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An Energy Efficient Approach for Routing in MANETS using GA and ACO

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Abstract: ***Power awareness is crucial in a mobile wireless network, particularly in a MANET. Nodes need to reduce their power consumption to prolong their battery lifetime. To resolve the quality of service (QOS) routing problem, we present an energy efficient hybrid algorithm by using GA&ACO. The proposed genetic algorithm depends on bounded end-to-end delay and minimum cost of the multicast tree. The genetic algorithm involve a large number of iterations, new hardware implementations have shown their ability of fast computation. In this regard the genetic algorithm is quite promising for multicast routing in MANETS.***

Keywords: Multicast routing, Quality of Service (QoS), Mobile Adhoc Network (MANET), Energy, Genetic Algorithm (GA), Ant Colony Optimization (ACO).

1. Introduction

MANET

A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. Ad hoc is Latin and means "for this purpose" [1]. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. They may contain one or multiple and different transceivers between nodes. This results in a highly dynamic, autonomous topology. MANETs are a kind of Wireless ad hoc network that usually has a routable networking environment on top of a Link Layer ad hoc network [1][2]. MANETs consist of a peer-to-peer, self-forming, self-healing network in contrast to a mesh network has a central controller (to determine, optimize, and distribute the routing table). MANETs circa 2000-2015 typically communicate at radio frequencies (30 MHz - 5 GHz).

Multi-hop relays date back to at least 500 BC.[2][3] The growth of laptops and 802.11/Wi-Fi wireless networking have made MANETs a popular research topic since the mid-1990s. Many academic papers evaluate protocols and their abilities, assuming
A mobile node is an Internet-connected device whose location and point of attachment to the Internet may frequently be changed. This kind of node is often a cellular telephone or handheld or laptop computer, although a mobile node can also be a router. Special support is required to maintain Internet connections for a mobile node as it moves from one network or subnet to another, because traditional Internet routing assumes a device will always have the same IP address. Therefore, using standard routing procedures, a mobile user would have to change the device's IP address each time they connected through another network or subnet.

Since mobility and ease of connection are crucial considerations for mobile device users, organizations that want to promote mobile communications are putting a great deal of effort into making mobile connection and uncomplicated for the user. The Internet Engineering Task Force (IETF) Mobile IP working group has developed several standards or proposed standards to address these needs, including Mobile IP and later enhancements, Mobile IP version 6 (MIPv6) and Hierarchical Mobile IP version 6 (HMIPv6).

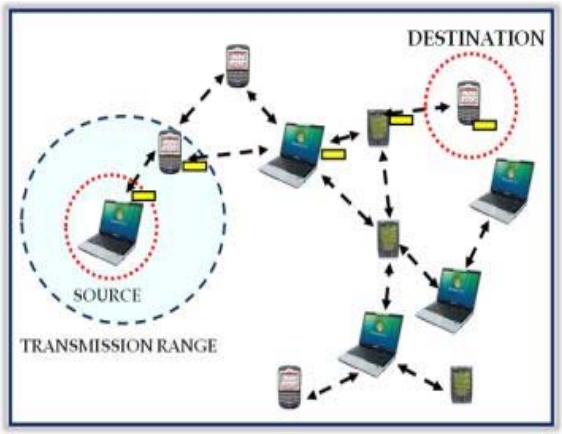

Figure 1: MANET

Different protocols are then evaluated based on measures such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput, ability to scale, etc.

2. Destination-Sequenced Distance-Vector (DSDV)

The destination sequenced distance vector routing protocol [8,9] is a proactive routing protocol based on the Bellman-Ford algorithm. Routing table is maintained at each node

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and with this table; node transmits the packet to other nodes in the network.

To guarantee loop-freedom DSDV uses a concept of sequence numbers to indicate the freshness of a route. The Broadcasting mechanism in the DSDV is of two types-Full dump and incremental dump. Full dump will carry all the routing information and the incremental dump will carry only last updation of full dump to improve the efficiency of the system.

DSDV is not fit for large networks. Ad hoc On-demand Distance Vector (AODV) Routing AODV is a reactive routing protocol [6, 7] implemented for mobile ad hoc networks. AODV is used for unicast, multicast and broadcast communication. AODV is combination of both DSR and DSDV. It adopts the basic on demand mechanism of Route Discovery and Route maintenance from DSR and the use of hop by hop routing sequence number and periodic beacons from DSDV.

