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POWER AWARE ROUTING PROTOCOLS FOR MOBILE ADHOC NETWORKS MANETS USING MODIFIED GENETIC ALGORITHM

Priya Mudgal [*], Dushyant Singh [**]
[*] M.Tech. Scholar, Department of Computer Science, Chandravati Group of Institutions, Bharatpur, Rajasthan, India
[**] Dushyant Singh, Head of Computer Science Department, Chandravati group of Institutions, Bharatpur, Rajasthan, India

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ABSTRACT

Mobile adhoc networks MANETs are very popular networks which are having many applications in science and engineering. MANETs are very dynamic networks which does not have any infrastructure for their operation. Routing in MANETs is an area of research for many authors in recent years. Devices in MANETs are battery operated so routing protocols must be power aware which consumes less battery of nodes in transferring data. Genetic algorithm (GA) is a very common optimizing algorithm which can maximize or minimize a function. In this paper a new power aware routing protocols in MANETs has been proposed using modified genetic algorithm. Proposed algorithm has been implemented and results show that proposed algorithm find better routing paths in transferring data in MANETs.

KEYWORDS: MANETs, Power Aware Routing Protocols, Genetic Algorithm

INTRODUCTION

Mobile Adhoc Networks MANET is very popular dynamic networks. MANET is infrastructure less networks in which nodes can move from one position to another. A node can send data to all the nodes which are in its radio range. Routing protocols in MANETS are of two types namely Table driven protocols and Reactive protocols. In table driven protocols every node maintains a routing table that stores the information about all the nodes which are in communication range of a node. In reactive protocols node does not store the information about neighbors but find it as and when needed by passing messages. In power aware routing protocols the remaining battery power RBP of nodes is an important issue while selecting a path for data communication. Nodes must be selected in the path on the basis of their remaining battery power. If routing algorithm select weak nodes i.e. nodes having very less remaining power then after the data communication these nodes may dead as their remaining battery power may become zero.

Genetic algorithms are optimization techniques which uses their special operators to find near optimal solution for an optimization problem. In MANETs the main challenge is to find a path with two constraints which are 1. A path in which less number of nodes are used; 2. A path is which the remaining battery power of nodes is high. The problem of finding such a node can be solved using genetic algorithm. In this paper a new algorithm for routing protocol in MANETs using Genetic Algorithm has been proposed.

Minimum Total Power Routing Protocol MTBR [2] protocol selects a path that consumes minimum power by selecting a path that consumes minimum power. The main disadvantage of this protocol is that it may select many intermediate nodes and thus activate these intermediate nodes which reduce the overall lifetime of the network. Power aware localized routing protocol [2] works on the bases that the every node is having information of every other node in the network and then selects an efficient path. The main disadvantages of this scheme are that the overhead of storing information about every other node need sending and receiving many messages. These messages further consume the battery power of nodes.

[1] Author proposes a cluster head based routing protocol for mobile adhoc networks. The author proposes three types of nodes in the network namely normal nodes NN, gateway nodes GN and cluster head nodes CH. The

structure of MANET having these types of nodes is shown in figure-1. Cluster head nodes control the transfer of packets from one cell to another. Data packets only passes via cluster head nodes and gateway nodes and do not disturb normal nodes. Author proposes formats for all the packets and all the messages to manage the information about all the neighbors of a node. The cluster head also send and receive some control messages to get information about all other nodes and their types in the cell. The main problem with that algorithm is that it activates all the gateway nodes to forward packet from one cell to another. In this paper a new approach has been proposed that do not activate and forward packet to all the gateway nodes but select a best gateway node to which the packet should be transferred. The best gateway is selected in such a way that there are maximum chances to successfully transfer the packet via that gateway node.

MATERIALS AND METHODS

In this paper a new modified genetic algorithm for power aware routing protocol has been proposed. The proposed algorithm use remaining battery power of all the nodes. Standard genetic algorithm to solve any problem is as follows:

Algorithm-1 Standard Genetic Algorithm

1. Encode the given problem into genetic form.
2. Generate initial population of chromosomes
3. Calculate fitness of every chromosome in the population
4. Perform selection to select parent chromosome to perform cross over
5. Perform cross over and generate new children
6. Calculate fitness of newly generated children and add these chromosomes in population
7. Select best chromosomes from this population
8. Perform mutation in the population
9. If stopping criteria reached then stop otherwise go to step 4.

