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Optimization Of Manet Routing Using Hybrid DSR with ABC Algorithm

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Abstract: Different mobile nodes are linked together through wireless networks using a system that is independent, self-configuring, and infrastructure-free called a MANET. AODV, DSDV, TORA, DSR& other routing protocols are used in Mobile Ad Hoc Networks (MANET). Mobility, overhead, battery depletion, delay, and interference are just a few of the problems and limitations that MANETs face because of their constantly changing topologies and lack of infrastructure. The best and optimal solution can be discovered using a variety of optimization techniques. Meta heuristics called "nature inspired algorithms" imitate nature to solve optimization issues, ushering in a new era of computation. The Artificial Bee Colony (ABC) program, developed by Karaboga, reproduces foraging behaviorof honey bees. Since ABC's beginnings, extensive study has been done to improve its effectiveness and expand its applications.

Keywords: *ABC Algorithm, Swarm Optimization, Scout bees, Onlooker bees ,Employed bees, meta-heuristics, evolution strategy.*

1. Introduction:

A network of independent, self-configuring nodes that function independently of any physical infrastructure & cooperate in a distributed manner is known as a mobile ad hoc networks.Individual devices in MANET are free to travel in any direction. There are many ways to distinguish a mobile ad hoc network from other wireless networks, including the use of a frequent changes in topology, mobility of node, infrastructure less communication, and multi-hop forwarding. Effective routing protocols are required to create a communication path between nodes. Reactive, proactive, & hybrid routing protocols make up the three primary categories of the numerous routing protocols utilized in MANETs.

Reactive routing protocols do not search for routes on their own; they only do so in response to requests. They wont continuously update the route tables. like AODV, DYMO, TORA, and ARA. In order to determine a node's immediate surroundings, proactive routing techniques keep a table of each node that contains the most recent information on routes to nodes. In this control system, messages are passed back and forth periodically. the same as DSDV, OLSR, & WRP. Hybrid Routing Protocols, on the other hand, are a blend of Reactive and Proactive Routing Protocols. such as ZRP, FSR, HOPNET& DDR.

We may choose the optimal outcome from all alternative possibilities via optimization. [2]. The optimal and best solution can be found using a variety of optimization techniques. Biologically inspired algorithms are a subset of optimization algorithms that are designed to mimic nature's processes. Due of their benefits, these algorithms can be used to tackle a variety of issues. First, we don't need to use any mathematical methods to arrive at a solution. Second, they arrive quickly and accurately [3]. The following are the some the popular algorithms:

- algorithms on Genetic
- Optimization of Artificial Bee Colonies
- Particle Swarm Intelligence
- Algorithm for Bacterial Foraging
- Ant Colony Optimization
- Virtual neural networks

ABC, an algorithm based on population, denotes a source of food's location as a potential optimization of the solution and quantity of honey in the source denotes how well (fit) that solution is to the problem at hand. The total number of responses from the population is equivalent to how many hired bees. The initialization is distributed at random. (food source placements) is created in the first stage [4]. Once initialization completes, the population is required to be carry out on the cycles of the employed, observer, & scout bees respective searches. A worker bee changes the location of its food supply in its memory & locates a food source newly. If the amount of nectar at the new source is higher than the prior source, the bee learns a new location for the new nectar source and overlooks the position of the former one. Otherwise, she can recall the individual's situation. When all bees working in the search have finished, they inform people observing on the dance floor about where to find the sources. Each observer assesses the details of nectar obtained from all active bees, and based upon the sources' nectar yields,

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selects a feeding source [5]. She alters the location of the source in her mind and counts the quantity of nectar there, just like she did with the hired bee. The Bee forgets its former location.memorizesand replace it if the nectar level is higher than the level of the place before it. Artificial scouts identify the neglected sources and generate new sources at random to replace them.

Design ideas for a Artificial bee colony

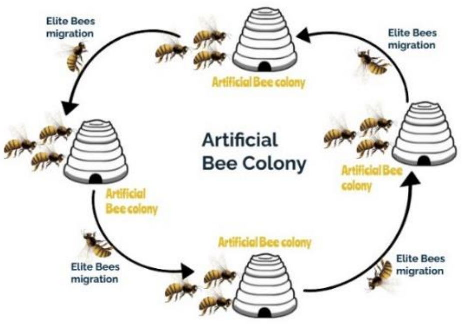


Fig 1: ABC System.

