IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

Ranking Web Pages using Ant Rank and Bee Colony Algorithm

M. Beulah Rani[1], B. Sujata[2], M. Priyanka[3]

Assistant Professor, Department of CSE, MVGR College of Engineering, Vizianagaram, India[1,2,3]

Abstract: Page rank plays an important role in displaying results list. Many factors are considered to assign rank for web pages. In traditional page ranking web page references for high weight, low quality and there by increases in its position of ranking. Page Rank is what some search engines are used to find the priority of a web page. It's one of many factors used to determine which pages appear in search results. The reason for this is people prefer to link to relevant content and pages with more links to them are usually better resources than pages with inactive links. Ranking the page works by counting the number and quality of links to a page to roughly estimate the importance of the website. The underneath assumption is that more important websites are likely to receive more links from other websites. This phenomenon of one page referring another page is called as Referential Concept of web pages. This Referential Concept of web pages results in hindering the retrieval of more relevant web pages. There is depiction that there is more relevant information available on the web. To achieve best results in displaying proper results this paper is implemented upon using Ant Rank and Bees Colony Algorithms.

Keywords: Page rank, Ant rank, ant colony, bee colony.

I. INTRODUCTION

The process of mining the data present in the World Wide Web in the form of web pages is referred to as Web Mining. The World Wide Web (WWW) is rapidly increasing on all aspects and has become a web resource in the world. Search engines are the tools for the users for finding and getting access to the web resources. Many times search engine results in thousands of web pages and few pages may meet the requirements.

The purpose of a search engine is to provide relevant information to the users according to their requirements. Upon a user's query, the search engines provide more number of links of web pages [1]. So it is necessary to assign ranks to the web pages in an efficient and effective manner in order to limit the links and also as the content in the web is increasing, there is a requirement that it should be organized in a proper way. Hence page rank algorithms plays a prominent role to navigate the web pages by the users and can be used by the search engines to produce the search reports by considering the relevance, content and importance over the web. But there is one drawback of traditional page rank algorithm [2], the ranking position of a web page can be increased by a high weighted web page referencing another web page of low quality.

The problem lies in finding the high quality of pages as it depends on the user's interest. Hence a fast and efficient algorithm is needed to overcome this problem. Ant Rank and Bee colony algorithms are focused on this issue. The aim of Ant Rank is assigning a rank to web pages which are inspired by the nature of the real ants. Ants (users) visit the web pages randomly and based on pheromone (user's interest) rank for a web page will be assigned. Hence Ant Rank algorithm takes the user interest into consideration and retrieves the results for a given query. Bee colony algorithm is a method in web page ranking, it takes the user's interest, total linkage to web sites, and growth rates in assigning rank to web page and thereby Ant Rank and Bee Colony algorithms are aimed at finding frequently used web pages [3].

There are various search engines available that works based on any of the above concepts. Page Rank is a one famous algorithm. Page Rank is used to determine the significance of web pages in search engine. The underlying assumption is that more important websites are likely to receive more links from other websites. There are certainly flaws in Page Rank. Now that people know the secrets to obtaining a higher Page Rank, because of which most of the relevant data in the web gets hindered. An alternative approach called swarm intelligence is used to achieve more relevant information from the web. Swarm intelligence (SI) is the technique adopted in this paper to achieve more relevant web pages. Example algorithms of swarm intelligence are Ant Rank algorithm, Bee Colony algorithm, Particle swarm optimization, artificial immune systems etc… The implementation of the paper involves two wings. First one is the implementation of "Ant Rank algorithm" and second wing is the implementation of "Bee Colony algorithm". For the implementation of paper a dataset has been created around five thousand URLs with their Meta dictionary maintained in the database. These are collected from "alexa.com" - web information.

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

In the first section upon the submission of keywords by the user in the Meta dictionary are compared with the database and propose some web links to the user. User clicks on some link heuristically by reading the description about the web page. The weight of that particular web link will be incremented in the database accordingly. This process is continued for a probation period of 5 days. After probation period of time, for a given keyword the results will be displayed in a sorted order of the user's interest.

