International Journal of Engineering Trends and Applications (IJETA) – Volume 5 Issue 2, Mar-Apr 2018

RESEARCH ARTICLE OPEN ACCESS

Multicasting Techniques to Enhance the Performance of Routing Protocol in MANETs

Narinder Kumar [1], Prof. Jahid Ali [2]
Research scholar [1]
I.K. Gujral Punjab Technical University, Punjab
Principal [2],SSICMT COLLEGE, Badhani,
Punjab - India

ABSTRACT

MANETs is a growing innovation of wireless system. In which node can move to each other place at whatever point. Routing is one of the critical research regions in the MANETs. Improvement and enhancement is one of the real key difficulties in the outline of Mobile adhoc network. Subsequently of the dynamic strategy for the Mobile Ad-hoc Network (MANET), routing in MANET gets the chance to test particularly when on demand multi-way routing traditions addresses certain issues, for example, message overheads, link failures and hub's high versatility and certain QoS necessities (like high data parcel conveyance proportion, low end to end delay, low coordinating overhead, and low energy consumption) are to be satisfied. The goal is to plan and build up a routing strategy that can be actualized on MANETs to increase the execution and increment the throughput of system. In this paper, In this paper, we are proposing an upgraded protocol, for example, multi-path routing project for mobile ad-hoc network, in view of the Ant Colony Optimization (ACO) a meta heuristic calculation, in which ants approach from source to destination by means of number of paths and considering pheromone, energy, mobility and distance –driven parameters. This protocol improved the performance metrics such as residual energy, throughput, pheromone value and average delay. And results are illustrated by simulations using NS2 simulators. The result is demonstrate that the proposed technique outperform as compare to traditional technique.

Keywords:- Mobile Ad Hoc Networks (MANETs); Energy optimization; Routing; Ant colony; pheromone;

I. INTRODUCTION

The unprecedented characteristics of an Ad Hoc Network isolate it from various classes of networks. MANET is a social affair of mobile devices, which frame a communication network with no prior wiring or framework. The essential demand in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such systems may work independent from anyone else or might be associated with the massive internet. They may contain one or numerous and diverse transceivers between nodes. This outcomes in a highly dynamic autonomous topology as appeared in figure 1. The devices used to frame an Ad Hoc Network have restricted transmission range; accordingly, the routes between a source and a goal are regularly multi hop. The fundamental issues of Ad Hoc Network are difficulties in routing, because of dynamic network topology and giving consistent quality of service in wireless nodes. [11]. Routing is the undertaking of finding and utilizing paths to direct data flows through a network while improving at least one execution measures. Routing is a principle issue for ad hoc network. The primary issue illuminated by any routing protocol is to direct movement from sources to goals. The request of quality of service (QOS) is builds step by step .The part of a QoS to compute ways which are reasonable for various kind of traffic generated when highly utilize network resources.

Routing protocol in utilized in MANETs for done the routing services. Routing protocol in MANETs is comprehensively grouped into two classes: Proactive routing protocol and Reactive routing protocol. In Proactive routing protocol, every node in the network keeps up a routing table and the data in the routing tables are updated occasionally. This routing data is utilized by each node to store the area information of different nodes in the network and this data is utilized to move information among various node in the system. At the point when a source node needs to send a packet to the target node, the route to that target is accessible instantly. This proactive routing protocol is likewise called table driven routing protocol [11]. In Reactive routing protocol, nodes keep up their routing tables on an on-request premise. On the off chance that a source node needs to send a data to target node, firstly the route to the destination node is determined and then a connection is established between these nodes [11].

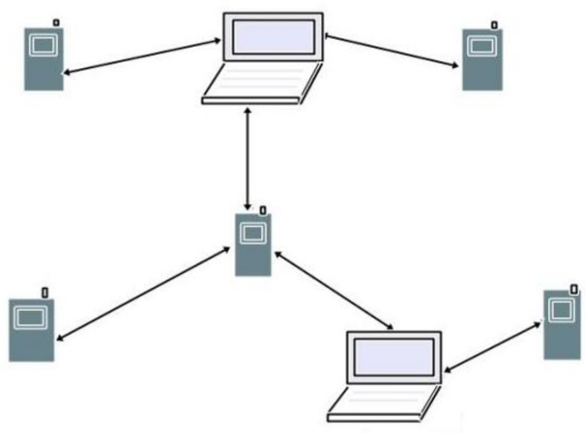

Figure 1. A Mobile ad hoc Network (MANET)

To determine these issues, numerous scientists have performed research and recently came up with new class of routing algorithms which is based on Swarm Intelligence along with basic routing protocols in MANET. ACO based routing algorithm take motivation from the lead of ants in nature and from the similar field of ACO to deal with the issue of routing in correspondence systems [10,12]. The control wellspring of motivation is found in the point of particular sorts of ants to find the most concise way between their home and a sustenance source utilizing an unstable synthetic substance called pheromone. Ants going between the home and the sustenance source leave hints of pheromone as they move. They in like way particularly go in the heading of high pheromone powers. Since shorter ways can be finished speedier.

