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Optimal Routing Based on Artificial Bee Colony in Mobile Adhoc Network

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Abstract— Artificial bee colony algorithms are considered as a search process used in computing to find exact or a approximate solution for dynamic optimization and search problems. There are also termed as global search heuristics. These techniques are dynamic optimization method for shortest path and other optimization problems which borrows ideas from biological bees behavior such as food source, employed foragers,unemployed foragers. These algorithms give a way programto instinctivelyimprove their parameters. Moreover, experimental results show that ABC algorithm finds the optimal routing than the other algorithms and enhances the performance in changing environments.

Index Terms—Dynamic Optimization Problem (DOP), Shortest Path Routing Problem (SPRP), ArtificialBee Colony, Foraging Behavior.

I. INTRODUCTION

Mobilead hoc network (MANET) [25], [26], [28] is aself-organizing and self-configuring multihop wirelessnetwork, that consist of group of mobile hosts (MHs) that may move around freely and cooperate in relaying packets on behalf of one another. MANET supports strong and economicaloperationsby incorporating the routing practicalityinto MHs. InMANETs, the unicast routing establishes amultihop forwarding path for two nodes on the far side the direct wireless communicationrange. Routing protocols additionally maintain property once links on these methods break owing to effects like node movement, batterydrainage, radio propagation, and wireless interference. Inmultihopnetworks, routing is one amongst the foremost necessary issuesthat encompasses a vital impact on the performance of networks. Therefore,to construct routing tables or search routes directly. In the geographicrouting, every nodeis aware of its own position and makes routing decisions supported on the position of the destination andthe positions of its native neighbors.wetend to investigate the shortest path (SP) routing drawback, thatbelongs to the topological routing. The SP routing drawback aimsto seek out SP from a selected source toa specific destination I during a given network whereas minimizing the total cost related to the path.

The SP routing problem isa classical combinatorial optimization problem arising in several style and coming up with contexts [1], [3]. There are many deterministicsearch algorithms for the SP problem: the Dijkstra'salgorithm, the breadth-first search algorithm, the Bellman–Fordalgorithm, etc. All these algorithms have a polynomial timecomplexness. They are effective in fastenedinfrastructure wireless or wired networks. But, they exhibit associate degree unacceptable high procedure computationalcomplexnesss for real-time communications involving quickly ever-changing network topologies [2]. Therefore, for thedynamic SP routing problem (DSPRP) in an exceedingly ever- changing network environment, we'dlike touse applicable newapproaches. The DSPRP has become a subject of interest in recent years, and there are some works managing with in the DSPRPs in the literaturefar, there are chiefly two sorts of of routing protocols in MANETs, namely, topological routing and geographic routing. Within the topologicalrouting, mobile nodes utilize the topological information.

A. MANET Routing

Normally the Network layer is employed to Route the information in MANETs. The most aim of routing in MANETs is to identify the path between the source node and destination node over that data packets may be forwarded. A MANET routing algorithm is not soley to identify the shortest path between the source and destination, however its additionally been custom –made. The majority of MANETs is connectionless in nature. The connections area unit less effective in delivering the QoSthat's needed with in the quickly ever-changing MANET environment. The MANETs is additionally multi-hop in nature. The packet must be relayed through different nodes to get to the destination. This MANETs needs that ancient algorithms to be redefined to accommodate these extra necessities. Each MANET routing algorithm has three essential parts specified route discovery mechanism, route error correction mechanism and route maintenance mechanism [5-9].

B. Inspiration from Nature

The central plan of this paper surrounds the application of Artificial Bee Colony Optimization to the problem of MANETs. Artificial Bee Colony Optimization falls into a category of biologically galvanized algorithms that have recently been developed. To call some, the techniques of Particle Swarm optimization and Bacterial Foraging have been galvanized by phenomenon. The Artificial Bee Colony Optimization mimics the behavior of Bees in nature whereas they'rechecking honey. Particle swarm optimization is galvanized by the behavior of flocks of birds as they fly in search of food. Microorganism hunting is yet one more recent

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algorithm rule that simulates the behavior of microorganism checking out food. Of these techniques area unit combined in nature andonce viewed within the perspective of optimization involve checking out the optimum answer during a given search house. It's beenascertained that once these patterns, that area unit ascertained in nature, area unit applied to advanced engineering issues, they supply better solutions [10-14].