The later part is the implementation of Bee Colony algorithm which is a multi – agent algorithm. The interests collected for the users in AR are one of its agents whereas the rest are growth direction rate values and the total websites linked to the web page. The results are sorted by aggregation of these three values. The information about the negative web pages will improve the scope of this paper. The dictionary that was maintained for web search describes only those positive web pages. The results shown are bound to the fact that there must be appropriate keyword that should exactly match with the user search query. There is a lot of scope for getting results in more number as well as in more relevance if we focus on the improvement of the Meta dictionary. The complete scan of web page content may have considerable impact on the results obtained. However the Meta keyword limit has been evolving.

Many users are still using the search tools for the meta keywords. But however, the search tools give very little weight to Meta keywords. The best way of doing this is to place only those keywords that are relevant to the web page. So better is to let the content of the web page be scanned based on the matching of the keywords. The technique of implementing the AR is made possible with data set of around 3K URLs with their respective Meta dictionary. The Ant Rank Algorithm implementation is done as follows. AR implementation is a heuristic single-agent search. It typically uses the description about the webpage as a heuristic agent. The user's interest on the web page is determined only by the number of clicks on the web page. By hosting the dataset over the web and by developing a search tool, we could able to collect the user interests on various web pages.

The major problem in page rank (Referential concept of web pages discussed earlier) is avoided in this approach by maintaining a race condition. The bee colony algorithm (BC) is the most recently used algorithm based on the intelligent foraging behaviour of honey bee swarm. The nature of bees is they look for food by exploiting the fields in the neighbourhood of their hive. They collect and accumulate the food for later use by other bees. Typically, in the initial step, some scouts search the region. Completing the search, scout bees return to the hive and inform their hive-mates about the locations, quantity, and quality of the available food sources in the areas they have examined.

Bee colony is an optimization technique which uses only few control parameters like maximum cycle number and colony size. The bee's (users) aim is to search the places of food sources with high nectar amount and finally the one with the highest nectar is selected. In BC system, artificial bees fly around in a multidimensional search space and some bees select the food sources based on the interest of them and their nest mates and they will adapt to the position.

Thus, Bee Colony system combines local search methods, carried out by employed and onlooker bees, uses global search methods, managed by onlookers and scouts, attempting to balance exploration and exploitation process.

II. RELATED WORK

Lofgren, Peter [4] proposed two algorithms Personalized PageRank estimation and Personalized PageRank search and has shown that these two algorithms are efficient in social networks with billions of edges but however allows us compute only the entries relevant to the query. Hence this PageRank can be further developed by applying on some existing algorithms to improve the performance and getting best results.

Nguyen Lu Dang Khoa [5] proposed an online anomaly detection technique with the help of commute time derived from random walks on graphs. They showed that this method incrementally estimates the commute time in constant time using properties of random walk and the number of hits. However this leads to a problem of personalised PageRank estimation and search.

Prajwal R Thakare [6] proposed a Web Access Table mechanism to hold the data such as who accessed what and how many times, and their rank on average to find the anomalous web access behaviour and found a solution for traffic estimation and user navigation. However, if this algorithm made online it may not work for the anomalies in a batch mode. Hence there is a need for further research in this regard.

Larry Page [7] has proposed PageRank algorithm for large number of pages for searching and navigation by the users and thereby leads to information retrieval. However, the problem exists while searching which may lead to traffic estimation and user navigation.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

III. PROPOSED WORK

Ant colony algorithm is technique defined for solving computational problems which is inspired by the nature of ants. Without knowing the problem, they search for the shortest paths and complete their work on time [8, 9].The ants travel the path for the search for food by leaving a substance called pheromone. So an isolated ant can easily follow the path. Initially this has been used for salesman problem for finding the shortest path.

Ant Rank Algorithm is the algorithm that perfectly mimics the food foraging behaviour of ants. In the real world, ants wander randomly, if they found the food they return to the colony by leaving the pheromone track. Then any other ant travelling that ways finds the track it just follows the path instead of travelling at random; returning and reinforcing it if they eventually find food. There is no hard and fast rule that every ant should reach food zone only by fallowing the path that was passed by some other ant previously.

Divergence is a process of selecting another new path .As the time passes, the pheromone track starts to evaporate and thereby the strength will be decreased. The more time takes for an ant to travel a path again, the more time the thickness of the pheromone increases on shorter paths than longer ones.

The idea of this ant colony procedure mimics the behaviour with some ants simulating like walking around the path and thereby leads to the solution of our proposed algorithm. Thus, when one ant finds a shortest path from the colony to a food source, the other ants are possible to follow that shortest path, and lead all the ants following a single path. As the pheromone track gradually evaporates, hence it reduces its attractive strength. The more time it takes for an ant to travel down the path and back again, the more time the pheromone density becomes higher on shorter paths then longer ones.