In this paper we discuss on ant colony optimization for routing protocol in MANETs which fulfill the Qos prerequisites. The introduction to proposed work zone is incorporated into Section 1. Related work is appeared in section 2. Section 3 demonstrates the problem formulation and the present work is elucidate in Section 4. Segment 5 incorporates result and discussions. At long last, Section 6 completes the paper.

II. RELATED WORK

In Past, considerable studies regarding the MANETs are done. Some of the researchers proposed models and systems for MANET with high achievement are deliberate in this section.

The authors in [1] have examined and executed E-Ant–DSR, a routing calculation enlivened by the ideas of development and self-association in organic frameworks of ants. The proposition concentrates basically on effective routing by evading link breakage occurrence and congestion. It additionally performs significant energy utilization. The author have assessed and contrasted proposed calculation with other ACO computations and other insight calculation and showed signs of improved results in regards to energy consumption, data delivery ratio, broken route and routing overhead.

In [2], the authors illustrated another ACO based routing algorithm called Life Time Aware routing algorithm for Wireless Sensor Networks (LTAWSN) with utilization of spatial parameters in its proficiency work for diminishing energy utilization of system nodes and another pheromone upgrade operator was intended to coordinate energy utilization and jumps into routing decision. Examinations were made by assessing previous ant colony based routing algorithms and gets more improvement in acquiring more adjusted transmission amid the node, in reducing the energy utilization of the routing and in this manner augments the system lifetime and increment the framework effectiveness.

The authors in [3], proposed the outline of a parallel on-request routing algorithm called source upgrade for MANETs utilizing a meta heuristic in view of the ant colony optimization (ACO) find procedure. They develop a framework to detect cycles, parallelize this algorithm on a scattered memory machine using MPI, and concentrate the execution of the parallel algorithm and report the execution of this algorithm on a scattered system of workstations. The best results were acquired in load balance and delivered a steady decline in execution time by not degrading the performance of proposed algorithm demonstrating a quick merging rate in searching the best ways.

In [4], creators displayed a protocol for routing in specially appointed systems utilizing dynamic source routing and Swarm Intelligence based ant colony optimization to optimize the node stop time and portability. The simulation comes about demonstrate that the algorithm manufactures routes based on node pause time achieving better packet delivery ratio and end-to-end delay and the enhanced execution of routing in the system.

In [5] creators examine parameterized investigation of energy effective protocol and how energy is a standout amongst the most critical requirements for systems, for example, MANET. In this paper benefits and confinement of different routing protocol have been examined for energy management in MANET by representing to three primary parameters - energy, delay and throughput. It has been inferred that the specific protocol can be utilized by the prerequisite. However, as the MANET covers the extremely tremendous range it is relevant to both little and expansive scale region.

In [6] authors demonstrate another convention for WSN routing Operations have been proposed. The protocol is accomplished by utilizing ACO algorithm to optimize routing ways, giving a powerful multi-way information transmission to get reliable communications in the case of node faults. The point of the paper is to keep up organize life time in most extreme, while information transmission is accomplished productively. The paper assesses the execution of insect based calculation and AODV routing protocol as far as Packet Delivery Ratio, Average end-to end delay and Normalized Routing Load and concludes that general execution of subterranean ant based algorithm is superior to AODV as far as throughput.

In [7], authors demonstrate an enhancement system for WSNs which can associated and advance the physical separation between two nodes and flag quality between source node (p) to sink node (q) in transmission extend. The examination detailed in light of ant colony optimization(ACO) meta heuristic strategy at the network layer routing conventions (data centric) in particular coordinated dissemination protocol, gradient based protocol, aware routing protocol and rumor routing protocol. The rest of the energy of the nodes has been figured in remote sensor arrange area using various parameter. The author observed that the node energy utilization is least in the coordinated dissemination routing moreover better with respect to connect transfer speed.

