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ANALYSIS OF ENERGY ROUTING PROTOCOLS USING ANT COLONY OPTIMIZATION TECHNIQUE IN WIRELESS SENSOR

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Abstract

The interest of researchers in wireless networking have increased tremendously in the recent years. Its application has made our lives easies in many areas such as health care, smart homes, smart phones, security and many others. Routing plays the major role of data transmission in networking. From Analysing the current routing WCDA approach we understand that the number of hops is more which reduce the energy level of the nodes which result in more no of dead nodes which in turn affect the efficiency. The present system also takes more time in packet delivery. So, in this paper we propose Ant colony optimization method to improve energy efficiency and to reduce the time required for packet delivery.

Keywords — *Energy efficiency, routes, cluster, hops, source nodes, WCDA, ant colony optimization, wireless networking, residual energy, dead nodes, alive nodes, lifetime ratio.*

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1 INTRODUCTION

Wireless sensor network is a collection of tiny, resource constrained sensors interconnected with each other to accumulate information about physical or environmental objects. Information accumulated by sensors is propagated towards a gateway (base station) that connects the network with Wired or other sort of systems where information can be analysed to produce the results .The node is a device which has the following characteristics [9]

a) Battery
b) Memory
c) Antenna

Network is simple terms can be treated as the collection of nodes. The network can be classified into 2 categories

1) Non-Hierarchical Network
2) Hierarchical Network

1.1 Non-Hierarchical Network

Non-Hierarchical network is a network in which all the nodes are spread in the single area. The network can be treated as a infrastructure less. The nodes do not have any controlling agent.

1.2 Hierarchical Network

Hierarchical Network is the network in which the nodes will be spread across multiple areas in the network. Each area will have set of nodes. This set is called by various names like cluster head, zone leader, group head or region head. In this kind of network there are 2 types of communication which are possible one is Inter Cluster and another one is intra cluster communication.[2]

For Inter Cluster Communication the communication happens between the nods within the same group or same cluster or same zone.

For Intra Cluster communication the communication will happen between the node in one cluster to a node in a different cluster.

2. CURRENT APPROACH

In the existing framework once the clusters are formed the route is decided by using normal nodes cluster heads and the base station. Once the source node and destination node are not inside the cluster at that point source node sends the control packet to cluster head. From the cluster head the control packet goes to base station. The base station begins the scanning of the remaining clusters and repeats the process until goal is reached.

3. PROPOSED SYSTEM

Within the proposed strategy ACO[7] based routing strategy is employed which has way better energy productivity which fulfills the conditions like It should visit each town particularly once, a outside town has less probability of being chosen (the visibility), additional intense the secretion path set out on a position between 2 cities, the larger the chance that that edge are chosen,

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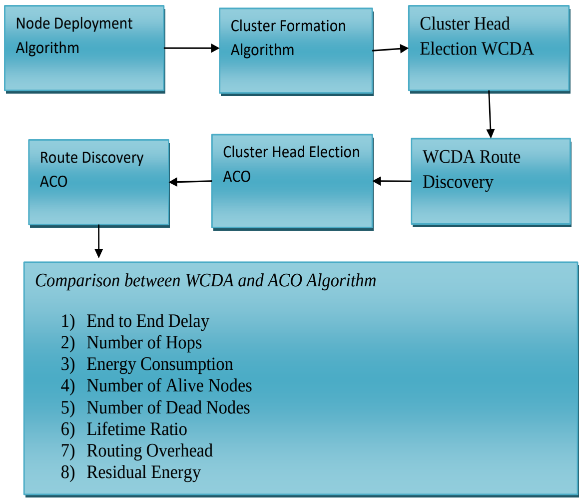
Having completed its travel, the hymenopter deposits a part of pheromones on all edges it navigated, in the event that the journey is short. The proposed strategy does not do development of trees as that of previous approaches. After finding the different routes based on remaining energy forward pick and most limited path the proposed approach computes the fitness factor and then performs the load balancing over different routes over the network



3.1 Node Deployment Algorithm

Node Deployment Algorithm is responsible for formation of network by randomizing the placement of the nodes within the limits $\{x_{\min}, x_{\max}, y_{\min}, y_{\max}\}$. $x_{\min}$ is the minimum value of x end point, $x_{\max}$ is the maximum value of x end point $y_{\min}$ is the minimum value for the y end point and $y_{\max}$ is the maximum value of y end point.