IV. IMPLEMENTATION

A. Implementation Of Ant Rank Algorithm

The Ant Rank Algorithm [10] implementation is done as follows. Ant Rank implementation is a heuristic single-agent search. It typically uses the description about the web page as a heuristic agent. The attention of any user on the web page can be computed by user's hit on the web page. The major problem is page rank is avoided in this approach by maintaining the race condition. The Ant Rank algorithm has been implemented by considering the following facts:
A search for some content will be posted on the search box which will be passed for Tokenizing. Tokenizing is a process of splitting the entire string into tokens. Tokens are formed based on the space (ASCII-32) between the substrings. The process is followed by forming the solid nouns are allowed to get searched in the indexed database. Initially for probation period of 5 days maintained. During this period, the URLs are displayed to the user in indexed fashion. Reading the description about a particular link the user clicks and gets directed to that web page. This process involves no suggestion to the user to click on any link. All links are equally likely important compared to others. It is clear that clicking a particular web page is purely random. This random approach increases the weights of the URLs randomly [11]. After we collected the interest of the user varies URLs depending on the search requirements. Upon a visit by the user value of weight of the URL got incremented.

This process of incrementing the weight of URLs is continued during the probation period and is allowed to continue after the probation period also. However during the probation period the results are retrieved based on the indexed order, but after the probation the retrieved results are sorted according to their weights. The difference between other approaches and ant lies in its race condition. After the probation period the weights of the web pages (W) are periodically updated by using equation below.

$$W = (\text{Initial weight} + \text{incremented weight}) / \text{constant value}$$

The interest on the web pages process is updated and will be continued even after the probation period. By doing this, the web page will not be always at the top. If the owner often updates the content of the web page having most relevant data, the user clearly gets attracted towards that web page only.

B. Procedure Of Bees Colony algorithm

In computer science terms, the artificial bee colony algorithm (ABC) is an optimal algorithm based on the intelligent fodder behaviour of honey bee swarm. It is so simple as particle swarm optimization and differential evolution algorithm which uses some common control parameters like colony size, maximum cycle number. As an optimization tool, it provides a population-based search procedure where the individuals called foods positions are updated with time by the artificial bees and the bee's aim is to find the places of food sources with high nectar amount and finally the one with the highest nectar.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

In ABC system, artificial bees adjust their position by flying around in a multidimensional search space and some employed and onlooker bees select their food sources depending on the experience of themselves and their nest mates. Some scout bees fly and select the food sources randomly without having experience even if the nectar amount of a new source is greater than that of the previous one in their memory, they remember the new position and forget the previous one. Thereby, ABC system combines local search methods, carried out by employed and onlooker bees, with global search methods, managed by onlookers and scouts, tried to balance exploration process. In detail, bee colonies have absolutely no room for slackers. Everyone has a distinct role and purpose, whether they are worker, drone or queens. Boredom is a concept that simply doesn't exist in the bee world – and definitely not for scout bees. Scout bees are a type of worker bee.

Role of Scout Bees: The important role of a scout bee lies in discovering new access to food. They sometimes used to travel some miles away from their hives. Scout bees venture out into their surroundings to carefully scour for food, from the interior of caves to the openings into buildings. At this point of time they are called as employee bees. Once they finally get back from these quests, they dutifully inform their fellow bees of the available sustenance. In looking for new residence for their swarms, worker bees also ponder a lot of criteria regarding uprooting everyone, from the size of the entrance to distance away from the ground. If a spot is too close to the ground, it might become susceptible to pesky instruction from other bugs, for example. Worker bees also carefully consider defense against the elements, whether intense winds or snow.

Dancing Ritual**:** Bees don't exactly speak in words, and because of that have no choice but to communicate in other ways. Scout bees express their exciting food finds by dancing. Dances are of two different types. A swaying dance and detailed swinging indicates exactly how far away everything will be – all based on the sun. A circular dance express, happily enough, that the food is ready by the hive. A rapid dance indicates nearby support. Slower ones, on the other hand, indicate somewhat of a journey.