When a source node desires to send information to destination node and does not have a route to destination, it starts the route discovery process. It broadcasts RREQ to neighbors and then forward the request to their neighbors on so on up to route for the destination is located .And also send a route reply packet to the neighbors which is the first receives RREQ.RREP is routed along the reverse path.

Each node maintains own sequence number and broadcast id. To maintain routes the nodes survey the link status of their next hop neighbor in active routes. If the destination or some intermediate node move, the node upstream of the break remove the routing entry and send route error (RERR) messages to affect the active route upstream neighbors. This continues until source node is reached.

3. Dynamic Source Routing (DSR)

DSR is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device.

Determining source routes requires accumulating the address of each device between the source and destination during route discovery. The accumulated path information is cached by nodes processing the route discovery packets. The learned paths are used to route packets. To accomplish source routing, the routed packets contain the address of each device the packet will traverse. This may result in high overhead for long paths or large addresses, like IPv6. To avoid using source routing, DSR optionally defines a flow id option that allows packets to be forwarded on a hop-by-hop basis.

This protocol is truly based on source routing whereby all the routing information is maintained (continually updated) at mobile nodes. It has only two major phases, which are Route Discovery and Route Maintenance. Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply).

4. Genetic Algorithms

[3, 4, 5] are Meta heuristics used for solving problems with both discrete and continuous variables. The population is the main element of genetic algorithms, and the genetic operations like crossover and mutation are just instruments for manipulating the population so that it evolves towards the final population including a “close to optimal” solution. The requirements set on the population also change during the execution of the algorithm. GA operates with a collection of chromosomes, called a population [6]. The population is normally randomly initialized.

As the search evolves, the population includes fitter and fitter solutions, and eventually it converges, meaning that it is dominated by a single solution. Holland also presented a proof of convergence (the schema theorem) to the global optimum where chromosomes are binary vectors.GA use two operators to generate new solutions from existing ones: crossover and mutation. The crossover operator is the most important operator of GA. In crossover, generally two chromosomes, called parents, are combined together to form new chromosomes, called offspring.

The parents are selected among existing chromosomes in the population with preference towards fitness so that offspring is expected to inherit good genes which make the parents fitter. By iteratively applying the crossover operator, genes of good chromosomes are expected to appear more frequently in the population, eventually leading to convergence to an overall good solution. The mutation operator introduces random changes into characteristics of chromosomes [7]. Mutation is generally applied at the gene level. In typical GA implementations, the mutation rate (probability of changing the properties of a gene) is very small, typically less than 1%. Therefore, the new chromosome produced by mutation will not be very different from the original one. Mutation plays a critical role in GA.

As discussed earlier, crossover leads the population to converge by making the chromosomes in the population alike. Mutation reintroduces genetic diversity back into the population and assists the search escape from local optima.

5. ACO

Ant Colony Optimization (ACO), an inspired algorithm from nature, has been successfully applied to classification tasks of data mining in recent years.

This paper proposes a rule-based system for medical data mining by using a combination of ACO and fuzzy set theory, named FACO-Miner. FACO-Miner utilizes an ACO algorithm to learn a set of fuzzy rules from labelled data in parallel manner which causes to reduce the computation time to build classifier. To detect the Don't Care (DC) attributes we have proposed a new heuristic

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information formula which measures the uniformity of attributes domain to find DC probability.

Also, FACO-Miner has some new features that make it different from existing classifiers based on ACO meta-heuristic. To classify test samples we have defined the new fuzzy reasoning method based on averaging which takes account both the number of rules and the covering value to classify the input samples. To evaluate the performance of FACO-Miner, we use several well-known medical data sets from UCI repository. Our experiments have confirmed that FACO-Miner leads us to significant results and outperforms several famous methods in classification accuracy for medical classification

6. Proposed Work

Hybrid Algorithm

The following algorithm presents the fundamental frame of GA & ACO

Step 1: Define numbers of nodes.
Step 2: Applying optimization algorithm in hybrid algorithm.
Step 3: GA & ACO.