Node Deployment places the nodes in the network and also generates a matrix known as Node Deployment Matrix which is of order $N * 3$. Where N is the number of nodes in the network. The first column will be Node ID, second column is the x position for the node and Third Column is the y position for the node.

3.2 Cluster Head Election WCDA

The Cluster Head Election of CWCDA algorithm is responsible for picking the node as the cluster head randomly from the set of nodes in the cluster.

3.3 WCDA

In WCDA method the source node transmits the packet to cluster head and then from there the packet is send to base station. The Base station will then scan each and every cluster one by one until destination is reached.

3.4 Cluster Head Election ACO

The Cluster Head Election in ACO algorithm is performed based on the closeness to the base station and then residual energy. The node which is having the highest energy and closer to base station is chosen as the cluster head.

3.5 Route Discovery ACO

This is responsible in order to discover multiple routes from source node to destination node and routing path is determined towards the destination node based on the selection of one of the node. After finding out the multiple routes the route which will have best probability of selection is chosen to send the packets.

4. PARAMETERS MEASURE

4.1 End to End Delay

End to End Delay is the time taken for the RREQ to go from the source node to Base Station node and then send back the RRPLY from Base Station node to source node.

$$E2E_{delay} = t_{stop} - t_{start}$$

Where,

t_{stop} = *This is the Time at which RRPLY is recieved*

t_{start} = *This is the Time at which RREQ is send*

4.2 Number of Hops

The Count of number of intermediate links between the source nodes to Base Station node

4.3 Total Energy Consumed

The total energy consumption can be computed using the following equation

$$TE_c = \sum_{i=1}^{l} Ec_i$$

Where,

l = *Number of links*

Ec_i = *Energy consumed for the* i^{th} *link*

The energy consumed on the link can be computed using the following equation

$$Ec = 2E_{tx} + E_{gen}\ d^{\delta}$$

Where,

E_{tx} = *energy required for transmission*

E_{gen} = *energy required for generation*

d = *distance between the nodes*

δ = *environment factor* $0.1 \le \delta \le 1$

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4.4 Number of Alive Nodes

The count of number of nodes whose remaining energy is greater than B/4 where B is the initial battery

4.5 Number of Dead Nodes

The count of number of nodes whose remaining energy is less than B/4 where B is the initial energy

4.6 Routing Overhead

The routing overhead is defined as

$$Routing\ Overhead = \frac{Number\ of\ control\ packets}{Number\ of\ Data\ packets}$$