In [8] the creators proposed a heuristic Theoretical Optimal Routing Algorithm(TORA) to achieve area - supported ideal information gathering structure in remote sensor networks(WSN). The estimation's advancement relies on upon a ant colony optimization (ACO) heuristic approach. The novel framework of heuristic component and pheromone overhauling standard can endow ant- like specialists with the capacity of identifying the nearby energy status of systems to approach the hypothetical optimal routing. By methods for the division of WSN into different utilitarian areas and introduction of energy capable weight in heuristic component, the establishment in routing choice can be adaptively adjusted in light of asymmetric power setups and utilization to enhance the robustness of data- routing tree.

The creators in [9] propound a novel adaptable astute routing plan for WSNs in light of Ant Colony Optimization (ACO). The creators describe a soft cover equation to figure transition probability in which the search scale for an ant to choose its next-hop node is restricted to a subgroup of the arrangement of the neighbors of the present node. By intertwining the residual energy and the global and local location data of nodes, pheromone on routes ,the new probability transition rules for a subterranean insect to pick its next-bounce nodes are portrayed that effectively achieve the strength in the next hop node energy and packet transmission delay. Differentiated and other ACO based routing algorithm for WSNs, the proposed routing algorithm has a better framework execution on parts of energy usage, energy productivity, and packet conveyance latency.

III. PROBLEM FORMULATION

Presently investigate on routing in wireless sensor arranges for the most part centered around conventions that are energy aware to expand the lifetime of the system, have adaptability for tremendous sensor nodes and tolerant to sensor harm and battery exhaustion. In MANETs the on request multi-path routing protocol addresses certain issues, for example, message overheads, link disappointments and node's high portability. More message overheads happen because of expanded flooding. Packets are dropped by intermediate nodes because of successive connection disappointments. Besides the general throughput and the packet conveyance proportion are reduced in high mobility scenarios [14]. Energy utilization is the most difficult issue in routing protocol outline. In MANETs devices are battery worked and the battery innovation has not been improving that well.

Swarm intelligence-based routing which uses the behavior of real biological species scanning for food through pheromone deposition while managing issues that need to discover ways. In ACO, ants come nearer from source to goal by means of number of ways. On their return, again they may utilize same number of ways. Whenever the backward ant agents come to the source via various ways where they store the pheromone value and time stamps at each intermediate node, so here traversing through different ways may result in loss of energy levels of the nodes. The MANETs like nodes mobility and energy consumption, a combination of these factors can be utilized to address this issue.

IV. PRESENT WORK

The straightforward ant colony optimization (ACO) metaheuristic can be utilized to locate the briefest way between a source node to goal node.

A. Fundamental of Ant Colony Optimization Based Routing Protocol in MANETs

Swarm intelligence is a rising field of biologically-inspired artificial intelligence light of the behavioral models of social insects such as ants, bees, wasps and termites. Separate algorithms are made in light of ants, honey bees, wasps, for example, Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO) and Bee Swarm Optimization (BSO). This infers routing information should be updated more as often as possible than in standard wired tele-transmission frameworks. In display work we are concentrating on the idea of ant colony optimization (ACO). ACO based routing algorithm take inspiration from the lead of ants in nature and from the related field of ACO to deal with the issue of routing in correspondence systems.

ACO routing algorithm builds up ideal ways to the goal utilizing various simulated ants that discuss in a roundabout way with each other by Stigmergy. Stigmergy is a method for aberrant communication between people which, in an adhoc network case, is done through the alteration of a few parameters in the nodes of the system. ACO embraces the foraging behavior of real ants. At the point when different ways are accessible from home to sustenance, ants do arbitrary walk at first. During their trip to food as well as their return trip to nest, they lay a compound substance called pheromone, which fills in as a course check that the ants have taken. Along these lines, the newer ants will take a path which has higher pheromone focus and furthermore will fortify the way they have taken. Because of this autocatalytic impact, the arrangement develops quickly. Ant routing fundamental rule can be characterized as:

- Each network node sends various disclosure packets - forward ants (F-ANT) towards the choose goal nodes of the network.
- The stochastic tables replace the routing at each node in order to choose next hops as per the weighted probabilities available.
- The routing tables are changed for choice of the following next node in the system.
- When forward ant (F-ANT) achieves the goal node, it creates a backward ant (B-ANT) and then dies.

