

Hybrid Routing Using ANT and BAT Algorithm for MANET

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Abstract- Now a day the wireless network demands increased because it's allow to user to connect with services anywhere. In wireless network, MANETs is an infrastructure-less network in which each node work as host and router provide more flexible routing in the network. There is no centralized node so failed of some nodes never affect the whole network. In this paper, firstly a survey is done on MANET routing and swarm intelligence techniques. Based on survey it's found that swarm intelligence algorithm gives best solution in minimum time. In the proposed work Ant and Bat algorithms are chosen for hybrid routing. Also, hybrid routing is done in a way that in minimum time, two wireless network graphs connected and route so there is no loss of packets. Moreover, the performance analysis is done on the basis of swarm intelligence algorithms parameters and execution time.

Keywords—Swarm Intelligence Algorithm, MANET, Routing, Local and Global Optimization.

I. INTRODUCTION

The wireless network demands increased in the last decades because it's provides an interface through users communicate and use service anywhere wirelessly. The wireless network structure also changed at a vast rate. The existing wireless network structure have centralized unit which controls all operation on the network. The limitation of this structure is that if any new node adds up in the network, its configuration has to register in the centralized unit. Also, the fault in centralized node affects the whole network. To overcome this limitation, infrastructure-less network is proposed in which any node add anywhere and if any node failed then it's never affect the whole network. In infrastructure-less MANET comes in picture as shown in fig 1 [1]. Each node in MANET worked as a host and router.

1.1 The MANET network required following advantages as compared to existing centralized network.

- The numbers of nodes are added or remove from the network so scaling possible.
- There is no centralized node so node fault never affect whole network.
- Network can be set up anywhere according to requirement.

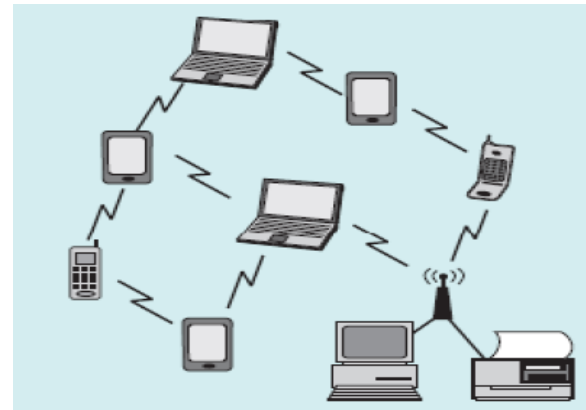


Figure 1 Infrastructure-less Network [2]

1.2 The MANET routing is divided into three parts [3].

- **Proactive Routing:** In proactive routing a look-up routing table is stored on each node for routing the packets in the optimize way. The advantages of look-up routing table are that it provides the next node in minimum iterations. But the limitation is that to maintain the look-up routing table up-to-date.
- **Reactive Routing:** In reactive routing according to requirement search route on the network. The reactive routing has two phase route discovery and maintenance. The advantages of reactive routing no need of maintain look-up-table on network so memory requirement reduces on nodes. But the limitation is that large execution time required as compared to proactive routing.
- **Hybrid Routing:** In hybrid routing the proactive and reactive routing features are combined to increase network size and nodes capacity. The nearby nodes are maintained using proactive routing and far away routing determine by reactive routing.

The rest of the paper is organized as follows: Section 2 describes the survey on MANET routing and Swarm Intelligence techniques and also define our contribution. The Section 3 presents existing Ant, Bat algorithm overview and proposed hybrid technique overview. In Section 4, the wireless nodes graph plotted in MATLAB 2013a and their simulation results shown. The performance analysis is done on

the basis of parameters and execution time. Conclusion is done in section 5.

II. RELATED WORK

In this section survey on optimization of routing for MANET and for swarm intelligence is done.