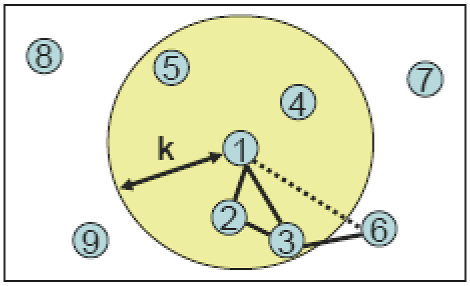

Fig. 1. Sample shortest paths in a MANET.

C. SP Routing Problem

In this section, we have tendency to present our network model and so formulate the SPRP.We take into a MANET operating within a fixed geographical region. We have tendency to model it by an undirected and connected topology graph G0 (V0 , E0), whereverV0 represents the set of wireless nodes (i.e., routers) and E0 represents the set of communication links connecting two neighboring routers falling into the radio transmission range. A communication link (i, j) cannot be used for packet transmission unless both node iand node j have a radio interface every with a common channel. However, the channel assignment is on the far side the scope of this paper. In addition, message transmission on a wireless communication link can incur exceptional delay and cost.

II. SWARM INTELLIGENCE

Several fashionable heuristic algorithms are developed for finding combinatorial and numeric optimization issues. These algorithms will be classified into totally different teams looking on many criteria. The standard will be population based, iterative based, settled.Swarm intelligence (SI) is that the behaviors of decentralizing,self-organizing system, natural process and artificial. This idea is used to in acting on artificial intelligences. Within the context of cellular'sAI systems SI system consisted generally of a population easy agents interacting native with 1 other and with their environments. This inspiration usually comes from natures, particularly biological system. The agent followed terrible easy rules follows, and though there's no centralizing controlled structures dictating however on an individually basis agent should have behaved, locally, and to a definite degrees random, interaction between like agent resulting the emergency of "intelligent" behaviors, unknown to the individual agent. Example in natural system of SI enclosed ant colony,birds flocking, animals swarming, grow thing, and fishes schooling. They definitions of swarm intelligences area unit still none quite clearing. During a principle, it ought to be multi-agent systems that have self-organizing behaviors that show someintelligence behaviors. The term swarm is employed for an aggregation of animals like fish faculties, bird flocks and insect colonies like ant, termites and bee colonies performing arts collective behavior. The individual agents of a swarm behave while notsuper intendance and every of these agents has a stochastic behavior due to her perception in the neighborhood. Native rules, without any relation to the global pattern, and interactions between self-organized agents lead to the emergence of collective intelligence called swarm intelligence. Swarm intelligence acts on two basic principles: self-organization, stigmergy.

A. Self Organization:

Bonabeau et al., in Swarm Intelligence, 1999 outlined the self-organization as, "Self-organization may be set of dynamical mechanisms whereby structures seem at the world level of a system from interactions of its lower-level components" [22]. A self-organized system may be characterized by three parameters structure, multi-stability, and state transaction.

Structure rising from a homogeneous start-up state, e.g., hunting trails, nest

B. Architecture:

Multi-stability beingness of many stable states, e.g., ants exploits just one of two identical food sources.

State Transitions with a dramatically amendment of the system behavior. e.g., termites move from a non-coordinated to a coordinated part providing their density is on top of a threshold value. The foundations specifying the interactions among the systems constituent units are executed on the idea of purely native information, while not relevecy to the global pattern, that isanascent property of the system instead of a property obligatory upon the system by an external ordering influence.

III. ARTIFICIAL BEE COLONY ALGORITHM

Based on the behavior of the bees in nature, variousswarm intelligence algorithms are available. Thesealgorithms area unit classified into two; foraging behavior and mating behavior. Artificial Bee Colony may be predominant algorithm simulating the intelligent foraging behavior of a honeybee swarm, proposed by Karaboga and Basturk. In ABC algorithm, the colony of artificial bees contains three team of bees: employed bees, onlookers and scouts[21]. A bee waiting for the dance space for creating a call to decide on choose a food source is named onlooker and one reaching to the food source visited by it before is known as employed bee. The other kind of bee is scout bee that carries out random look for discovering new sources. The position of a food source represents a potential solution to the optimization problem and therefore the nectar amount of a food source corresponds to the standard(fitness) of the associated solution. A swarm of virtual bees is generated and commenced to maneuver every which way in two-dimensional search space. Bees after theytheyrealize some target nectar value [19-20].