Focus on Trees and Flowers: Scout bees diligently fly around looking for food in desirable spots, namely in trees that are empty inside. They also do a lot of searching amid clusters of flowers. The goal of scout bees on these hunts is to be attentive to the presence of ample pollen and nectar.

Scent Communication**:** Scout bees also give off valuable details about the new food stashes via smell. Not only do they dance to explain to the others where the food is all waiting, they express it through smelling like the flowers and sugary nectar.

Role of onlooker Bee: The onlooker bees observes the waggle dance and takes the information for it about the direction, distance and the direction and distance at which quality and quantitative nectar is present. After grabbing all the nectar and pollen from the destination these onlooker bees will again become scout bees and performs random search of food. The user interest calculated during the probation period of ant colony implementation is used as one of the agents in this multi agent search. The resemblance is made in such a way that scout bee that becomes employee bee during its food search to the ant which in turn depicted to be the user in real world.

TABLE I COMPARISON OF BEE COLONY ALGORITHM WITH REAL TIME

Bee colony algorithm	**In real time**
Scout bee	User in real time
Direction of more honey	Growth analysis of site
Quality	Interest from ant rank
Distance	Total sites links in to the page

C. Implementation Of Bees Colony Algorithm

Phases of Artificial Bees Colony Algorithm Implementation:
Scout Bee Phase**:** As discussed earlier the scout bees do a randomized search for nectar and honey in and around the hive. This randomized search for food foraging is done at the first section of this paper i.e., during the implementation of ant colony algorithm. The user interest calculated during the probation period of ant colony implementation is used as one of the agents in this multi agent search. The resemblance is made in such a way that scout bee that becomes employee bee during its food search to the ant in ant colony which in turn depicted to be the user in real world implementation. In detail, the scout bee that becomes the employee bee when it goes for searching nectar is related as ant that goes for random search in ant colony algorithm.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

This can be granted for the reason that both are similar biotic components. In fact the ant in ACR is considered to be a user in the real world who heuristically clicks on a link depending on the description of a particular link. So bee in ABC can be treated as ant in ACR which in turn is a user in real world. So, ultimately it is the user who randomly chooses his path to reach the food zone (here relevant web page). The immediate action after the completion of search is the performance of waggle dance during which the information is shared to all other fellow bees.

Onlooker phase**:** The waggle dance performance by an employee bee informs his fellow bees about the following facts.

They are
1. Quality of the nectar available
2. Direction of availability nectar or pollen.
3. Distance of food zone from the hive.

These are the agents that contribute for the successful forging of food. Hence it is called multi-agent system.

In real world it can be depicted as:
1. Quality is considered as the interest values obtain from the ACR algorithm.
2. Direction of more honey is considered as growth analysis of the web page.
3. Distance of food zone from the high bees is considered and is the total is sites referring this web page.

The growth analysis of the web page is obtained from the web information site"alexa.com". The value of each web page present on the data set is collected from the web site. These values are assigned to the web page based on the various facts like network traffic analysis, number of distinct user of the site, average time spent by the user on the web page etc. This value can be positive or negative. It is purely dependent on its value versus the previous three months .Based on the above factors the growth analysis can be determined [12]. This value can be compared to direction of more honey because the direction of more honey and direction of more relevant data spells one and the same.

The distance of hive from the food zone is considered as total sites linking into the webpage. The ultimate food zone is the most relevant web page in the real world. The total sites referring the web page considered can be considered as the distance of the web page from the root. This makes sense because no web page either positive or negative can be reached without a referential bank links. However this referential concept is hammered as bank drop in the ancestor algorithms. But here it is considered as one of the agents but not the main and only agent.

The total sites that a typical webpage gets referenced by are obtained from the web information company alexa.com. With this we could be able to make the direction and distance agents in ABC algorithm. Likewise the quality of the web page can be depicted only by the user. So the ratings of the users that are collected from the ACR algorithm are used in ABC as the last agent. The ordering dataset is done with the aggregation of all these values. So, ultimately it is the user who randomly chooses his path to reach the food zone.