The Artificial Bee Colony technique, an approach to optimization which imitates the gathering behaviour of honey bees, thathas been utilized to successfully to address several real-world problems. Honey bee swarms have been shown to cooperate to successfully execute tasks [6].

2. Artificial Bee Colony Algorithm:

An optimization technique called Artificial Bee Colony algorithm that imitates honey bee foraging methods, has applied successfully to address a number of issues from the actual world. Honey bee colonies can work together to complete tasks successfully. Bees are divided into three groups by the ABC algorithm.: employed bees, spectator bees, and scout bees[7]. The hired bees also hunt for food near the food source in their memories in addition to telling the watcher bees regarding such food sources. The observation bees often select the best food sources among those that the employed bees have found.The likelihood that the watching bees will select the more nutritious food source (fitness) is notably higher than the likelihood that they would select the less nutritious one. The scout bees were created by a small number of paid bees that left their old sources of food in search of new ones. Three different artificial bee colony contains various species of bees used in the ABC algorithm: workers, observers, and scouts [8]. While a spectator bee decides which food source to select while waiting on the dance floor., an employee bee flies to the food source it has already visited. The entire area is surveyed by a scout bee. The working artificial bees make up ABC algorithm's part of the colony, and the observers make up the other half. Each source of food is currently being used by one bee. Or, to put it another way, the number of food sources close by corresponds to the number of bees actively working to maintain their hives. The worker bee becomes a scout.once the observer and the workers have consumed all of its food supplies [9].

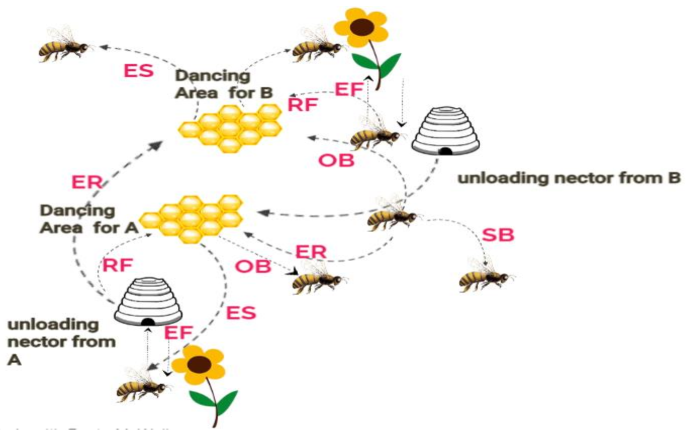


Fig 2: Bee Behaviour in Nature

Bees in the dancing area are communicating with one another through waggle dancing about the food's quality sources. Bees use waggle dancing to indicate which way the food supply is located in connection with the sunand strength of waggles to indicate distance, as well as the length of the dance to indicate the quantity of nectar present at the associated sources of food. [10]. One of the following rules is followed by each bee. They could change as they went through various foraging periods.

***The collection of nectar proceeds as follows*:**In the colony's early stages, there are only a few SB and OB. When OB waits near the hive in anticipation of being recruited, SB is dispatched to look for suitable nectar Employed bees sources. Any SB will turn into an EB if it finds a nectar supply.[11].

- Onlooker bees
- Scout bees
- EB goes to the hive after collecting some nectar & dances using various forms to reveal the source to OB. Many dance forms represent various nectar sources of varying quality.
- Each OB evaluates the nectar sources' quality after being led to a corresponding source by one of the EB [12]. According to some likelihood, all OB select EB. Better sources with more nectar are more appealing to OB and have a higher likelihood of being chosen.
- When a source is depleted, the accompanying EB will stop using it, change into an SB, and look for another source [13].

the population's initialization:

xi(i = 1, 2,..., SN) is a solution, which D is a dimensional vector, in the initial population of uniformly distributed SN solutions generated by ABC. D denotes how many variables are present in the issue with optimization, while xi is the population's ith food source. The techniques outlined below are used to create each food source[18]:

$$x_i^j = x_{min}^j + rand(0,1)(x_{max}^j - x_{min}^j), \forall j = 1, 2, ..., D \quad (1)$$

where x_{min}^j and x_{max}^j are bounds of x_i in j^{th} direction.