DiaaEldein Mustafa Ahmed, Othman O. Khalifa [2], surveyed on MANET networks and defined their applications, features and characteristics challenges faced in deployment of MANET. Also, based on survey define some research issues Amrita Chakraborty and Arpan Kumar Kar [4], discuss that swarm intelligence is an integral field of artificial intelligence and now-a-day gaining attentions because providing solutions for complex problem within reasonable period of time. They survey also shows that the swarm intelligence techniques are mostly based on biological behavior. The main focus of this paper is to survey 8 different techniques such as Ant, bees, glow-worms, bats, fireflies, monkeys, lions and wolves for different applications. There conclusion shows that they provide an initial understand of techniques and provides future work.

Sharma, *et al.* [5], in this paper, they provides a summary of existing routing classes and focused on their uniqueness and their functionality. Also, define how to judge based on routing functionality and information to build routing algorithm.

B. Nancharaiiah and B. Chandra Mohan [6], discuss that delay and communication cost are important metrics for routing in MANET. Also, they define current work going on swarm intelligence techniques for optimizing the routing. From their survey they defined that Ant is the most algorithm for optimization. In their work the ant output is input to PSO algorithm to determine the best solution based on particles position and velocity. There hybrid work gives better performance as compared to Ant technique.

DweepnaGarg and ParthGohil [7], in this paper using Ant algorithm for optimizing the routing in MANET. They used Ant behaviors property to solve complex problems by their cooperation.

2.1 Our Contribution

In this paper, hybrid routing technique is proposed. The near-by nodes are designed based on ANT Colony pheromones concentration. On the other hand, the far away nodes are found out using BAT Algorithm. The advantages of BAT algorithm over PSO is that in place 2 parameters (Velocity and Position) 3 parameters (Velocity, Frequency, Loudness) are used for efficient node in minimum execution time. Also, based on parameters and execution time performance analysis are shown.

III. OVERVIEW OF ANT AND BAT ALGORITHMS AND THEIR HYBRIDIZATION FOR MANET ROUTING

In this section, firstly overview of Ant and Bat Algorithm is done. Based on both algorithms a hybrid technique is proposed for local and global optimization.

- Overview of ANT Colony [8]

In Ant Colony algorithm according to pheromones concentration the ant moves in the network and which

path has high concentration of pheromones concentration the ants follow that path and provides the shortest path.

The Pseudo code for the Ant Colony given below.

Pseudo code for ANT Colony for MANETs

1. Forward the ant from source node.
2. Get the next node based on the pheromones concentration probability values
3. If (forward ant reached destination node then stop)
Backward starts from destination node to source node with updating the pheromones concentration probability on the network.
Else
Go to step 2

- Overview of BAT Colony [9]

The Bat have ability is that they found their food in their path using echoes. Also, Bat have capability is that they differentiate between obstacles and food. In Manet for far node routing Bat algorithm these properties is used which give next node or connect with other wireless network in minimum time. The Pseudo code for bat colony given below.

Pseudo code for BAT Colony for MANETs

```
Objective Function  $f(x)=[x_1, x_2, x_3 \dots \dots x_n]^T$ 
Initialize the bat population  $x_i (i = 1,2,3 \dots \dots n)$  and  $v_i$ 
Define pulse frequency  $f_i$  at  $x_i$  Initialize pulse rate  $r_i$  and the loudness  $A_i$ 
While( $t < \text{Maximum number of iterations}$ )
Generate new solutions by adjusting frequency and updating velocities and locations/solutions
If( $\text{rand} > r_i$ )
Select a solution among the best solutions
Generate a local solution around the selected best solution
End if
Generate a new solution by flying randomly
If ( $\text{rand} < A_i$  and  $f(x_i) < f(x_*)$ )
Accept the new solution
Increase  $r_i$  and reduce  $A_i$ 
End if
Rank the bats and find the current best  $x_*$ 
End while
Post process results and visualization
```

- Hybrid Routing using ANT and BAT Techniques for MANET

In the hybrid routing the Ant and Bat parameters are used for route between near-by nodes and far nodes. The Pseudo-code given below.

