nagaveni, 2011). Clustering is the conceit of grouping up of relevant dope for easy retrieval of content. The accuracy of clustering can be enumerated using ontology. Annotations are performed by using the proposed clustering algorithm named Particle Swarm Optimization (PSO). The main motive of the proposal is to afford a considerable improvement in the keyword based full-text search by using ontology. The advanced technology used here is KIM ontology. This kind of ontology is civilized with common word knowledge that is utilized as the ambience background for semantic annotation. For further research

this improved framework with clustering methodology can be combined with vector space model. And the future implementation is made with fuzzy ontology based methodology for clustering knowledge and personalized searching method.

There is a recent research on the scenario of information retrieval (Ritu *et al*., 2012). Resource Description Framework (RDF) is the W3C standard for the web information description. In this research they have proposed a search engine based methodology called intelligent semantic web search engine. The queried information is extracted efficiently by XML meta-tags. The data retrieved from XML tags are then converted to the RDF which in turn makes RDF graph by getting the input through Xforms. The automation technique in generation of Xforms can be implemented for further studies.

In the affirmed research, researchers made an attempt to bowled-over the limitation went through the above related works. The conceit of ontology determination and the synonym determination has banded to produce results at high and accurate rate. The outcome is properly ranked in its priority rate using semantic perspective density ranking approach. Thus, the efficacy rate of search mechanism has been amended considerably and amuses the user with sufficient results.

PROPOSED MECHANISM

With concern to the retrieval of information from the internet in an effective manner, the proposed work consumes various abundant methods. Those methods abate the processing time and amuse the user with the root knowledge of their need of concern. The proposal actualizes us with the banding advantage of both the ontology and synonym determination. Documents are ranked through semantic perspective density and lexical resource conviction approach. Lexical resource includes the description term of the query with its own dictionary. The method of annotation paves an avenue to filter up key terms from the query phrases. By combining all the above explained concepts, researchers designed the proposal to make accuracy and adept in information retrieval.

The adduced Semantic Perspective Density Approach (SPDA) flow of processing query comprises of five steps. The process starts with grabbing the query from user. Then the grabbed query is expanded, this query expansion process consisting of two technologies namely ontology and synonym determination. Expanded query is then phrased and given for annotation to drain up the key phrase in order to extract match the user query for affording accurate search mechanism. Semantic

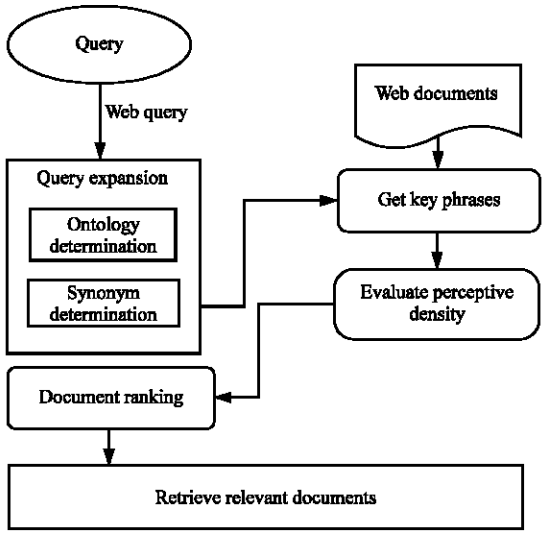

Fig. 1: System architecture for SPDA

perspective density approach and lexical resource analysis are the techniques used for document ranking. Figure 1 shows the system architecture of the proposal concrete healing of information from the large data storage.

Query grabbing: The system grabs the query from the user initially. The user means to enter whatever the data they want to search about. The part is to analyze with the concern of the user whether it may be a single word or a statement replicates the information needed by the user and offer them with sufficient results for their updating process. Given query is continuously searched still it spot out the root. User query is the scope of the project.

Query expansion: Once user queried to search engine the proposed method expanses the query by ontology and synonym determination. Query expansion is incorporated to increase the quality of search results. By stemming up the user entered query, the process formulates the matching document which increases the total recall. Stemming is the process of cutting up of the enriched content of the query to make the search key adept. The query expansion deals with the recall and precision. Precision is for providing accuracy in search mechanism whereas recall is the process of collecting relevant match from the web documents.

Ontology determination: With the efficacy of ontology determination, the concept within the domain and the better relationship between the concerns will be analyzed. It provides a structural framework for organizing

information. The conceit of ontology determination provides general understanding of the information structure of user concern. It empowers the reusability of domain specifications and analyses the specifications. The data retrieval process will be done on the basis of conceptualized specifications. Regarding to the search mechanism the ontology determination works with the consideration of classes, attributes, relations, logical form, events and functional terms. Thus, the determination process gives us with better combination of relevant results.