4.7 Lifetime Ratio

The Lifetime Ratio would be computed by using the following equation

$$LifetimeRatio = \frac{Number\ of\ Alive\ Nodes}{Number\ of\ Dead\ Nodes}$$

4.8 Throughput

$$Throuhput = \frac{No\ Of\ packets}{Total\ Unit\ Time}$$

4.9 Residual Energy

$$RE = \sum_{i=1}^{l} E_i$$

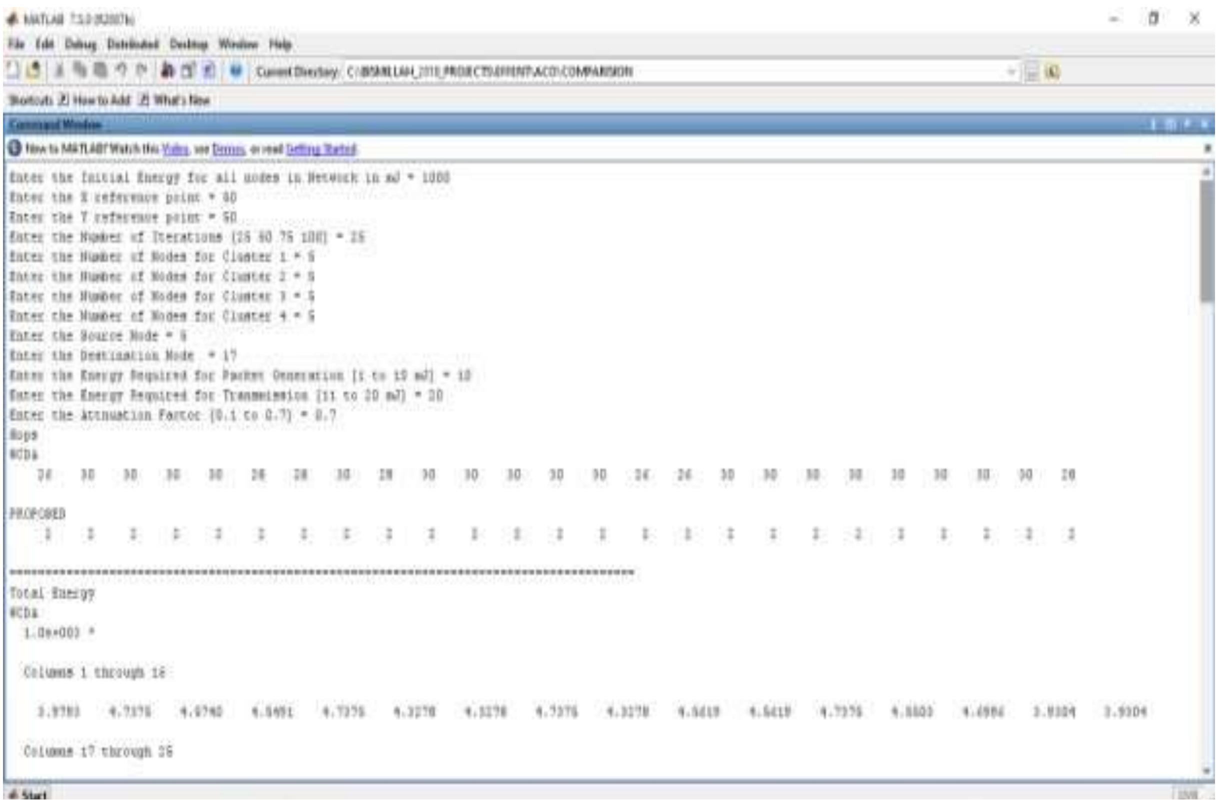
$$Where,$$

$$l = Number of\ \ Nodes$$

$$E_i = Rremaining\, Energy\ \ for\ the\ i^{th}\ \ Node$$

5. SIMULATION

Results are simulated on MATLAB Simulator. The simulation results are shown in figure below



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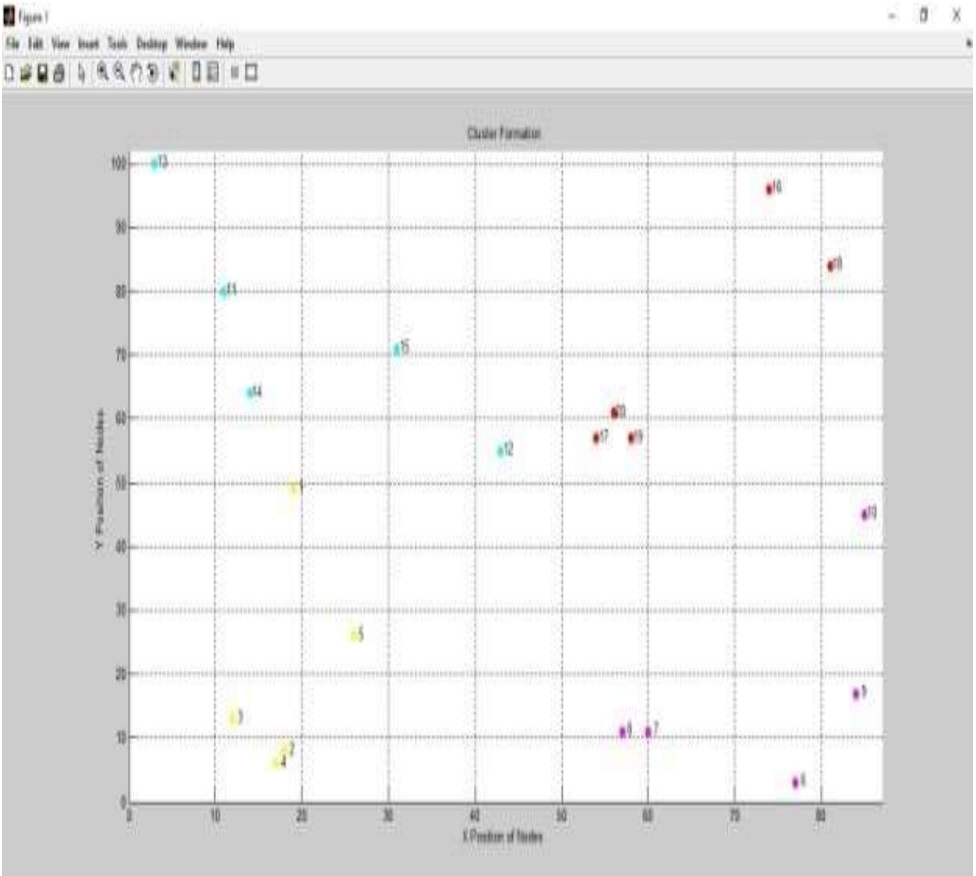