Employed bees phase:

On the basis of their knowledge and the fitness worth (quantity of nectar) of the fresh approach, employed bees change the current solution at this stage. If the fresh supply of food has a superior fitness value to the old one, the bee will replace the old one with the new one and discard the old one. The equation for updating position for the ith candidate's jth dimension This stage demonstrates by using the equation:

$$v_{ij} = x_{ij} + \phi_{ij}(x_{ij} - x_{kj})$$

The indices k, 1, 2….SN &j, 1, 2….D are picked at random when the step size is given as ij (xij- xkj). For step size to be useful, it must be distinct from i and ij must have a random value between [-1, 1].

Fig1 depicts the employed bee phase (a) position update procedure. Here, the bee (xk) is shown in the position (xi) that was chosen at random, and the highlighted box indicates the direction (j) that was chosen at random. This stage involves subtracting the direction of the ith bee from the direction of a bee selected at random with a value of k = I, and multiplying the result by a number selected at random with a value of ijj [1, 1]. The j^{th} dimension of the fresh food job vij is eventually created by adding this amount to the jth dimension of xi. This v_{ij} is depicted in the figure by a vertical vector that is formed next to x_i and has the same other dimensions as xi[18].

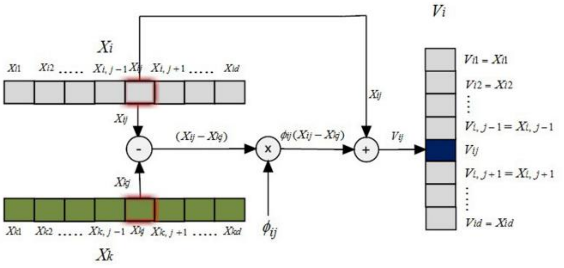
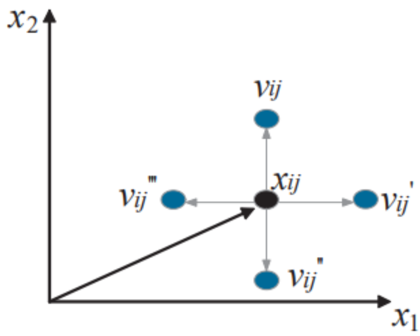


Fig 3: Exemplifying a straightforward position update equation



In the vicinity of xij, various potential new vectors were created as a result of the update equation for position in the 2.D search area.

phaseof Onlooker bees:

As soon as the employed bee phase is through, the observer bee phase starts. At this time, all employed bees exchange information about their whereabouts and the nutritional status of updated solutions (food sources) with the hive's watching bees. Observer bees consider the available data and select a solution based solely on the probability of its fitness, pi. The following equation (there could be more, but they all need to be functions of fitness) the ability to compute the probability pi[18]:

$$p_i = \frac{fit_i}{\sum_{i=1}^{SN} fit_i}$$

Where fit_i is the ith solution's fitness score. The observation bee alters the place in her memory and decides whether the possible source is acceptable, much as the hired bee. If the new posture requires more fitness than the old one, the bee memorizes it and forgets the old one.

phaseof Scout bees:

The bee scout phase is initiated if an object is in a food supply is not updated for a set period of time number of cycles, after which it is believed to have been abandoned. During this phase, the original food supply is swapped out for the picked at random as a food source in the search region, and the bee attached to it transforms into a scout bee. The predetermined number of cycles, often known as the abandonment limit, is one of the most crucial control parameters in ABC. If the rejected source is xi, the scout bee will perform the following[18] to replace it with a new supply of xi:

$$x_i^j = x_{min}^j + rand[0,1](x_{max}^j - x_{min}^j), \forall j = 1, 2, ..., D \quad (4)$$

where x_{min}^j and x_{max}^j are bounds of x_i in j^{th} direction.

Pseudo Code[18]:

Initialise the population of solutions, $x_i (i = 1, 2, ..., SN)$ using (1);
cycle = 1;
while cycle <= MCN **do**

1. Produce new solution v_i for the employed bees using (2) and evaluate them
2. Apply the greedy selection process for the employed bees
3. Calculate the probability values p_i for the solutions x_i using (3).
4. Produce the new solutions v_i for the onlookers for the selected solutions x_i depending on p_i and evaluate them
5. Apply the greedy selection process for the onlookers
6. Determine the abandoned solution for the scout, if exists, and replace it with a new randomly produced solution x_i using (4)
7. Memorise the best solution achieved so far
8. cycle = cycle + 1

end while

Steps involved in ABC Algorithm:

Step 1: Creating the first source of food

Step 2: Sending bees that are working to the source of food

Step 3: Determining the probabilities used in probabilistic selection

Step 4: spectators choosing a food source based on data provided by working bees.