Proposed modified algorithm applies Genetic Algorithm for finding routing paths in mobile adhoc networks. As the fitness of a path is calculated by using two criteria's which are less number of nodes and remaining battery life. The fitness criteria is as follows:

Fitness Criteria for Routing Paths

1. Routing path must have as much less number of intermediate nodes as possible.
2. Routing path must select those nodes which are having high value of remaining battery power.

Using fitness criteria the proposed algorithm must try to find paths in which there are less number of intermediate nodes. If a path includes large number of intermediate nodes then all these nodes participate in data transfer which consumes the battery power of all these nodes. So number of intermediate nodes must be kept as less as possible. Further the proposed algorithm has to take care about the remaining battery power of intermediate nodes. Algorithm must select those nodes as intermediate nodes which are having higher values of remaining battery power.

Proposed Formula for Calculating Fitness

In this paper a new algorithm has been proposed for solving routing problem in mobile adhoc networks. The proposed algorithm applies Genetic Algorithm to find optimal paths for routing. The path is optimal if it uses less number intermediate nodes and selects those nodes as intermediate nodes which are having higher values of remaining battery power. A new formula for calculating fitness of chromosomes has been designed. The formula gives higher value if fitness if a chromosome has less number of intermediate nodes and selects those nodes as intermediate nodes which are having higher value of remaining battery power. The proposed formula is as follows:

x = (1/No of Nodes in Path)
y = (Average Remaining Battery Power of Each Node in Path/100)
fitness = (x+y)/2

Here x is a factor that gives high preference to those paths which are having less number of intermediate nodes. Factor y gives high preference to those paths in which intermediate nodes have high value of remaining battery power. So fitness value be the average of x and y.

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Propose Modified Genetic Algorithm

The modified genetic algorithm which calculates fitness using the proposed formula is as follows

Algorithm-2 Modified Genetic Algorithm

1. Encode the given problem into genetic form.
2. Generate initial population of chromosomes
3. Calculate fitness of every chromosome in the population **using the proposed formula**
4. Perform selection to select parent chromosome to perform cross over
5. Perform cross over and generate new children
6. Calculate fitness of newly generated children **using the proposed formula** and add these chromosomes in population
7. Select best chromosomes from this population
8. Perform mutation in the population
9. If stopping criteria reached then stop otherwise go to step 4.

The proposed modified genetic algorithm has been implemented on a sample network of 55 nodes and 17 ADHOCs.

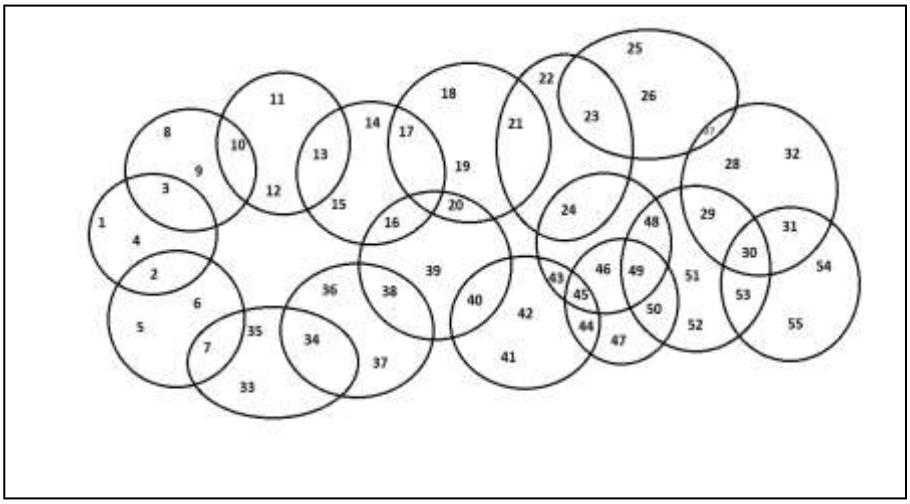

Figure 1 - A sample network of 55 nodes and 17 ADHOCs

All the 55 nodes in the sample network have a list of neighbor nodes and a remaining battery power value which is in the percentage of battery left. For implementation a random remaining battery life of all the nodes has been taken. Fig-2 is the link representation and remaining battery power of all the nodes of ADHOC network shown in Figure -1.