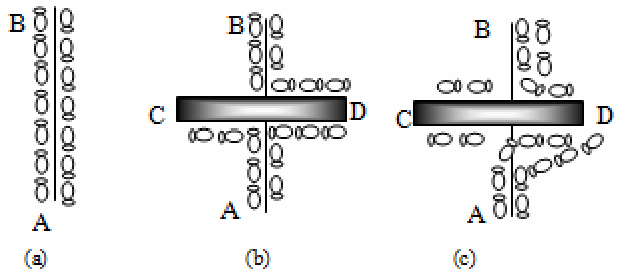

Figure 2. Bahaviour of ants for searching the food.[10]

The basic ant colony optimization (ACO) metaheuristic can be utilized to locate the briefest way between a source node vs to destination node vd.

Let G = (V, E) be an associated chart with n = |V | nodes. The pheromone fixation, Φi,j means that the use of the edge i, j. An insect situated in node vi utilizes pheromone Φi,j of node vj and Ni to compute the probability of node vj as next hop. Ni is the arrangement of one-stage neighbors of node vi. A insect situated in node vi utilizes pheromone i,j of node vj Ni to process the probability of node vj as next hop. Ni is the arrangement of one-stage neighbors of hub vi.

$$p_{i,j} = \begin{cases} \dfrac{\varphi_{i,j}}{\sum_{j\epsilon N_i} \varphi_{i,j}} & if\ j\epsilon N_i \\ 0 & if\ j \notin N_i \end{cases} \qquad (i)$$

The move probabilities pi,j of a hub vi satisfy the limitation:

$$\sum_{j\epsilon N_i} p_{i,j} = 1,\ \ i\ \ \epsilon\ \ [1, N] \qquad (ii)$$

An ant changes the measure of pheromone of the edge e(vi, vj) while moving from node vi to node vj as takes after:

$$\varphi_{i,j} = \varphi_{i,j} + \Delta\varphi \qquad (iii)$$

Like genuine pheromone the simulated pheromone fixation decreases with time to restrain a quick joining of pheromone on the edges.

$$\varphi_{i,j} = (1 - q).\varphi_{i,j}\ , q\ \epsilon\ [0,1] \qquad (iv)$$

B. *An Pheromone Energy Distance Driven Ant Colony Optimization Algorithm for Routing of Mobile Adhoc Networks(PED-ACO)*

In mobile ad hoc systems, every one of the nodes is portable in nature. The mobility is one of the components that must be given significance while enhancing the route amongst source and destination. The mobility of the nodes postures different difficulties to the execution of the system like the changing topology may prompt to link breakage between the nodes. For the communication the essential need is establish path between nodes. So for this requirement various routing protocols have been proposed. The following are various assumptions of the proposed work:

- To study and analyze various existing routing protocol and implement the Ant Colony Optimization concepts.
- To propose and implement the PED-ACO (Pheromone, energy and distance driven ACO)
- To compare and analyze the performance metrics of proposed scheme and existing scheme based on parameters:
  - **Throughput**
  - **Average Delay**
  - **Residual Energy**
  - **Pheromone Value**

A number of energy-aware routing protocols for MANETs based on the ACO principle have been exist. Our aim will be to design a scenario which hybrids the three parameter namely, pheromone value, residual energy of the nodes and the Euclidean distance between the node and the destination. We call this as PED-ACO (pheromone-energy-distance driven ant colony optimization).The proposed PED-ACO routing algorithm deals with reward penalty system that will describe below:

- The path having the highest pheromone value will be rewarded with more points as compared to other paths.
- The path in which the nodes have highest residual energy levels will be rewarded with more credit points.
- And the shortest path will be given more credit points.
- Reverse will follow: for the paths having less pheromone value, less residual energy and longer paths, they will penalized.

The path that aggregates more credit focuses will be considered as the best upgraded path and will be decided for transmitting the information from source to destination node.