Step 5: Limit & scout production as an abandonment criterion

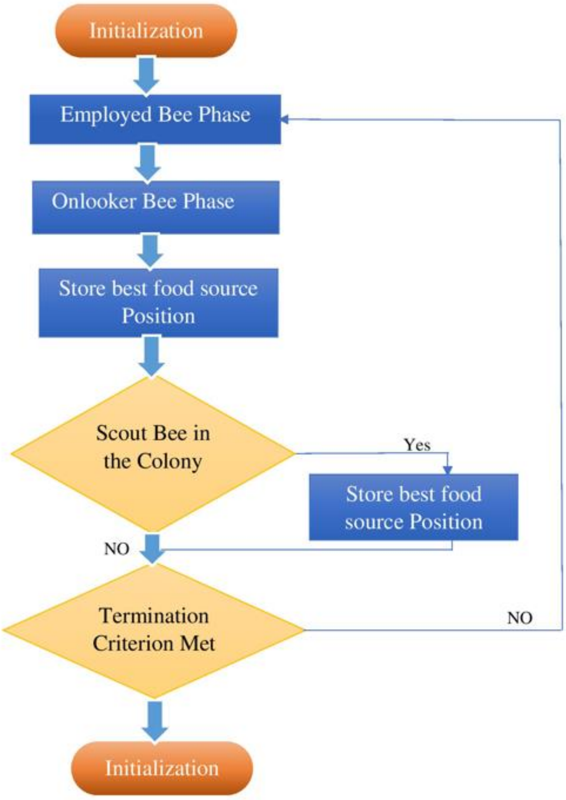


Fig 4:ABC Algorithm Flow Chart

Uses for the ABC Algorithm

- Segmentation of Images
- Issue With Vehicle Routing
- Difficulty in Scheduling [14]
- The neural network training
- categorization of patterns [15]

Benefits of the ABC Algorithm

- A few control variables.
- quick convergence
- Explaining AND explaining.
- It ensures that these things, that are making a significant investment there, are subject to more rigorous and attentive scrutiny.
- Working cash that would have been otherwise locked for a more lucrative investment route is released [16].
- It lowers the cost of carrying inventory.
- It makes it possible to relax the control and over "c" items, enabling the construction of a sufficient buffer stock.
- This makes it possible to maintain a high turnover rate of inventory [17].

3. Implementation of Hybrid DSR Using ABC Algorithm:

Manet is one of the area to be research for optimization, therefore we adapt hybrid DSR,and we have certain algorithms DSR,AODV and all..so we have hybrid DSR to implement shortest path,but we apply optimization, and we have more enhanced shortest path algorithm.for establishing shortest path for route nodes,so it provides optimized results or optimized routing instances