A. Artificial Bee Colony optimization (ABCO)Algorithm for Shortest Path Routing Problem (SPRP)

The following steps are repeated until a terminationcriterion is met.

a. Calculate the nectar amounts by sending the employedbees on to the food sources.

b. After sharing the information from employed bees select the food sources by the onlookers and determine the nectar amount of food sources.

c. Determine the scout bees and send them to find out new food sources.

B. Pseudocode for ABCO algorithm:

a. Initialize population with random solutions.

b. repeat

c. places the bees on their food sources

d. places the bees on their food sources depending on theirnectar amount.

e. Send the scouts to the search area for discovering new food sources.

f. Memorize the best food source found so far

g. Until requirement are met.

The search cycle of ABC consists of three rules: (i) sending the employed bees to a food source and evaluating the nectar quality; (ii) onlookers selecting the food sources when getting information from employed bees and calculating the nectar quality; (iii) determining the scout bees and sending them onto potential food sources. The positions of the food sources are every which a way elect se by the bees at the initialization stage and their nectar qualities are measured. The employed bees then share the nectar information of the sources with the bees waiting at the dance space interval the hive. When sharing this information, each employed bee returns to the food source visited throughout the previous cycle, since the position of the food source had been memorized so selects another food source mistreatment its visual information with in the neighborhood of this one. At the last stage, associative in nursing onlooker uses the information obtained from the employed bees at the dance space to pickout a food source. The chance for the food sources to be chosen will increases with increase in its nectar quality. Therefore, the employed bee with data of a food source with the highest nectar quality recruits the onlookers to that source. It afterwards chooses another food source within the neighborhood of the one presently in her memory supported on visual information (i.e. comparison of food source positions). A brand new food source is randomly arbitrarilygenerated by a scout bee to replace the one abandoned by the onlooker bees.

Steps of the ABC algorithm

Send the scouts onto the initial food sources

REPEAT

Send the employed bees onto the food sources and determine their nectar amounts

Calculate the probability value of the sources with which they are preferred by the

Onlooker bees

Stop the exploitation process of the sources abandoned by the bees

Send the scouts into the search area for discovering new food sources, randomly

Memorize the best food source found so far

UNTIL (requirements are met)

Each cycle of the search consists of three steps:

i) Moving the employed bees onto the food sources and calculating their nectar amounts

ii)choosing the food sources by the onlookers once sharing the information of employed bees and calculating their nectar amounts

iii) Determining the scout bees and directive them onto potential food sources.

*Stage 1:*At the initial stage, a group of food source positions are randomly selected by the bees and their nectar amounts are determined. Then these bees come into the hive and share the nectar information of the sources with the bees waiting on the dance space among the hive.

Stage 2: At the second stage, after sharing the information, every employed bee goes to the food source space visited by her at the previous cycle since that food source exists in her memory so chooses a replacement food source by means that of visual informationwith in the neighborhood of the current one.

Stage 3: At the third stage, an onlooker prefers a food source space depending on the nectar information distributed by the employed bees on the dances pace.

Key Parameters, Constraints and Measures of ABC algorithm:

For the implementation of ABC algorithm there are many parameters and constraints to be followed, the're summarized as below

a) A food source potential resolutiona to the matter to be optimized.

b) The number of nectar of a food source corresponds to the standard (fitness) of the solution represented by that food source.

c) The number of employed bees or the onlooker bees is capable the quantity of solutions with in the population.

d) Onlookers are placed on the food sources by using a chance primarily based selection method. because the nectar amount of a food source will increase, the chance value with that the food source is most popular by onlookers will increases.

e) Each bee colony has scouts that are the colony's explorers. The explorers don't have any steering whereas probing for food. Since they're primarily involved with finding any quite of food source, thereforethe scouts are characterized by low search costs and aoccasional average in food source quality.

In the case of artificial bees, the artificial scouts might have the quick discovery of the cluster of possible solutions or a task. during this work, one amongst the employed bees is chosen and classified as the scout bee. The selection is controlled by a control parameter called “limit”. If a solution representing a food source is not improved by a preset variety of trials, then that food source is abandoned by its employed bee and the employed bee is reborn to a scout.

f) The quantity of trials for releasing a food source isadequate to the value of “limit” that is very important control parameter of ABC.

g) with in the ABC algorithm, whereas onlookers and employed bees perform the exploitation process with in the search space, the scouts control the exploration process.

h) with in the case of real honey bees, the enlisting rate represents a “measure” of how quickly the bee swarm locates and exploits the new discovered food source.

