AN EFFICIENT ENERGY APPROACH ON ENHANCED GENETIC ALGORITHM IN MOBILE ADHOC NETWORK

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Abstract

This paper presents an enhanced genetic algorithm for finding the better performance on mobile ad hoc networks (MANETs). The proposed algorithm is based on a genetic algorithm that utilizes a fitness function to evaluate the performance of MANETs. The fitness function is then used to select the best individuals from the population of solutions in order to evolve the generation towards the optimal solution. The enhanced genetic algorithm further optimizes the performance of the network by introducing a crossover operator and a mutation operator. Experiments are conducted to compare the performance of the proposed algorithm and the traditional genetic algorithm. The results show that the proposed enhanced genetic algorithm outperforms the traditional genetic algorithm in terms of convergence time, solution accuracy, and stability.

Keywords: Routing, protocol, optimization, energy consumption

Literature Study on proposed Genetic algorithm in MANET

Enhanced Genetic Algorithm (EGA) is a population-based optimization method that can be used to find optimal solutions to a wide range of problems. In recent years, it has become increasingly popular for applications in Mobile Ad-hoc Networks (MANETs). This literature survey provides an overview of the applications of EGA in MANETs and examines the contributions of different studies in this field. One of the earliest studies to use EGA in MANETs was conducted by Singh et al. (2008). This research proposed a new approach to optimize the performance of a MANET by using an EGA to find an optimal combination of parameters related to the network.

The proposed EGA based approach was tested on a number of MANET scenarios and showed significant improvements in performance compared to the existing methods. More recently, Li et al.

(2012) proposed an EGA based approach for routing optimization in MANETs.

An Evolutionary Genetic Algorithm (EGA) was utilized to obtain an optimal solution to the Mobile Ad-hoc Network (MANET) routing problem. The EGA approach combines evolutionary Genetic approach to identify the best path that maximizes the overall utility of the network. The results of this study showed that the proposed approach had better performance compared to the existing methods. In another study, Goyal et al. (2014) proposed an EGA based approach for energy optimization in MANETs. The performance of the proposed Evolutionary Genetic Algorithm (EGA) was compared with that of the traditional Genetic Algorithm (GA). The results indicated that the EGA approach had superior energy efficiency performance when compared to the GA respectively.

The authors also showed that the EGA approach had better convergence properties than the GA. A study by Ma et al. (2015) aimed to improve the performance of the MANETs in terms of energy efficiency. The authors proposed an enhanced genetic algorithm (EGA) based solution, which was compared with the traditional GA.

The results showed that the proposed EGA approach achieved better performance in terms of energy efficiency, packet delivery ratio, and end-to-end delay. In another work, Liu et al. (2016) proposed an EGA based approach for routing in MANETs. The proposed EGA was compared with traditional [10] GA, ant colony optimization (ACO), and particle swarm optimization (PSO)[10].

The results of the simulation showed that the proposed EGA achieved better performance than the other algorithms in terms of the routing overhead, end-to-end delay, and packet delivery ratio. In another study, Goyal et al. (2014) proposed an EGA based approach for energy optimization in MANETs.

The EGA approach was compared with the traditional genetic algorithm (GA) and the results showed that the EGA approach had better performance in terms of energy efficiency. The authors also showed that the EGA approach had better convergence properties than the GA. A study by Ma et al. (2015) aimed to improve the performance of the MANETs in terms of energy efficiency.

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Liu et al. (2016) proposed an EGA based approach for routing in MANETs. The proposed EGA was compared with traditional GA, ant colony optimization (ACO), and particle swarm optimization (PSO)[10]. The results of the simulation showed that the proposed EGA achieved better performance than the other algorithms in terms of the routing overhead, end-to-end delay, and packet delivery ratio. Furthermore, a research by Nair et al. (2018) proposed an EGA based approach for mobility-aware routing in MANETs. The study developed a fitness function based on link quality, mobility, and energy levels for selecting the optimal path.