A search for some content will be posted on the search box which will be passed for Tokenizing at the search tool. Tokenizing is a process of splitting the entire string tokens. Tokens are formed based on the space (ASCII-32) between the substrings. The process is followed by forming the solid nouns with these tokens. These solid nouns are the inputs for the search mechanism. These solid nouns allowed to get searched in the indexed database. Here, unlike ACR there are no probation periods in this approach. In fact it is a multi-agent system where in the interest values calculated for probation period of time will become one of the agents for the algorithm. There are three agents considered in this approach one as discussed earlier interests form the ACR, second is the growth analysis of sites, third is the total sites(T) referring the present site.

$$T = \text{order by } (num\_i + num\_Di + num\_Ds)$$

This process of updating the interest on the web pages is continued even after the probation period. This makes no web page to be always at the top. If the content of the web page is frequently updated by the owner with most relevant data, obviously the user heuristically gets attracted towards that web page and this makes the web page to get more interests than his competitors.

D. Algorithm for Ant colony algorithm
Step-1: Initialization of values s=0; ct= current
time ;
ct[]=null; t1=100 initial value of

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

pheromone
(say 100 is threshold value)
Step-2: ct[]=tokens(k)
Step-3: Procedure before probation while (each(ct[])
with URL || meta) Display as hyperlink to
the webpage; Increment s value until end of
web pages;
Step-4: end while
Step-5: set of web pages that match for given keyword
s={1,2,3,….,n}
Step-6: for all s={1,2,…..,n}
Step-7: choose web page i with highest Probability
Step-8: repeat
Step-9: choose next web page j ε s with probability until
s=null
Step-10: Procedure after probation ct[]=tokens(k) while
(Each (ct[]) matches with URL
Meta) Consider pheromone updated value
that is calculated as
initial value + current user interest
Step-11: Calculate pheromone evaporation value
Step-12: Choosing a relevant web page, consider
pheromone updated value and pheromone
evaporation value and display as hyperlink
to the webpage

E. Algorithm for Bee colony algorithm
Step-1: n_count = 0
Step-2: t[] = null
Step-3: n_i = User interest on the web page
Step-4: n_t = Current Timestamp
Step-5: n_ Ga = Store the growth analysis value of the web
page
Step-6: n_d = Store the distance of web page
Step-7: t[]=tokens(n_s) // Query Processing
Step-8: while(each(t[]) matches with meta) Display as
hyperlink to the location of the web page order by
(n_i + n_Ga + n_d)
Increment the value of n_count
/* To show the dimension value (To show how
many results found applicable) */
Step-9: n_i is incremented whenever
user clicks on the particular
link //server side
upgradation
Step-10: If ((I=i/L) >= Threshold)
Step-11: Perform I=I/L for every
L days to keep sites in
race condition //End if
Step-12: Repeat step (8(1)), (8(2)) when the query is
raised each time and step (11) for every L
days.

F. Flow Charts for Ant Rank algorithm and Bee Colony Algorithm
The following flow charts represent the procedure for ranking the web pages using Ant Rank and Bees Colony algorithms. The flow describes that initially the end user enter a query to search then the corresponding query will be parsed by tokenizing it. The connection to query will be established and these tokens will be matched against the keywords in database.

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

Depending on the matches the related URLs will be matched and when user clicks the weight of the URL will be updated by a constant value and the URLs will be aligned in descending order. After the probation period was reached then the weights of all the URLs will be divided with a constant value, this was just to keep all the URLs in the race condition. Then onwards again the same procedure will be repeated. The connection to query will be established and these tokens will be matched.

TABLE II VARIATIONS IN PAGE RANK, AR AND BC ALGORITHMS

Keywords	Number of Url's retrieved	Page Rank	Ant Rank	Bee Colony
News	343	0.1464	0.0122	0.1611
Movies	64	0.1565	0.2439	0.1527
Health	82	0.1429	0.1414	0.2150
World	106	0.1408	0.1440	0.1397
Tourism	315	0.1249	0.1355	0.1424