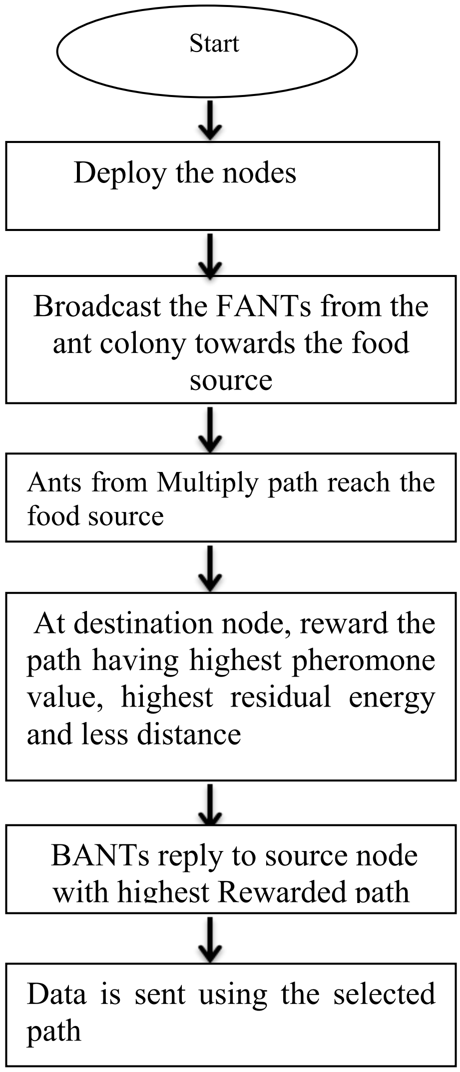

Figure 3. Flowchart of PED-ACO

Pseudo code 1. Pseudo code of PED-ACO

```
While (Food Source != Not found )
{
        Find neighbor in communication Route
        Forward / Broadcast FANTS
        Deposit pheromone;
        Check Routing table for destination, call
Route Reply ()
if
    Destination Found
else
    Forward FANTS
    }
if  (Food Source == found )
    {
    Fetch paths from where FANTS were received.
    Generate BANTS & send from food source to colony.
        Update pheromone;
if  BANTS reach colony ;
        call Select path ();
    }
Select path ();
    {
    Suppose n is no. of paths or no. of Route Replies
        for i = 1 = N
        find pheromone;
    pheromone = Initial deposition – Evaporation
        end
        find maximum pheromone
    {
            Select path ()
    }
Route reply ()
    {
        if ( Food source == found )
        {
fetch paths from where FANTS were received find pheromone
, Residual Energy, Distance.
    Pheromone = Initial deposition – Evaporation
        Residual energy =
```

$$\sum_{i=1}^{N} \text{initial Energy (i)} - \text{Energy consumed (i)}$$

```
    Where N is the no. of nodes in ith path
        Distance =
```

$$\sum_{i=1}^{N-1} \text{sqrt } ((xi - x\,i + 1)2 + ((y\,i - y\,i + 1)2)$$

```
    Assign Rewards ();
    Select path having highest Reward route
        {
        Send BANTS over the selected path.
        }
        Assign Rewards ();
            {
        for i = 1 : M      ( M = no. of paths)
            if pheromone == highest
            { {
                Residual Energy == highest
                Distance == Minimum
                Assigned points = highest

            End
        End
}}
```

V. RESULTS AND DISCUSSIONS

In this area, the proposed strategy has been simulated in Network Simulator 2 (NS2.35) and the simulation comes about are displayed. The parameters utilized in simulation, are appeared in Table 1. A set of experiments are conducted to measure parameters like throughput, Average delay, Pheromone value, Residual energy, values are calculated in following section:

C. *Simulation Scenario*

Table I. Simulation Parameters for the Network

Sr. No.	*Parameter*	*Value*
1	Simulator	NS2.35
2	Channel	Wireless Channel
3	Propagation Model	Two Ray Ground
4	No. of Nodes	50
5	Dimensions of simulated area	500x500
6	Routing Protocol	PEDM-ACO
7	Queue	Droptail-Priqueue
8	Antenna	Omni-Directional
	Mac type	802.11
10	Max Packet size	200
11	Energy Model	Radio Energy Model
12	Initial Energy	90J