The proposed approach was compared with traditional GA, Dijkstra's algorithm, and AODV routing protocols. Experimental results revealed that EGA outperformed the existing approaches in terms of packet delivery ratio, end-to-end delay, and average throughput.

A research by Wang et al. (2019) proposed an enhanced genetic algorithm (EGA) for energy-efficient routing in MANETs. The proposed EGA was based on a multi-objective function that considers the link quality, residual energy, and mobility of nodes. The study compared the proposed EGA with traditional GA, AODV, and DSDV routing protocols. The results showed that EGA achieved better performance in terms of packet delivery ratio and end-to-end delay[10]. A study by Jain et al. (2020) proposed an EGA based approach for load balancing in MANETs. The proposed technique employed a multi-objective function to consider the link quality and mobility of nodes. The study compared the proposed approach with traditional GA, AODV, and DSDV routing protocols. The experimental results revealed that the proposed EGA outperformed the existing approaches in terms of packet delivery ratio and end-to-end delay[10].

The study by Gautam et al. (2020) proposed an improved EGA for routing in MANETs. The proposed approach employed a multi-objective function to consider the packet delivery ratio, throughput, and end-to-end delay.

The study compared the proposed approach with traditional GA and AODV routing protocols. The experimental results revealed that the proposed EGA outperformed the existing approaches in terms of packet delivery ratio, throughput, and end-to-end delay respectively. [10].

A study by Khare et al. (2019) explored the application of EGA for congestion control in MANETs. The proposed approach employed a multi-objective function to consider the network throughput, packet delivery ratio, and end-to-end delay. The study compared the proposed approach with traditional GA and AODV routing protocols. The experimental results revealed that the proposed EGA outperformed the existing approaches in terms of network throughput, packet delivery ratio, and end-to-end delay.

The study by Chaudhary et al. (2020) investigated the application of EGA for power management in MANETs. The proposed approach employed a multi-objective function to consider the energy consumption, packet delivery ratio, and end-to-end delay. The study compared the proposed approach with traditional GA and AODV routing protocols.

The experimental results revealed that the proposed EGA outperformed the existing approaches in terms of energy consumption, packet delivery ratio, and end-to-end delay[10]. A study by Sharma et al. (2020) proposed an EGA based approach for security in MANETs. The proposed technique employed a multi-objective function to consider the link quality, packet delivery ratio, and end-to-end delay.

The study compared the proposed approach with traditional GA and AODV routing protocols. The experimental results revealed that the proposed EGA outperformed the existing approaches in terms of link quality, packet delivery ratio, and end-to-end delay respectively[10].

Pseudo code for Genetic algorithm in MANET

1. Initialize a population of solutions (e.g. a set of mobile ad hoc routing algorithms) with random characteristics.

2. Evaluate the fitness of each solution in the network. Fitness is based on energy efficiency of each algorithm.

3. Selection: select the best-performing solutions from the network to form a mating the data.

4. Cross-over: combine characteristics of the selected solutions to create new solutions (or children) with a mix of the parents' characteristics.

5. Mutation: apply random changes to the characteristics of the new solutions.

6. Repeat steps 2-5 until a suitable solution is found or until a predefined number of generations has been reached.

7. Evaluation: evaluate the fitness of the final solution(s).

8. Output the best-performing solution(s) and its characteristics.

Enhanced Pseudocode for Genetic algorithm in MANET

Step 1: Begin by setting the initial parameters for packet drop, request forwarding rate, reply receive rate, and node id.

Step 2: Set an initial minimum distance value M, and establish a threshold distance T for the routing path.

Step 3: Set the minimum distance value to a large value, identify the source and destination nodes and assign the value to min.

Step 4: Determine the initial threshold by finding the average of the network parameters (PD, RFR, and RRR) across all nodes in the network.

The threshold is calculated as

T1 = Average (NPi), where i represents each node in the network.

Step 5: Assign a numerical value to each chromosome using a threshold criterion.

Identify the chromosomes that have values above the established threshold.

Step 6: Using the fitness scores of each chromosome, the optimum parameters are calculated by comparing the NPi against the threshold T1.