Synonym determination: The methodology intakes another mode of determination called synonym determination. As far as the synonym concept is concerned the search process analyze with the match for exact meaning of the user concern. For example, the user query we grabbed is axiom, the search result comprises the words that are related to the meaning of axiom like postulate, proverb, law, etc.

Hypernym determination: Hypernym is the conceit deals with similar words related to the category of the user concern. For example, researchers consider the word color to be entered in the user interface. The results will not only explains the meaning of colors and also gives the various color sets, its origin and the related manuals and magazines. The mechanism also shows the property relevant matches regarding the user concern.

Hyponym determination: With the consideration of hyponym in the methodology, researchers enhance the retrieval process with the theme just opposite to the hypernym search. It provides the subordinate name for a particular group.

Hyponym can be used to narrow a search for specific topic. For example Asparagus, fern, mantis and laurel are all hyponym of green which in turn hyponym of color.

Holonym determination: Holonym express the relationship between a term denoting the hole word and denoting a part or member of the hole. An example for holonym, body is a holonym of arm, leg and heart.

Meronym determination: Meronym defines a constituent part of or member of something. For example, arm is a meronym of body.

By binding all concepts explained above, the task of annotation is made with the consideration of web documents and to effectively retrieve information that meets the user interest from internet.

In the affirmed researh, the query expansion phase comprises all the determinations explained earlier to afford us with optimized results on the basis of complete analysis of user query.

Getting key phrase: While the user enters a large phrase, it's the work for the process to annotate the key phrase from the large query to make the process of information retrieval more facile. Getting the key phrase is the process like stemming up the user query and retrieving the key terms with respect to the outcome of the query expansion process and analyzing that on web documents. The approach requires preprocessing methods to process the user query. Stemming, stop words elimination are some of the preprocessing methodologies which are time consuming and made the approach to move with annotation. Annotation is the process of retrieving the significant context in the document using some annotation tools avail like GO ontology based annotation, KIM annotation and web annotation. In other words researchers can mention the process involves glossing up of the query. In the approach researchers have executed the process with KIM ontology which is a knowledge information based methodology. KIM is used in semantic annotation for context background. The modifications and extensions can be suited for specific applications. Annotation process is taken out in order to find the occurrence of given query and to calculate scores of query occurrence.

SPDA: The proposed approach bestows us with an adept searching methodology by the dominance in the conceits such as ontology determination, synonym determination and the document ranking methodology. In order to rank the documents and to display results to users, it is essential to calculate scores of final document. Final document score is calculated using algorithm in section-final document score.

Score calculation: Score calculation is a valuable research in the methodology to calculate the score on the basis of analyzing the user query with the web documents. The need of score is to rate the web document by comparing it wills the query relevant to the matched phrases, matched words and semantics similarities in order to provide document ranking.

Query occurrence score should be calculated to determine the user query is matched with web document for predicting the Score 1 (S1). The words in user query is separately compared with the document to find the Score 2 (S2). Synonym of the query is examined with the document for generating the Score 3 (S3). The final score value (S) is calculated with the formula S = S1+S2+S3.

Final document score: Input to this algorithm is the score calculated in the above step. Given query is compared and analyzed to find hypernym, hyponym, meronym and holonym and generates occurrence set of hypernym set, hyponym set, holonym set and meronym set. Lexical similarity is calculated using Eq. 1:

$$L = \sum_{i=1}^{n} Sim(w_i, w_q) \quad (1)$$

where, w_i, w_q represents the weight of the documents and query. Sim() is calculated using the Eq. 2 for n number of documents:

$$Sim(w_i, w_q) = \sum_{j=1}^{m} \frac{2 \times depth\,(LCS)}{depth(w_j) \times depth(w_q)} \quad (2)$$

Here:

w_j and w_q = The weight of word and query
LCS = The Least Common Super concepts of w_j and w_q
m = Total number of words in a document

On adding the score obtained at previous step, query occurrence sets and Lexical similarity value (L) calculated using Eq. 1, researchers obtain final documents score.

Algorithm 1:
Input: Score S
Output: Final document score

Step 1: Hypernym of query compared with doc and find the Occurrence of hypernym set, h1.

C1 = (h1*0.5) +2

Step 2: Hyponym of query compared with doc and find the occurrence of hyponym set, h2.

C2 = (h2*0.5) +2

Step 3: Holonym of query compared with doc and find the occurrence of holonym set, h3.