Pseudo-code for Hybrid Routing for MANET

1. Input Source Node
2. Input Destination Node
3. Apply Ant Colony for local optimization.
4. Apply Bat algorithm when two wireless networks have to connect.
5. Performance Analysis is done on the basis of their parameters and their Execution time.

IV. SIMULATION RESULTS

In this section, the ANT and BAT algorithm is simulated in MATLAB 2013a for optimizing the routing in MANET. Also, hybrid algorithm is proposed based on ANT and BAT colony algorithm for local and global optimization in MANET. The Graphical Representation and their simulation are shown below.

- Two Input Graph

The two wireless graph nodes are shown in fig 2.

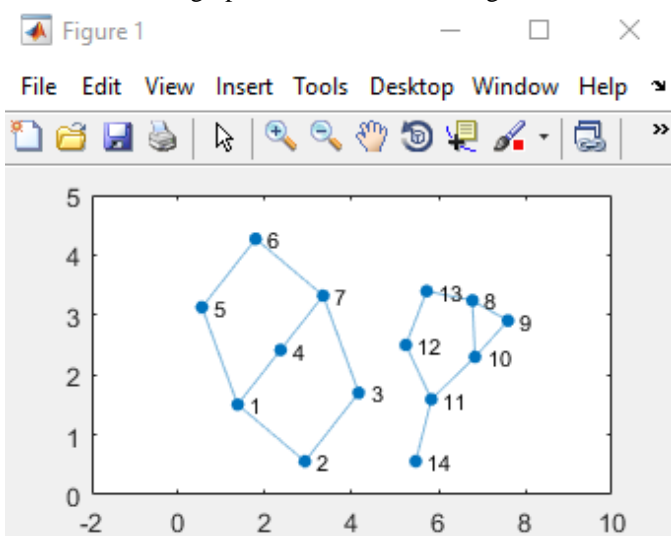


Fig.2 Wireless Graph Nodes Representation

- Internal Routing using Ant Colony Optimization

The internal routing or near-by nodes routing is done using Ant Colony algorithm. The Ant colony algorithm based on pheromones concentration finds the shortest path and updates the pheromones concentration in the look-up table. Because of this feature the table remains up-to-date. The optimized routing is using ANT Colony shown in fig. 3.

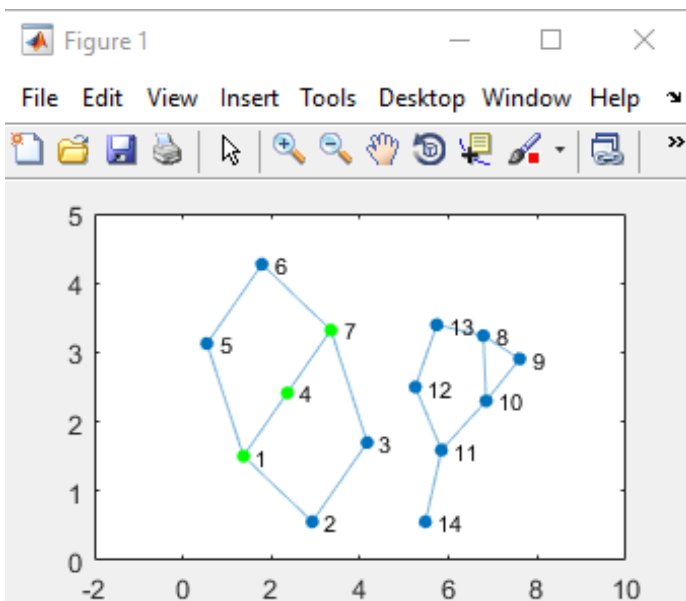


Fig 3 Shortest Path between 1-7 node using ANT Colony Optimization Technique

- Far away nodes are connected using BAT Optimization algorithm

The far away nodes or two wireless network graph are connected using bat optimization algorithm. The advantage of bat algorithm is that it based on 3 parameters bats velocity, frequency and loudness found out the next node in the wireless network. Also, bats based on length parameters differentiate between nodes and obstacles. In our algorithm bat algorithm return node index through which second graph is connected. Moreover, for bat algorithm the iteration vs. cost function is plotted as shown in fig. 4.

