Agent Based Learning using Improvised Artificial Bee Colony Algorithm on Network Routing

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***Abstract*— The aim of this paper is to highlight and propose an algorithm to find the shortest and the most optimal path in network routing, by using one of the Swarm Intelligence algorithms - Artificial Bee Colony(ABC) Algorithm. This paper discusses the improvisation required for the existing ABC algorithm to obtain best results for network routing. The proposed algorithm thus discusses to overcome the defects of native ABC algorithm by implementing a prior learning and Information Learning on the native ABC algorithm. Two techniques of Information learning like Multi population strategy and Two Search Mechanisms with a prior learning on QoS metric paths are applied to get the most optimized results. The survey depicts that this improvised ABC algorithm performs better than the existing ABC algorithm.**

Keywords—Artificial Bee Colony;Information Learning;Multi Population;Two Search Mechanism;

I. INTRODUCTION

Routing is the process of selecting paths in a given network along which to send the traffic. It is one of the important aspects of network communication which plays a major role in affecting the performance of any network, because other parameters of the network like reliability, congestion and throughput depend directly on it. With the enormous amount of data flow occurring on the Internet in addition to the conventional routing mechanisms, there are several scenarios for increased bottlenecks in the routing paths[1]. A network bottleneck results in slow communication speeds and limits user efficiency and productivity on a network. In order to improve the network routing there is a need for implementation of optimization techniques for the existing paths. The main challenges faced in obtaining an efficient routing path are various factors like increased operational costs, vessel utilization and reducing transport time have to be considered. Since many engineering and scientific fields involve these optimization issues, researchers pay greater attention to optimization techniques such as Swarm Intelligence.

Swarm intelligence (SI) is defined as the collective behavior of decentralized and self-organized swarms [2]. Some of the well known examples for these swarms are fish schools, bird flocks and the colony of social insects such as ants,bees and termites. The Artificial Bee Colony (ABC) algorithm is a swarm based meta-heuristic algorithm for optimizing numerical problems inspired by the intelligent foraging behavior of honey bees. The comparison results demonstrated that ABC is better than or at least comparable to the other EAs, such as GA, differential evolution (DE), and PSO [3].

Due to its simplest nature and efficiency ,ABC is preferred over EA,GA,DE and PSO.Exploitation and Exploration are the two main characteristics of ABC.One possible limitation with the normal ABC algorithm is that for a given bee colony ,the colony always tends to maximize exploitation and restricting exploration. Since exploration is also one of the important features of ABC algorithm, there exist a need to improvise the existing ABC algorithm to balance between Exploration and Exploitation processes to obtain better performance [4]. There are several learning mechanisms that can be used to improvise the results of ABC algorithm, out of which this paper focuses on Information Learning technique. Basically the whole population is been divided into several sub populations so that it can assign different individuals to different sub regions. So the whole population is divided into different groups and different sub regions and hence every neighbour's information can be improvised [5].Due to this independency there may be chances of inappropriate and inefficient solution to the given problem. Thus this can be solved by hence implementing multi population technique and two search mechanisms.

The rest of the paper contains the following sections. Section II briefly covers various topics like Network Routing, Learning Mechanisms, Bio Inspired Algorithms, Artificial Bee Colony algorithm .In Section III, the design module of the proposed system is developed based on the above principles. Section IV contains details of the system requirements and finally Section V draws the conclusion.

II. Literature Review

A. Network Routing

Network Routing is the process of forwarding data packets from the source to destination. A mobile ad hoc network (MANET) is a continuously self configurable network of wirelessly connected mobile devices [6]. Routing in mobile ad hoc networks is broadly classified as Reactive (on Demand) and Proactive (Table Driven) Protocols. Reactive protocols set up routes on demand. In the Ad-Hoc On-Demand Distance Vector (AODV) reactive routing protocol, the topology information is sent by the nodes on-demand to only those nodes to which it wants to establish a route. Proactive protocol like the Destination Sequence Distance Vector or DSDV maintains a list of all the destinations and their routes, by sending routing tables throughout the network in a periodic manner. However both the protocols are not highly scalable since they result in traffic overhead due to increased mobility. This drawback can be overcome by Improved Artificial Bee Colony Algorithm as described in the following sections.