C3 = (h3*0.5) +1

Step 4: Meronym of query compared with doc and find the occurrence of Meronym set, h4.

C4 = (h4*0.5) +1

Step 5: Calculate the Lexical Similarity (L) using Eq. 1.

Step 6: Finally document score is calculated using

DOC_{score} = (S+ (C1+C2+C3+C4+L))

The algorithm demonstrates the calculation of occurrence values of hypernym, hyponym, holonym and meronym regarding the concern query where C1, C2, C3, C4 are the occurrence values of above said hypernym, hyponym, holonym and meronym with respect to the hypernym set value h1, hyponym set value h2, holonym set value h3 and the meronym set value h4. The calculated values of occurrences replicate the number of relevant set present in the grabbed query given by the user and the value 0.5 is an arbitrary constant value to stabilize the presence of C1-C4 in the relevant concern. Then the next step proceeds with the lexical based similarity analysis using the Eq. 1 which is followed by the document score calculation. The total score value S is calculated on the basis of the process explained in the section-SPDA.

After finishing the lexical similarity based comparison and the document score calculation the output will be fed up for document ranking process.

DOCUMENT RANKING

In accordance with the calculations made above in algorithm, the document ranking conceit proceeded. Ranking documents depends on DENSE ranking approach. Dense ranking is the computational function that formulates the rank of the row in an ordered manner. The document ranking based on the sequential integers initialized with 1. Conferring to the scores of the matched document for the user concern, the documents are dashed on the web page. Based on the evaluated density values calculated under score calculation process with the annotated key phrases is the essence of document ranking procedure. The matched documents can be visualized by the user in the density dependent order or the score values calculated. The document with high matching score will be presented first on the web page. The query has been matched with the web documents on the basis of the methods explained above to give away the results with immense accuracy and efficacy.

EXPERIMENTAL RESULTS

For the sake of experimenting have utilized the dataset such as Reuters -21578. Initially researchers have preprocessed the dataset on applying tags parsing, stop words elimination and stemming. The results obtained from this provided a conclusion that those methods of retrieval are time consuming. The process also resembles that there is a lack of accuracy in the acquired results. Consequently researchers have applied SPD approach. Initially query expansion is done following with the semantic and lexical process and then terminates the retrieval process with the document ranking process as

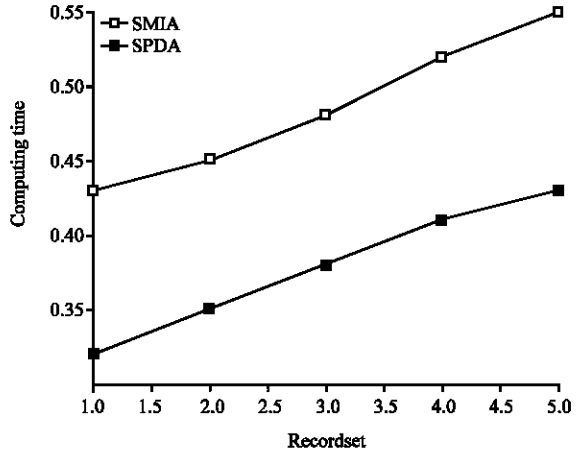

Fig. 2: Record set vs. computing time

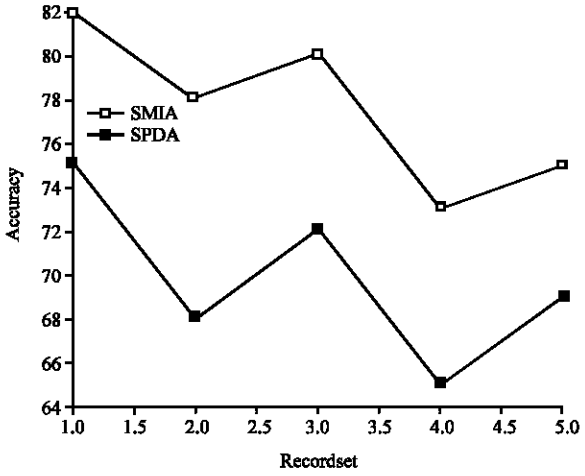

Fig. 3: Record set vs. accuracy

per the SPDA. Researchers have evaluated the results on the basis of computing time, accuracy, memory usage and the number of documents retrieved. Researchers have contemplated the approach with the SMI (Semantic Modeling of Information approach) in order to demonstrate the efficacy of the affirmed research.