FIGURE I ANT RANK ALGORITHM

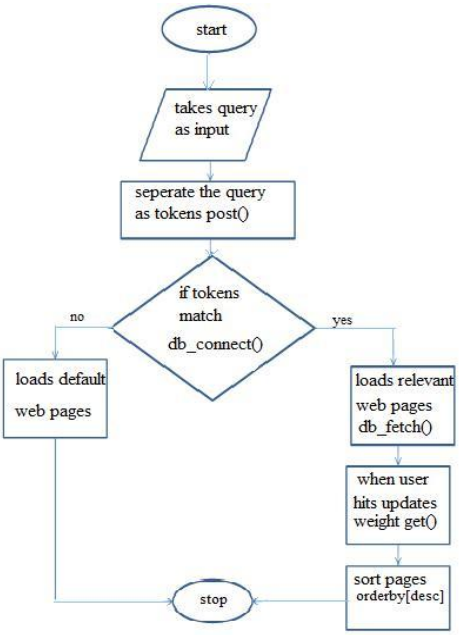
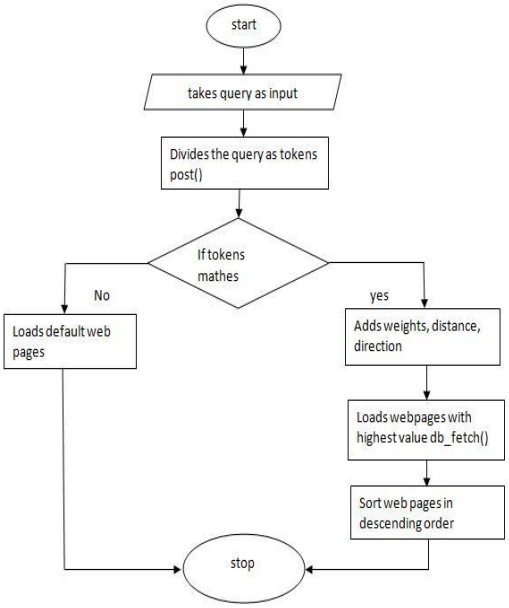


FIGURE II BEE COLONY ALGORITHM



DOI10.17148/IJARCCE.2017.6743

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

V. RESULTS AND PERFORMANCE COMPARISON

We tested the search tool with different keywords like health, news, movies, tourism and we can also call this stage as probation period. Implementation of Ant Rank Algorithm and Bee Colony Algorithm for searching various keywords on the considered dataset produced significant results. The search results are obtained manually and then the difference in the search results determined for the same keywords as shown in Table II. The table shows variation in the top five reports obtained in page rank, AR and BC algorithms.

FIGURE III COMPARISON CHART FOR AR AND BC OVER PR ALGORITHM

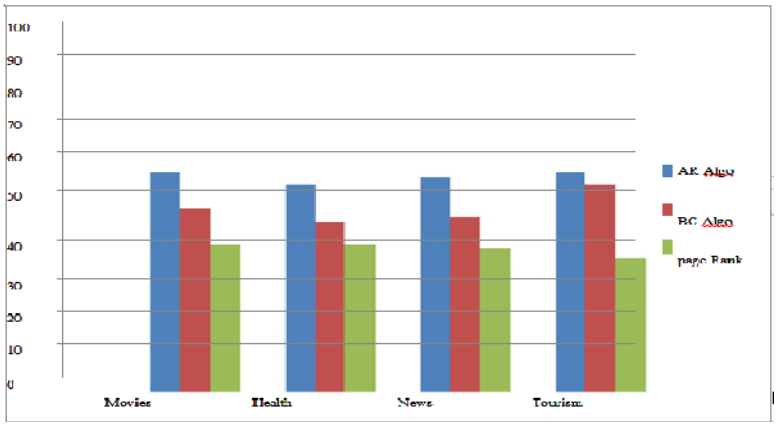
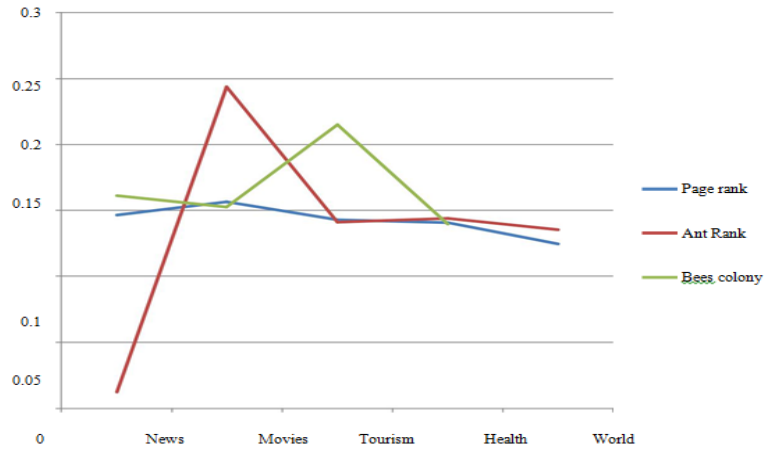


FIGURE IV COMPARISON GRAPH FOR AR AND BC OVER PR ALGORITHM



And also the performance of the three algorithms is shown when compared on various keywords and the values mentioned in the table represent the efficiency of the three algorithms. The table contains keywords, number of URLs retrieval values of page rank algorithm, values of ant rank algorithm and values of bee colony algorithm.