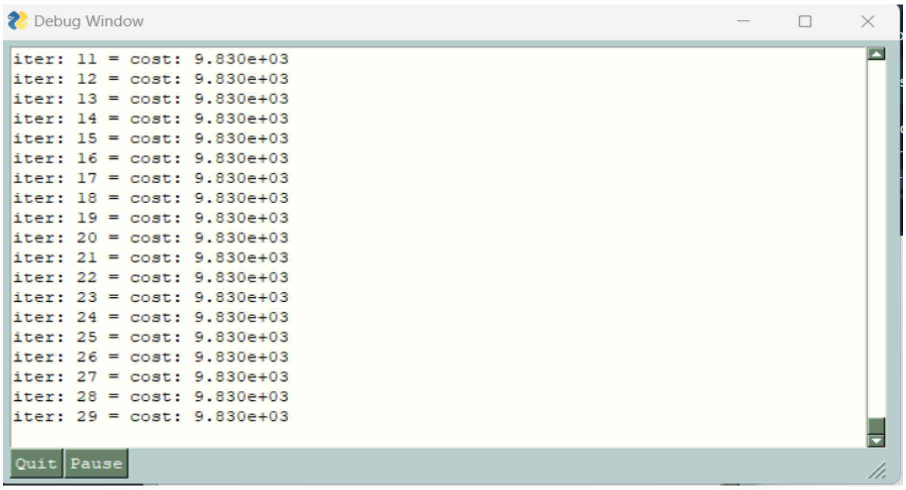


Fig 5: Cost Calculation using ABC

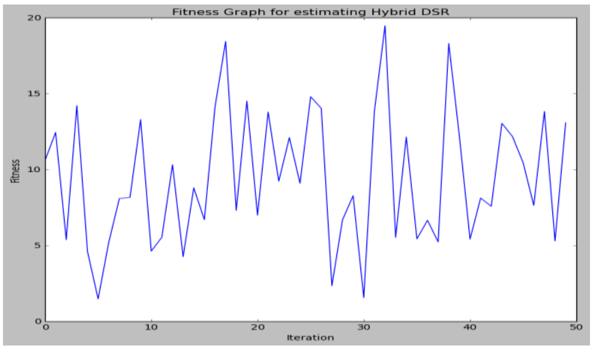


Fig 6: Fitness calculation w.r.t colony Size

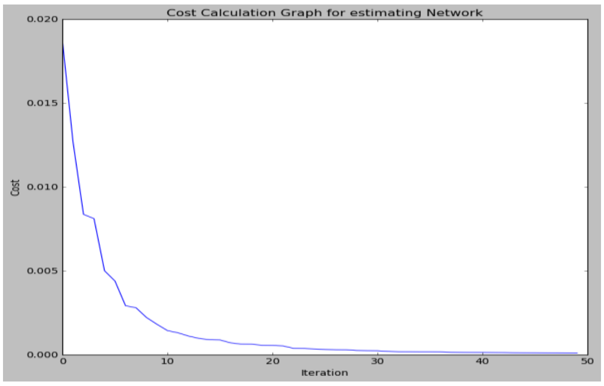


Fig-7: Cost Calculation w.r.t colony size

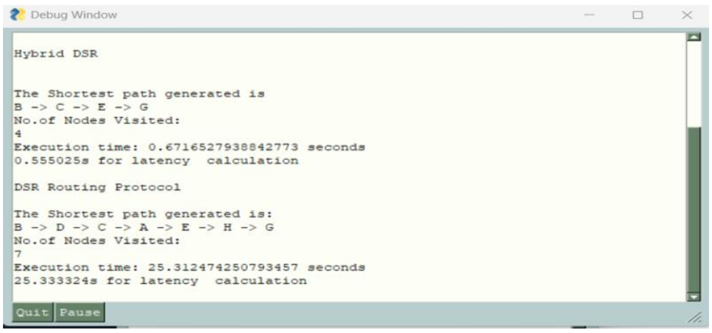


Fig8: Execution time for generating shortest path using ABC optimization

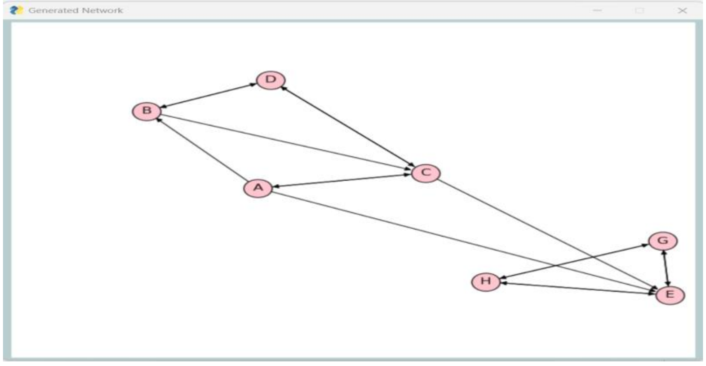


Fig 9: Generated Network Graph

4. Conclusion:

The primary criterion for selecting the optimum solution from all potential outcomes is optimization. There are numerous optimization approaches that can be used appropriately to get better results. The main emphasis is on an optimization strategy that increases the network's dependability, efficiency, and prevents any loss of the original link during data transmission. With the help of this article, we now understand how the Artificial Bee Colony algorithm works, how it resembles a bee colony, and how to use it to solve optimization problems.

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