Artificial recruiting processes equally represent the “measurement” of the speed with that the possible solutions or the optimal solutions of the difficult optimization issues are often discovered.

i) The survival and progress of the important bee swarm depended upon the fast discovery and efficient utilization of the best food sources.

j) There square measure four management parameters used in the ABC algorithm:

1. The quantity of food sources which is equal to the number of employed or onlooker bees (SN),
2. The value of limit, and
3. The maximum cycle number (MCN).

IV. EXPRIMENTAL RESULTS

The simulation experiments were created on the ns-2 (14) network simulator. The ns-2 simulation setting offers sound reproduction to represent propagation development, physical and network layer. The simulations include a full simulation of the IEEE 802.11 physical and mac layers.

The experiments consist on nodes at random placed on an oblong plane area, of 1000 [mt] x 1000[mt] of surface. every node moves in step with the Random means purpose quality model planned in Broch et al (1L5), during this model every node begin static for a disruption time so selects a destination within the simulation area and moves towards it with a consistent distributed speed. this implies that dominant the pause time and also the most speed it's attainable to random variable the "mobility" of the simulation situation. In our simulations the utmost speed was set to 1 O[m/s], that correspond to the most attainable for a pedestrian, and, the pause time of 0, 30, 60 and, 120 seconds. For 0 seconds pause time we have a tendency to get a high mobility situation and for the 120 seconds we tend to get an occasional quality scenario. The following figure 1 shows the comparison of proposed algorithms with the existing algorithms. From the comparison, ABC outperform than the other algorithms like GA, PSO and ACO with minimum delay.

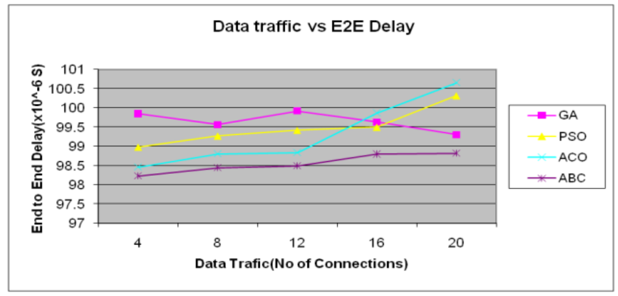

Fig 1 Comparison of No. ofConnections Vs End to End Delay

Comparison of no. of connections with the throughput is shown in figure 2. ABC transmits more number of packets than other algorithms like GA, PSO and ACO.

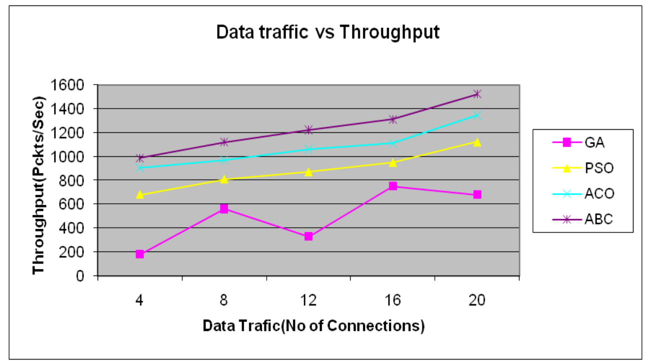

Fig 2 Comparison of No. Connections Vs Throughput

V. CONCLUSION AND FUTURE ENHANCEMENT

This paper compared the performance of the ABCO therewith of GA, PSO and PS-EA which are also swarm intelligence and population based mostly algorithms as the ABC algorithm. There are a unit many problems that remain because the scopes for future studies like the investigation of the control parameters’ impact on the performance of the ABC algorithm and alsothe convergence speed of the algorithm. Thus the Artificial Bee Colony algorithm is extremely versatile and may be effectively used to find the shortest path by considering very few control parameters as compared with the other heuristic algorithms.

Future work wouldpossibly the comparative study of Artificial Bee Colony algorithm with the other optimization algorithms. Also, the impact of constraint handling strategies on the performance of the ABC algorithm will be investigated for multicast routing in dynamic environment.

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