- Define chromosomes and ants are equal to numbers of nodes.
- Apply nodes fitness or check distance and energy factor.
- Share pheromones or shortcut distance take maximum ants or leader ants.
- Check fitness and select node.
- Find crossover results or
- Accordingly to fitness selection, find mutation result.
- Combine both pheromone and P best value.
- Find G best value according to above condition.
- End.

Parameters

1. Delay
Transmission delay is a function of the packet's length and has nothing to do with the distance between the two nodes. This delay is proportional to the packet's length in bits,

It is given by following formula:
Dt= N/R, seconds
Where Dt is the transmission delay in seconds
N is the number of bits, and
R is the rate of transmission (in bits per second)

2. Throughput

In communication networks, network throughput is the rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per seconds (bits/s or bps), and second or data packets per time slot.

3. Cost

The minimum-cost flow problem is to find the cheapest possible way of sending a certain amount of flow through a flow network. Solving this problem is useful for real-life situations involving network with costs associated (e.g. telecommunications networks)

7. System Framework

To generate the MANET environment first we initialized the mobile nodes. With the help of mobile nodes the MANETs network is created.

To choose the optimized route between the mobile nodes energy efficient hybrid algorithm used by using GA & ACO (Ant Colony Optimization) which to increase the efficiency and lifetime of the system.

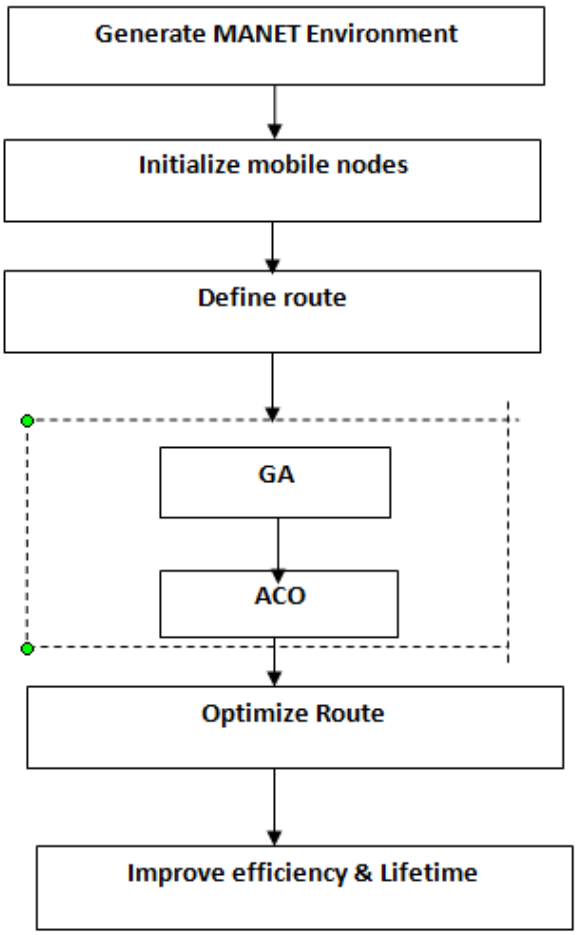

Figure 2: Flow of Work

8. Related Work

Energy consumption in wireless ad hoc networks prevents the problem of the network exhausting batteries, thus partitioning the entire network. Power-aware multicasting is proposed to reduce the power consumption. This paper has proposed an efficient power saving protocol for multi-hop mobile ad hoc networks, called p-MANET. The main goals of p-MANET protocol are to reduce significant power consumption and transmission latency and to achieve efficient power saving [17].They has addressed

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the problem of energy efficient multicast routing in wireless Mobile Ad-hoc Network (MANET). It is a challenging environment because every node operates on limited battery resource and multi-hop routing paths are used over constantly changing network environments due to node mobility [13]. In this work lifetime of network is improved by optimizing the route and this can be done by using artificial intelligence algorithms named genetic algorithm (GA) and ant colony Optimization (ACO). Firstly scenario is generated by introducing number of nodes and then optimized route is found out with the help of artificial intelligence scheme by doing hybridization of GA and ACO and in this way lifetime is increased.