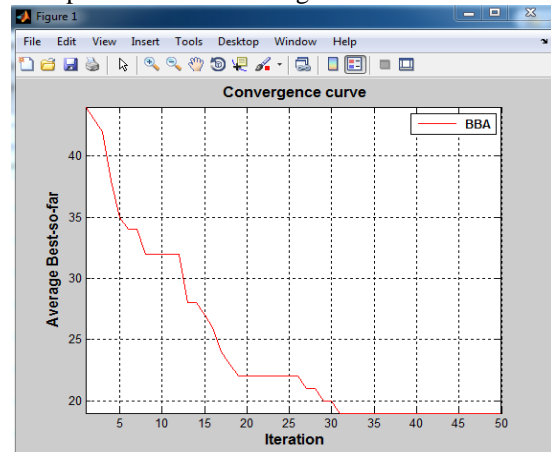


Fig 4 Iteration vs Average Best-so-far Frequency

- Shortest Path Graph for Hybrid Routing in MANET

The Ant and BAT algorithm are hybrid for optimizing routing between two graphs as shown in fig. 5.

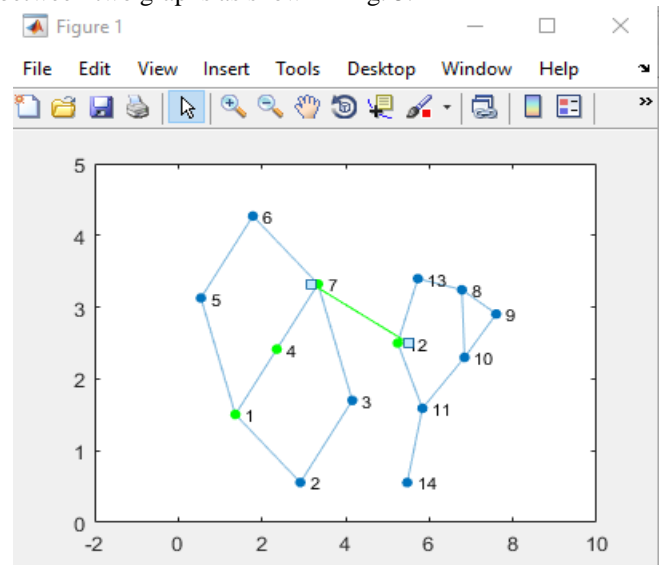


Fig. 5 Hybrid Routing between two graph using ANT and BAT algorithm

Moreover, the algorithms are compared based on their parameters, execution time. The parameters defined such as

- Execution Time:
- Parameters:

Table 1: Performance Analysis using Parameters and Execution Time

Algorithms	Parameters used for Routing	Execution Time
Ant Colony Optimiz	Pheromones Concen	0.85sec
Bat Colony Optimiz	Velocity Frequency Loudness	0.83sec
Hybrid of ANT and	Pheromones concent	0.93sec

The table shows that the hybrid routing algorithm takes approximate same time for finding optimize routing in MANET to connect two different wireless networks.

V. CONCLUSION

In this paper, Hybrid routing technique is proposed. In which near nodes routing is done using Ant colony and far nodes routing is done using Bat colony techniques. The Ant colony maintains the look-up table according to pheromones concentration. The bat algorithm based on three parameter velocity, loudness, frequency determines the far nodes in minimum time and better than PSO algorithm because Bat algorithm also differentiates between obstacles and nodes.

BIOGRAPHIES



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The simulation results shows that the execution time for hybrid routing is approximate the individual Ant and Bat algorithms.

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