RESULTS AND DISCUSSION

The proposed algorithm has been implemented using Java and Netbean IDE 8.0.2. A random initial population has been generated for proposed genetic algorithm. Characteristics of the initial population in terms of fitness of best path, Average remaining battery power of nodes in best path, average fitness of the whole population is as follows:

Fitness of best path = 0.3147
Average remaining battery power of nodes in best path = 57.68
Average fitness of the whole population = 0.2561
No of Nodes in best path = 20

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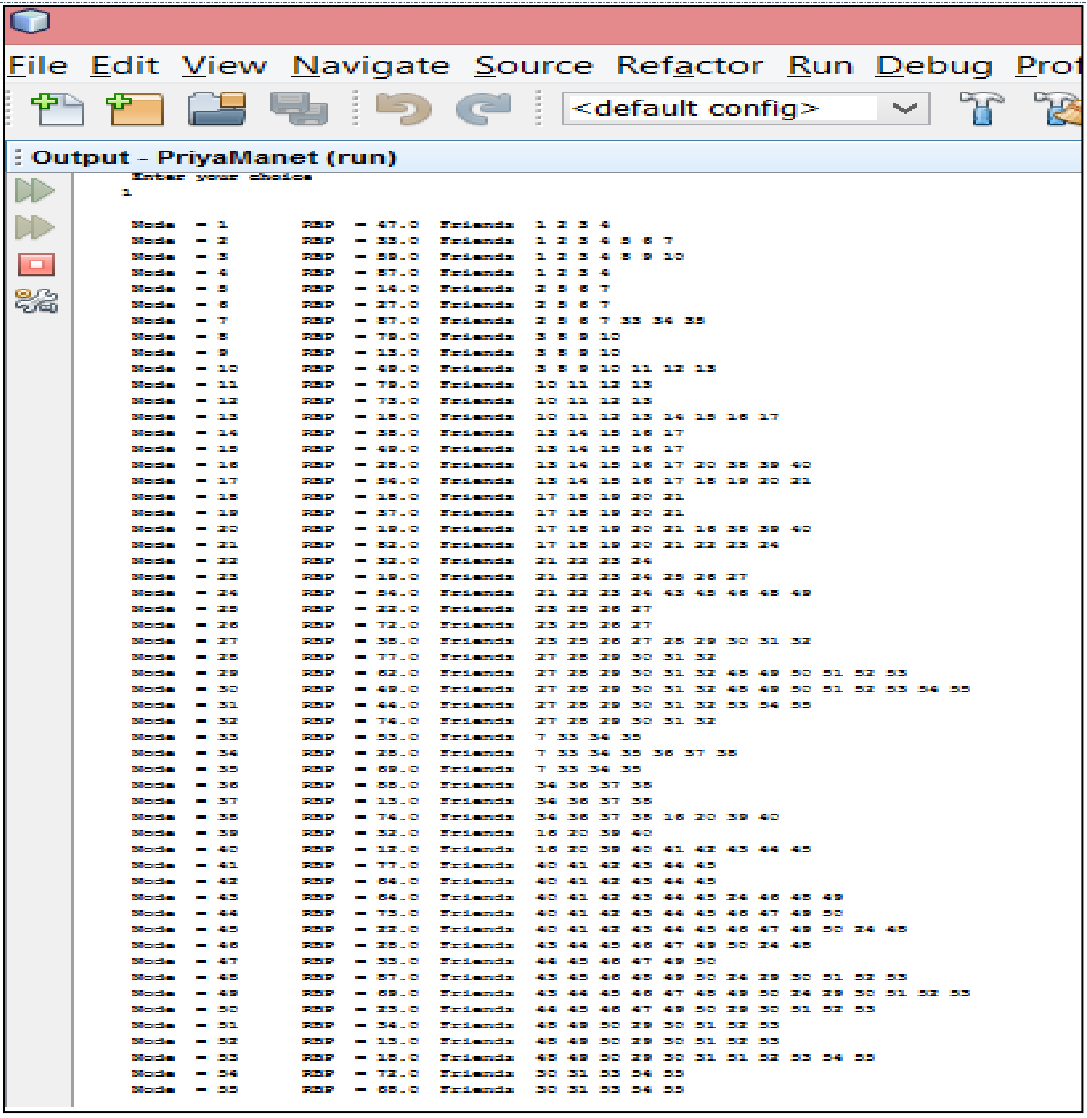