9. Results

Table 1: Simulation Table

Parameter Name	*Value*
Channel	Wireless channel
Number of Nodes	20
Antenna	Omni antenna
Network Simulator	NS2.35
Mac version	802.11
Simulation Time	90s
Area	640m*640m
Packet Size	512
Hello Interval	2s
Traffic Rate(packets/s)	10s
Network Interface	Physical

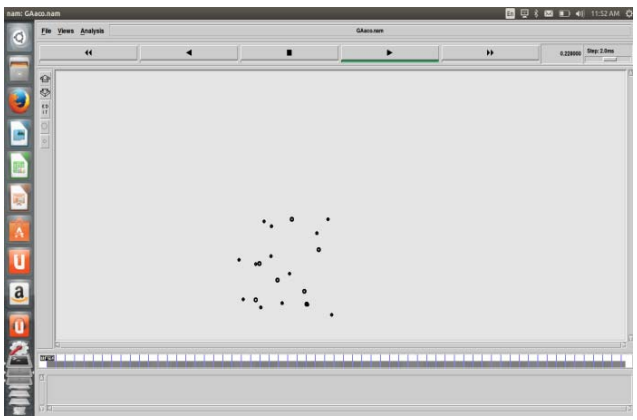

Figure 1: Scenario containing nodes

Figure 2: Comparison of throughput of GA & 3GA-ACO

This graph shows that the proposed appearance using GA-ACO has better throughput than GA.

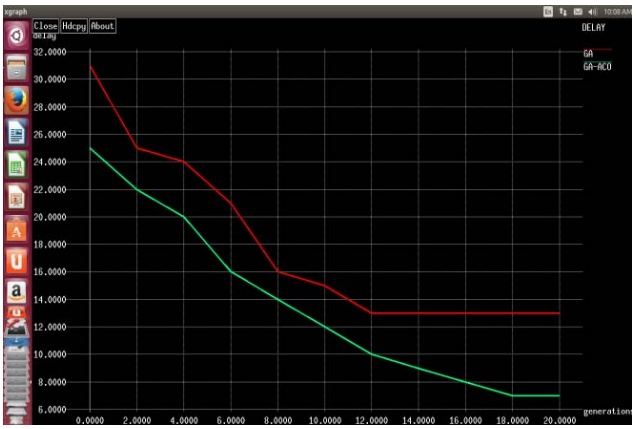

Figure 3: Comparison of Delay of GA & GA-ACO

In above graph delay is shown for both case that is for GA and GA-ACO.

Graph shows minimum delay that means GA-ACO gives better result because minimum the delay better the system.

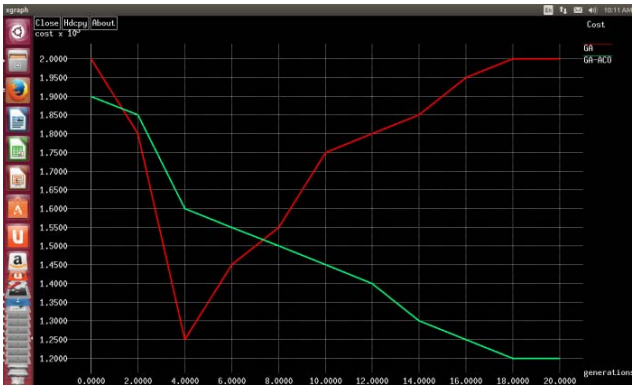

Figure 4: Comparison of Cost of GA & GA-ACO

Above graph shows cost occurred during the system which include both hardware and software system. From above graph it is clearly shown that when we are using GA-ACO the cost occurred is low as compare to using GA.

10. Conclusion

A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers and associated hosts connected

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by wireless link. To increase the energy efficiency of MANET, many routing protocols have been developed. In this work lifetime of network is improved by optimizing the route and this can be done by using artificial intelligence algorithms named genetic algorithm (GA) and ant colony Optimization (ACO). Firstly scenario is generated by introducing number of nodes and then optimized route is find out with the help of artificial intelligence scheme by doing hybridization of GA and ACO and in this way lifetime is increased. We can enhance the performance of our work by using Hybrid algorithm to get more efficiency in results. Performance will be evaluated on the basis of three parameters named as throughput, cost, and delay. In future this can be better enhance by using fuzzy set or some another artificial intelligence scheme.

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