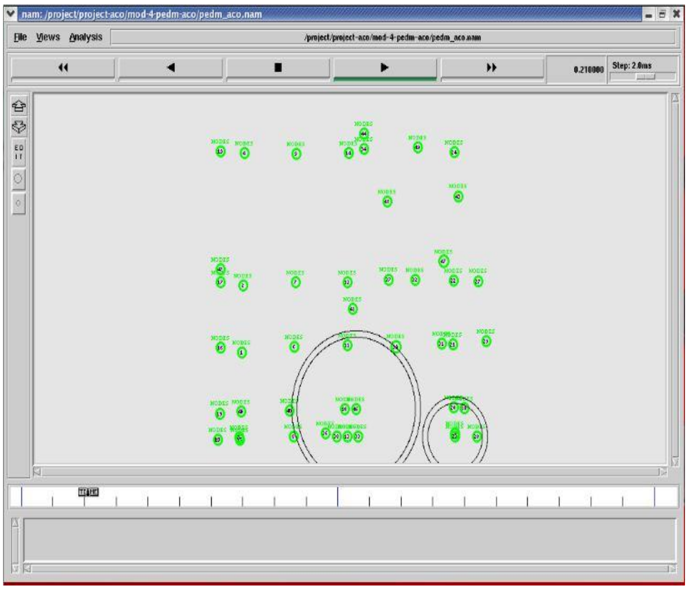

Figure 4. Simulation results for PED-ACO

D. *Graph Results*

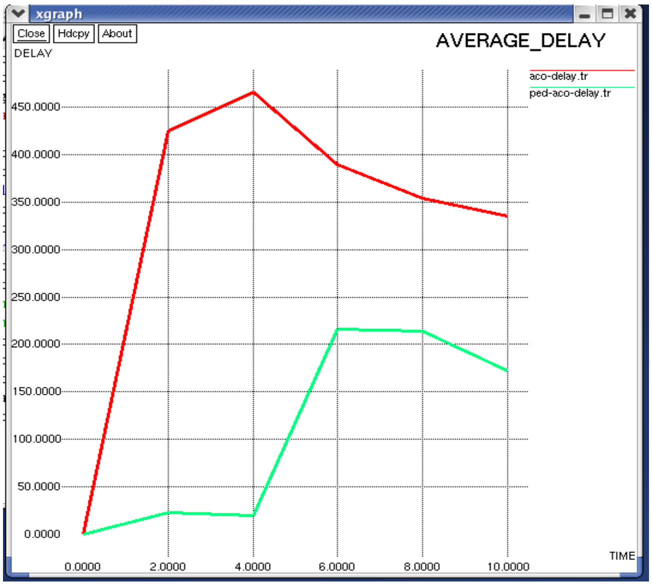

Figure.5. Comparison of Average Delay for the heuristic techniques of network

From the Figure 5, proposed approach is compared with the Ant Colony Optimization. In graph, the x-axis illustrates the simulation time and the Average Delay on y-axis. The green line represents the Average delay of PED-ACO and other represents the existing method. From the graph, it observed that proposed technique is performing well as compare to existing one.

Table II. Average Delay with ACO, PED-ACO

Simulation times (ms)	***Average Delay***	
	ACO	***PED-ACO***
2.0000	425.0000	25.0000
4.0000	455.0000	23.0000
6.0000	390.0000	220.0000
8.0000	351.0000	219.0000
10.0000	340.0000	180.0000

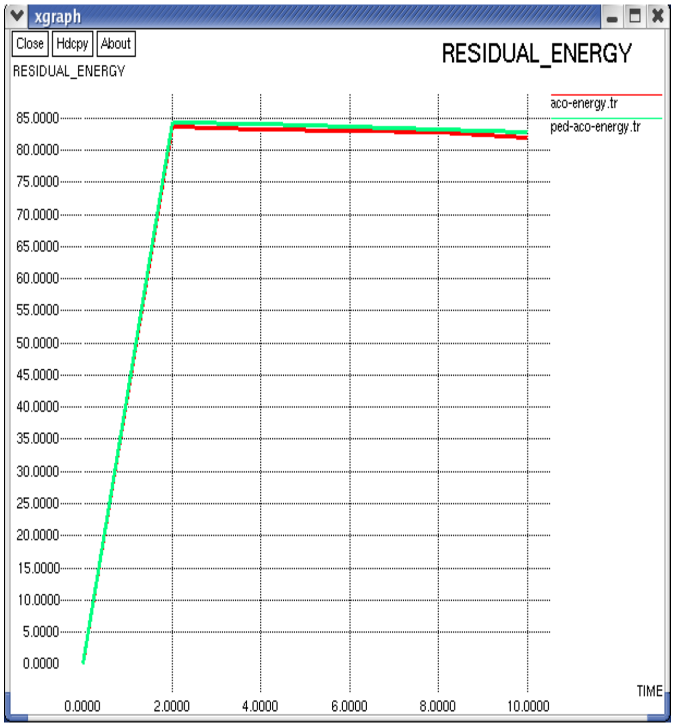

Figure 6. Comparison of Residual Energy for the heuristic techniques of network

From the Figure 6, results obtained by comparing the Ant Colony Optimization with proposed algorithm. From the graph, it observed that proposed technique is performing well as compared to existing one.