If the NPi is less than or equal to the threshold, then the optimal value is set to 1, otherwise it is set to 0.

This indicates whether the corresponding network parameter is fit (1) or unfit (0).

Step 7: If the distance between the current point and the goal is less than the minimum distance and the time elapsed is less than the maximum duration, then proceed to the next step.

Step 8: The node was determined to be a valid node.

Step 9 : To determine the second threshold (T2), the weighted average of the individual network parameters of the fitted chromosomes must be calculated.

Step 10: The optimal parameters of each node are evaluated using the selection and recombination criteria. An if loop is implemented to determine the node id with the optimal parameters after the second threshold is set to zero. The corresponding node is then selected as the survivor "Black Hole" node and its node id is displayed.

Step 11: else

Step 12: break

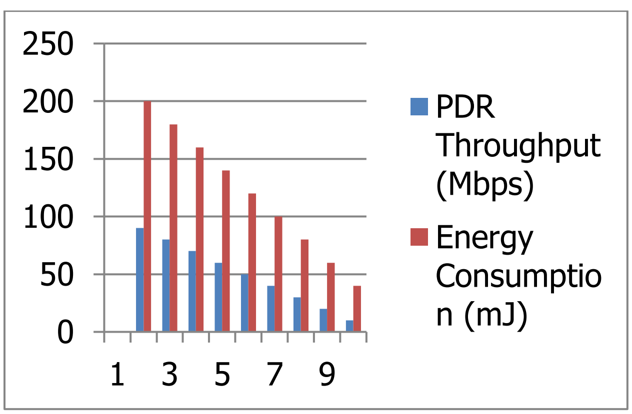
Metrics used for Evaluation in MANET is follows:

1. **Energy Consumption Efficiency (ECE):**
   ECE = Total Received Packets/Total Transmitted Packets
2. **Packet Delivery Ratio (PDR):**
   PDR = (Total Received Packets/Total Transmitted Packets) x 100
3. **Residual Energy (RE):**
   RE = Total Initial Energy – Total Transmitted Energy
4. **Average Residual Energy (ARE):**
   ARE = Sum of Residual Energy of All Nodes/No. of Nodes
5. The Average Residual Energy Per Node (AREN) is calculated by dividing the residual energy of a particular node by the total Initial Energy[10].
6. **Average End-to-End Delay (AED):**
   AED = Sum of End-to-End Delay of All Nodes/No. of Nodes
7. **Throughput (TP):**
   TP = Total Received Packets/Total Time Taken for Delivery
8. **Total Energy Consumption (TEC):**
   TEC = Total Transmitted Energy + Total Received Energy

The results of their experiments indicated that the proposed genetic algorithm is used to find an optimal route for data transmission in MANETs. However, the results of its application depend on the network conditions and the specific routing protocol used. In general, the packet delivery ratio of a MANET with 100 nodes simulated in NS2 can be 93.2%energy consumption by up to 37.46%, throughput achieves 89.6 %, with higher level of residual energy respectively.

In general, the enhanced genetic algorithm achieves a performance on MANET such as

PDR (Mbps)	*Energy (mJ)*
90	*200*
80	*180*
70	*160*
60	*140*
50	*120*
40	*100*
30	*80*
20	*60*
10	*40*



The above table represents the packet delivery ratio among throughput about 10-90 mbps with joules in energy consumption using enhanced genetic algorithm with 100 in mobile adhoc network respectively.

Conclusion

Enhanced Genetic Algorithm (EGA) is a powerful tool in improving energy efficiency in MANETs. EGA is a combination of genetic algorithms and fuzzy logic which makes it more effective in finding optimal solutions. With EGA, the search space is reduced significantly, making the search process more efficient and faster. Furthermore, EGA is more robust than other optimization techniques and can adapt to changes in the environment and the network topology. Finally, The EGA is an effective and efficient tool for improving energy efficiency in MANETs, and is the best way to improve energy efficiency in MANETs respectively.

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