These comparison chart and graph clearly display the advantages of the Ant Rank (AR) and Bee colony (BC) algorithms over the previously popular algorithm called as page rank (PR). The results mentioned in Figure III and Figure IV are the proportionate values which pictographically describes the variations in the URLs retrieved by the usage of these three algorithms.

VI. CONCLUSION

As Specified earlier Ant Rank algorithm (AR) is a non-certainty technique to solve algorithmic problems which can be used to find good paths through charts and graphs. This algorithm is a member of the ant colony algorithms family, in swarm intelligence methods, and it constitutes some ant colony optimizations. We implemented the Ant Rank and Bee colony algorithms which aim to search for an ideal path in finding results which includes a search for some content will be posted on the search box which will be passed for tokenizing and are allowed to get searched in the indexed database. Initially for probation period of 5 days maintained. After probation period, the interest of the user has been collected on various urls upon which the corresponding weights of the urls got incremented.

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2017

The comparison of page rank, Ant Rank and Bee colony algorithm for various keywords is as follows. The Number of urls retrieved for the keyword "NEWS" is 343 and the relevancy and accuracy for page rank is 0.1464 and for Ant Rank is 0.0122 and for Bee colony algorithm is 0.1611 and similarly for various keywords like MOVIES, HEALTH, WORLD, TOURISM comparisons are made between these algorithms and in all situations it is proved that Ant Rank and Bee colony algorithms are best at retrieving the relevant results than Page Rank. So it was concluded that AR and BC algorithms can produce better results than the legacy algorithm (Page Rank).

REFERENCES

[1] Tyagi, N., Sharma, S. 2012. Weighted PageRank Algorithm Based on Number of Visits of Links of Web Page. International Journal of Soft Computing and Engineering (IJSCE), vol.2, pp. 441- 446

[2] Majid Javid Moayed, A. Hamid Sabery, Alireza Khanteymoory, " Ant Colony Algorithm for Web Page Classification " , Putra University, Malaysia Zanjan University, Iran AmirKabir University, IEEE.

[3] Applying Ant Colony Algorithm for Page Ranking Calculation Chonawat-srisa-an faculty of Information Technology Rangsit University.

[4] Lofgren, Peter, Siddhartha Banerjee, and Ashish Goel. "Personalized pagerank estimation and search: A bidirectional approach." Proceedings of the Ninth ACM International Conference on Web Search and Data Mining. ACM, 2016.

[5] Nguyen, Khoa & Chawla, Sanjay. (2016). Incremental Commute Time Using Random Walks and Online Anomaly Detection. 9851. 49-64. 10.1007/978-3-319-46128-1_4.

[6] Thakare, Prajwal R., and K. Hanumantha Rao. "Anomaly Detection Based on Access Behavior and Document Rank Algorithm." arXiv preprint arXiv: 1402.1946 (2014).

[7] L. Page, S. Brin, R. Motwani, and T. Winograd, "The PageRank citation ranking: Bringing order to the web," Stanford InforLab, Tech. Rep. 1999-66, 1999.

[8] Sara Setayesh, Ali Harounabadi and Amir Masoud Rahmani "Presentation of an Extended Version of the Page Rank Algorithm to Rank Web Pages Inspired by Ant Colony Algorithm", International Journal of Computer Applications (0975-8887), Volume 85- No 17, January2014

[9] Daniel Merkle and Martin Middendorf "Swarm Intelligence" Department of computer science, University of Leipzig, Germany.

[10] DistanceRank: An intelligent ranking algorithm for web pages Ali Mohammad Zareh Bidoki, Nasser Yazdani Department of Electrical and Computer Engineering, University of Tehran.

[11] Sim Rank, a page rank approach based on similarity measure by Shaojie Qiao, Tianrui Li Hong Li and Yan Zhu School of Information Science and Technology Southwest Jiaotong University.

[12] Page rank algorithm Brin.S, and Page.L,Journal of Computer Applications (0975 – 8887) Volume 85 – No 17, January 2014.