Table III. Residual Energy with ACO, PED-ACO

Simulation times (ms)	***Residual Energy***	
	ACO	***PED-ACO***
2.0000	83.0000	84.0000
4.0000	82.0000	83.0000
6.0000	81.0000	82.0000
8.0000	81.0000	82.0000
10.0000	81.0000	82.0000

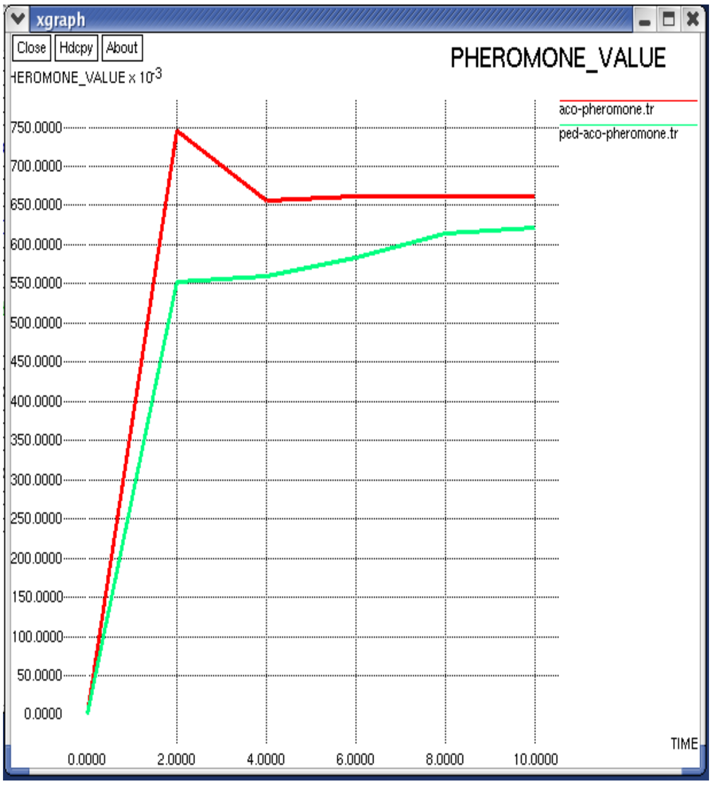

Figure 7. Comparison of Pheromone Value for the heuristic techniques of network

From the Figure 7, results obtained by comparing the Ant Colony Optimization with proposed approach. In the graph simulation time is varying x-axis and the Pheromone Value on y-axis. From the graph the proposed technique performed better in case of pheromone value.

Table IV. Pheromone Value with ACO, PED-ACO

Simulation times (ms)	*Pheromone Value*	
	ACO	***PED-ACO***
2.0000	750.0000	550.0000
4.0000	650.0000	552.0000
6.0000	652.0000	557.0000
8.0000	651.0000	620.0000
10.0000	653.0000	630.0000

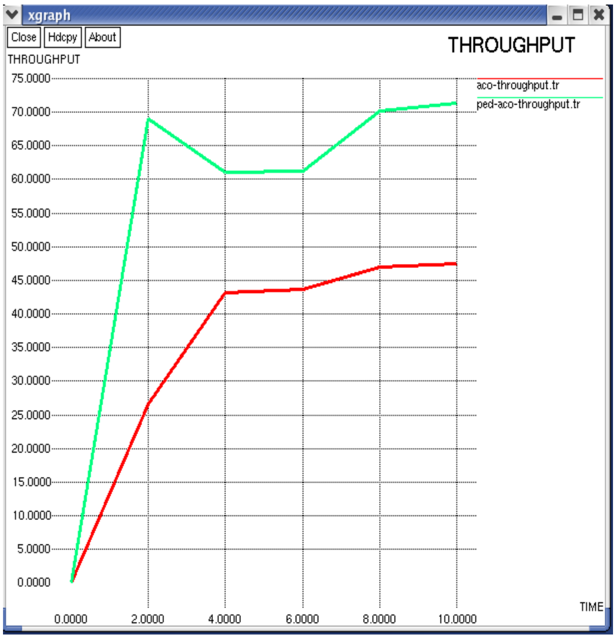

Figure 8. Comparison of Throughput for the heuristic techniques of network

From the Figure 8, results obtained by comparing the Ant Colony Optimization with proposed approach. The graph is plotted with the varying simulation time on x-axis and the Throughput on y-axis. From the graph, it observed that proposed technique performing well as compared to other in case of throughput.