B. Learning Mechanisms

Learning is a process of modifying the existing or acquiring new knowledge and behaviors. The ability of learning is acquired by all living creatures including human beings and some machines. There are many types of learning mechanisms out of which they are broadly classified into Supervised and Unsupervised Learning. From their names only it is evident that Supervised learning is a task of inferring outputs from the supervised trained data [7].This supervised trained data is under the supervision of supervisor or trainer. Using this trained data set learning can be easily implemented to any test data to obtain an optimal solution. On the other hand, under Unsupervised learning algorithm, results are inferred from datasets without labeled responses or classes [7].

C. Bio Inspired Algorithms

Optimization plays a significant role in solving complex mathematical problems in engineering. Optimization algorithms can be categorized as deterministic and stochastic in nature. The former method requires an enormous computational effort which tends to fail as the size of the problem increases, which is a motivation to employ bio inspired algorithms[5].These algorithms are a motivational approach for employing computationally efficient alternative models for deterministic approach. Also they are a problem solving methodology derived from the structure, behavior and operation of natural system and remarkably flexible and adaptable nature. The significant beauty in nature inspired algorithms is that it receives its sole inspiration from nature, they describe and resolve complex relationships from intrinsically very simple initial conditions and rules with little or no knowledge of the search space.

Bio inspired computing is efficient in solving problems of almost all areas, including computer networks, data mining, power systems, image processing, security, control systems, robotics and many more.[8]

III. ABC and Related Work

A. Original ABC

Artificial Bee Colony Optimization is inspired by the behavior of bees in nature [9].This solution search process is a step by step iterative process. The colony of artificial bees contains three groups of bees: onlookers, employed bees and scouts. A bee which is waiting in the dance area, making decision to choose a food source is called Onlooker bee. The one which is going to the food source visited by it before is called a employed bee and the one that carries out random search for new food sources is called a Scout. The food source location corresponds to a possible solution to the optimization problem and the nectar amount corresponds to quality of the solution. For every food source, there is only one employed bee[2]. An employed bee makes modification on the position in her memory depending on the local information and tests the nectar amount of the new source. The employed bee whose food source is exhausted by the employed and onlooker bees becomes a scout. If the nectar amount of the new food source is higher than the previous one, then the employed bee memorizes the new position and forgets the old one[10]. After completing the search process, they share the nectar information of the food sources and their position information with the onlooker bees in the dance area[10]. The search process of ABC has three major steps:

I) Employed bees are sent to a food source and their nectar quality is estimated

II) food sources are selected by Onlooker bees based on information collected from employed bees and estimate their nectar quality

III) scout bees are determined and are employed on possible food sources for exploitation.

The position of the food sources are selected by the bees at the initial stage and their nectar qualities are measured. The employed bees then communicate the nectar information of the sources with the onlooker bees waiting at the dance area within the hive.

The main steps of the algorithm are as below:

1: Initialize Population
2: **repeat**
3: Place the employed bees on their food sources
4: Place the onlooker bees on the food sources depending on their nectar amounts
5: Send the scouts to the search area for discovering new food sources
6: Memorize the best food source found so far
7: **until** requirements are met. [3]

B. *Drawbacks of Original ABC*

- As from the above working of the Artificial Bee Colony algorithm it is evident that the algorithm provides efficient results in exploration processes at the cost of exploitation process.
- For a given bee colony, best results are obtained only for exploration of food source and exploitation process is not that efficient.
- So there exists a need for an improvisation for this existing system which is the purpose of this paper.[4]

IV. Existing Improvisations

To overcome the drawbacks as mentioned above, many improvisation techniques were applied to the original ABC algorithm. One of the techniques used was Information Learning mechanism on the original ABC algorithm. Two main modifications were Multi Population Strategy and Two Search Mechanism [5].