Figure 2 exemplifies the comparison of computing time between SPD and SIM. The record sets are consisting of 200-300 documents. There are entirely five sets extracted. For instance the computing time for SMIA is found as 0.43 for dataset 1 and 0.32 for SPDA. Likewise it follows for each datasets. Thus proves the computing time for the retrieval process is considerably low for the SPD approach, since researchers have embedded the proposed methodology with the immense conceits which speeds up the retrieval process. Here, researchers use the KIM annotation method reduces the computation time than the process proceeding with the procedures like stemming and the stop words elimination.

Figure 3 explicates the pictorial representation between the record set and the accuracy rate. Recordset1 implies the accuracy rate of 75% for SMIA and 82% for SPDA. It is carried out also for other record sets in the sample. Since, researchers combine the crowned concepts such as semantic and ontology determination which comprises the steps for matching the user query with the web document by determining set values of hypernym, hyponym, holonym and meronym. The Lexical similarities are also analyzed for producing better certainty. Thus, the graphical representation of our proposed SPDA generates the best accuracy rate.

Figure 4 clarifies the memory usage with respect to the record set. For the sake of processing 250 record set as per the graph shows SMI requires 20 kB of memory, SPDA consume 17 kB of memory likewise proceeding

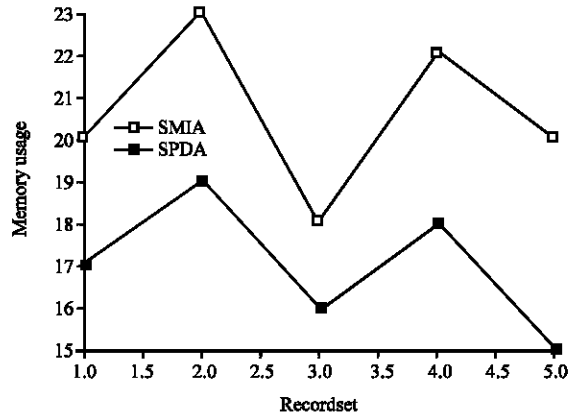

Fig. 4: Record set vs. memory usage

record set 2 SMI necessitate 19 kB of memory and 23 kB is enough for SPDA. There is a process called annotation which compares the user concern with the web documents and filters up the key phrase. This paves a way for averting the retrieval of irrelevant or less relevant documents regarding user concern and saves the system memory from unwanted dissipation. Thus, the memory consumption is lesser with the SPDA mechanism than the SMI approach.

Figure 5 depicts the processing time between the phase of query grabbing and the information retrieval of the SPD approach. Hence, from the pictorial representation, researchers can conclude that the user concern is directly proportional to the retrieval time. By considering the earlier representations, researchers can strongly allege that the processing time acquired by the approach is considerably less that the other information retrieval approaches. On account of using perspective density approach, the proposed system proves the high

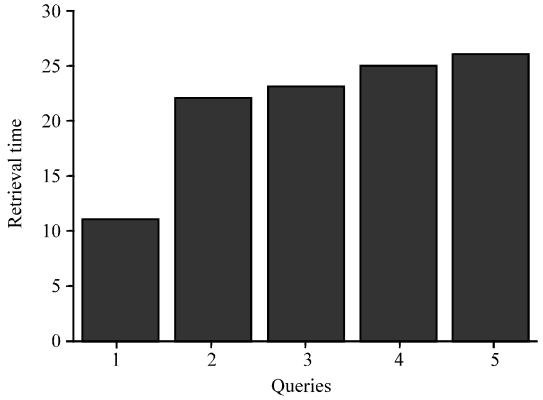

Fig. 5: Query vs. retrieval time

efficacy and efficient memory usage in the information retrieval process. Thus, the system equips an immense methodology for information retrieval on the basis of semantic perceptive density. The banding concept of adept process such as ontology and synonym determination for query expansion makes the project efficient and provides accurate results to the users. The document ranking method embeds in the project for list out the retrieved relevant information in an ordered manner and which amuses the user with considerable memory usage and appropriate results.

CONCLUSION

In the affirmed study, researchers have framed an adept information retrieval methodology using Semantic Perspective Density Approach (SPDA) which constitutes immense procedures such as banding of ontology and semantic determination, annotation and calculating similarity based lexical resources and the termination process is document ranking. The asset of the concept is merging up of searching methods with ontology and synonym determination. The annotation process directs the project work to provide less computation and processing time. This affords us with accurate retrieval of documents regarding the user concern on the basis of better computing time, accuracy and memory usage.

RECOMMENDATIONS

In future research, approaches can be framed to reduce the processing time considerably than the proposed methodology and that may also focus on the aspects such as optimized memory usage and more accuracy rate. The affirmed research can be further enhanced by flourishing it with specialized domains such as Bio-medical applications, e-Learning process, etc.

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