Table V. Throughput with ACO, PED-ACO

Simulation times (ms)	*Throughput*	
	ACO	***PED-ACO***
2.0000	27.0000	70.0000
4.0000	43.0000	61.0000
6.0000	44.0000	61.0000
8.0000	47.0000	70.0000
10.0000	58.0000	71.0000

VI. CONCLUSIONS

Ant Colony approach is broadly used to give QoS parameters for unicast and multicast routing algorithms. This paper exhibits a novel way to deal with improved multi criteria routing algorithm. PED-ACO, enlivened by the ideas of development and self-association in organic frameworks of ants is displayed. The significant complexity in mobile ad hoc network is to keep up the QoS features in the presence of dynamic topology, absence of centralized authority, time varying QoS Requirements etc. An enhanced PED-ACO protocol has been proposed by using NS2 simulation. We have assessed and contrasted our algorithm with conventional ACO and gotten better results as far as throughput, average delay, pheromone value, and residual energy. The future extension is to bid this proposed plan that can be stretched out to Vehicular Adhoc Networks. VANET is a GPS (Global Positioning Framework) upheld organize. We are additionally attempting to build up our PED-ACO conspire further to support different QoS necessities like Security and Privacy.

ACKNOWLEDGMENT

The paper has been made with the kind help, direction and support of my supervisor who helped me in this work. We would want to thank all of the people whose help and encouragement me throughout the work.

REFERENCES

[1] S. Chatterjee and R. Das, "An Ant Colony optimization based enhanced dynamic source routing algorithm for mobile Ad-hoc network" Information Sciences Elsevier, pp. 67–90, 2015.

[2] A. Mohajerani and D. Gharavian, "An Ant colony optimization based routing algorithm for extending network lifetime in wireless sensor networks" In Wireless Networking. Heidelberg: Springer, pp 2637–2647, 2015.

[3] X. Jiang, and B. Hong, "ACO based energy-balance routing algorithms for WSNs" In LNCS-6145 Heidelberg: Springer, pp. 298–305, 2010.

[4] N.Umapathi, N.Ramaraj, "Swarm Intelligence based Dynamic Source routing for improve quality of service," journal of Theoretical and Applied Information Technology vol. 61, no. 3, pp. 604–608, 2014.

[5] R. S. Kale and V. M. Deshmukh, "Benefits and Limitations of Existing Energy Efficient Protocol in MANET," International Journal of Information and Computation Technology, vol. 4, no. 3, pp. 293–298, 2014.

[6] K. S. A. Fathima, "Ant Colony Optimization Based Routing in Wireless Sensor Networks," Int. J. Advanced Networking and Applications Volume, vol. 1689, pp. 1686–1689, 2013.

[7] R. Arya and S.C. Sharma, "Optimization approach for energy minimization and bandwidth estimation of WSN for data centric protocols" International Journal of System Assurance Engineering and Management. Springer, pp.1-10, 2015.

[8] R. Huang and G. Xu, "Swarm Intelligence- inspired adaptive routing construction in WSN" 6th International Conference on wireless Communications Networking and Mobile Computing (WiCOM),2010,

[9] Xi. Wang, Q. Li, N. Xiong and Y. "Ant colony optimization-based location –aware routing for wireless sensor networks" International Conference on Wireless Algorithms, Systems, and Applications WASA: Wireless Algorithms, Systems, and Applications, pp. 109-120, 2008.

[10] Bibhash Roy, Bibhash, Suman Banik and Sugata, "Ant Colony based Routing for Mobile Ad-Hoc Networks towards Improved Quality of Services", Journal of Emerging Trends in Computing and Information Sciences,vol.3, pp. 10-14, 2012

[11] K. Kaur and B. Singh, "Survey Analysis of Routing Protocols and Mobility Models in MANETs," International Journal of Advanced Science and Technology vol. 85, pp. 55–64, 2015.

[12] A. Horane, S. Patkar, and A. Jaykumar, "Energy Optimised Routing Protocol for MANET," nternational Journal of Emerging Trends in Electrical and Electronics vol. 5, pp. 33–36, 2013.

[13] S. Banerjee, A. Majumdar, H.N.Saha and R.dey "Modified Ant Colony Optimization (ACO) Based Routing Protocol for MANET," International conference and workshop on computing and communication, pp. 1–7, 2015.

[14] R. Sharma, R. Kumar and N. Sharma, "Energy Efficient DSR Protocol Using ACO", International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 4, Issue 5, May 2014
.