A. *Multipopulation Stratergy*

Initially the given population is been divided into a number of sub populations, where each of the sub population is been assigned to a different sub region. Each of the sub population will search for that given sub region and later through Two Search Mechanisms information will be exchanged between the sub populations [5]. A random size is selected from the set of population size and the results are calculated, if the obtained result is not optimizing the solution in terms of global fitness factor , then the size of the population is varied accordingly to optimize the solution.

B. *Two Search Mechanism*

The Two Search Mechanism basically involves the Lbest Search equation and the Gbest Search equation. Both of these search equations are applied to each of the sub population to obtain an optimal solution through information exchange between the sub populations. Lbest search equation is applied onto the Employer Bee phase to obtain a Lbest candidate for that given population[5]. Similarly Lbest candidates are found for each of the sub population in the given whole population. Based on the fitness factor , Lbest candidates are obtained. This hence optimizes the exploration process. Similarly the Gbest Search equation is applied onto the Onlooker Bee phase to improve the exploitation process. The Gbest candidate thus determines how the information has to be carried between the populations through a Transmission Vector to maximize the output[5]. The global fitness factor is the main determining criteria as to who is the Gbest candidate for the given population. Higher the global fitness factor higher the optimum results. Thus by these techniques mentioned above Information Learning is applied onto the existing ABC algorithm to get optimized results[5].

V. Proposed System

From the above seen Literature Review and ABC related works, it was evident that there is a need for an improvisation for the existing algorithm. When ABC algorithm with Information Learning (ILABC) is implemented on network Routing to obtain optimized results, it will be inefficient to apply it on all paths becomes its time consuming and also waste of resources allotted. Therefore the proposed system implements a prior learning before Information Learning to improve efficiency. This prior learning includes selecting all possible paths based on the QoS constraints set by the user. The QoS metrics used for this system are bandwidth and delay. Higher bandwidth and lesser delay is preferred for optimized results. Thus this proposed system improves efficiency according to the user requirements.

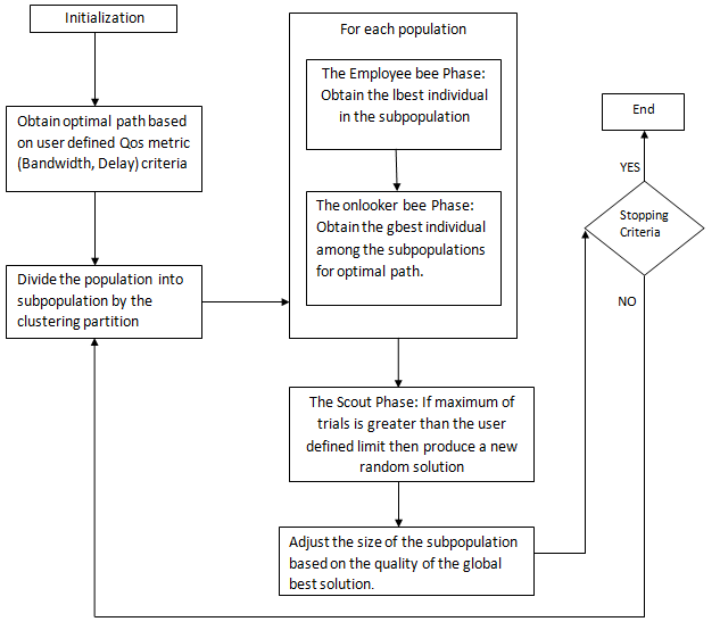

Fig. 1. Flowchart of the working of the proposed system.

VI. Conclusion

From the above seen Literature Review it can be easily concluded that there exists a need for an improvisation of the native ABC algorithm. The original ABC Algorithm performs the exploration process well, but is not so efficient in the exploitation of the sources. This is handled by the Artificial Bee Colony Algorithm with Information Learning. ILABC implements division of labor by dividing the populations into many subpopulations. The learning within a subpopulation and between subpopulations occurs with the search mechanisms of Gbest and Lbest individuals. An even more optimal solution can be obtained by implementing an early

learning prior to ABC algorithm where all the paths satisfying the threshold value defined by the user based on the QoS constraints are satisfied.

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