Figure 2- Link representation of network and remaining battery power

Then the proposed genetic algorithm has been executed for 100 iterations. The characteristics of the population after 100 iterations are as follows:

Fitness of best path = 0.3447
Average remaining battery power of nodes in best path = 62.27
Average fitness of the whole population = 0.3267
No of Nodes in best path = 16

Table-1 shows the comparison of proposed algorithm. The results are compared between values found before starting proposed genetic algorithm and after executing 100 iterations of proposed algorithm.

So the results of proposed algorithm are better than the results found before applying the proposed algorithm. The proposed algorithm is finding a path in which remaining battery life is 4.59% more. Also it is finding a path in which no of nodes is 25% less than the results found before applying proposed algorithm. So the proposed algorithm is better in finding a solution in terms of average remaining battery power and no of intermediate nodes. Fig-3 shows a graphical representation of comparison of results found before and after applying the proposed algorithm.

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Table-1 Comparison of results of proposed work

	Fitness of best path	Average RBP of nodes in best Path	Fitness of population	No of Nodes in best path
Initial population	0.3147	57.68	0.2561	20
Population After 100 Iterations	0.3447	62.27	0.3267	16

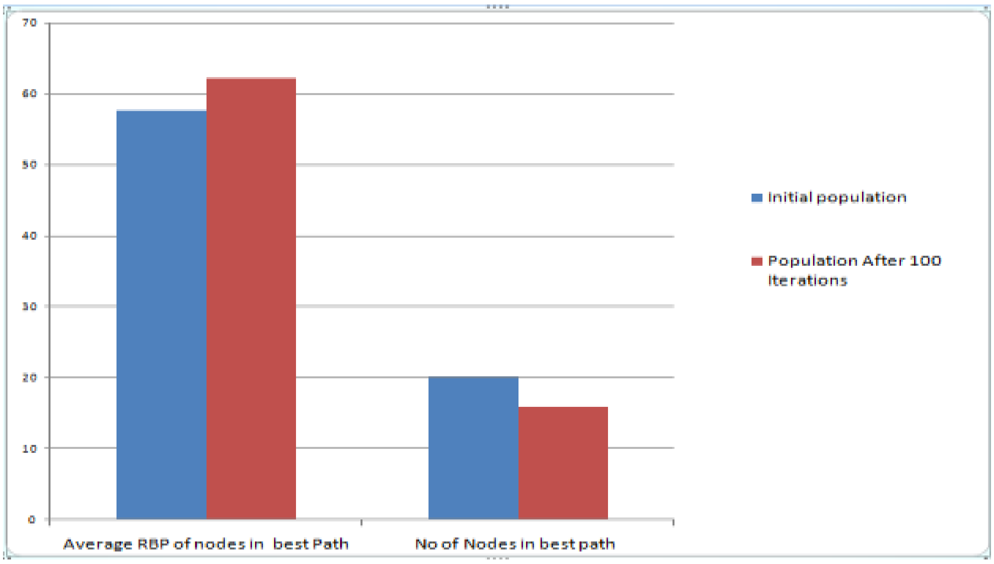

Figure-3 Comparison of results before and after applying the proposed algorithm

CONCLUSION

In this paper routing problem of MANETs has been solved using Genetic Algorithm. An attempt has been made to find a routing path which has less number of intermediate nodes and select those nodes for data transfer who is having higher values of remaining battery power. Proposed genetic algorithm has been executed 100 times and it founds results which are 4.59% better in terms of remaining battery power and 25% better in terms of number of intermediate nodes. In future the proposed algorithm can be applied on a network having thousands of nodes. Also it can be simulated on a Network Simulator like NS-2 and results van be verified. In future results of proposed algorithm can be comparing with other recent existing algorithms.

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