Fig 1: Shows X axis as X poition of Nodes and Y axis as Y Poisition of Nodes

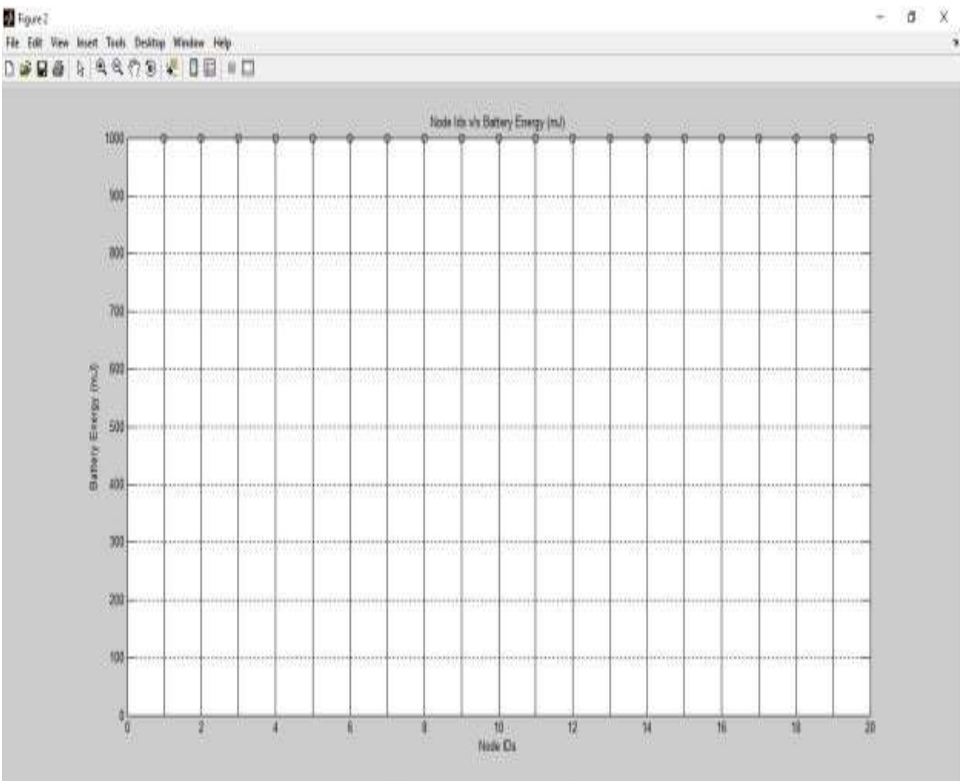

Fig 2: Shows X axis as Node IDs and Y axis as Battery Energy(mJ).The figure shows the initial energy levels of the nodes which was given as 1000.

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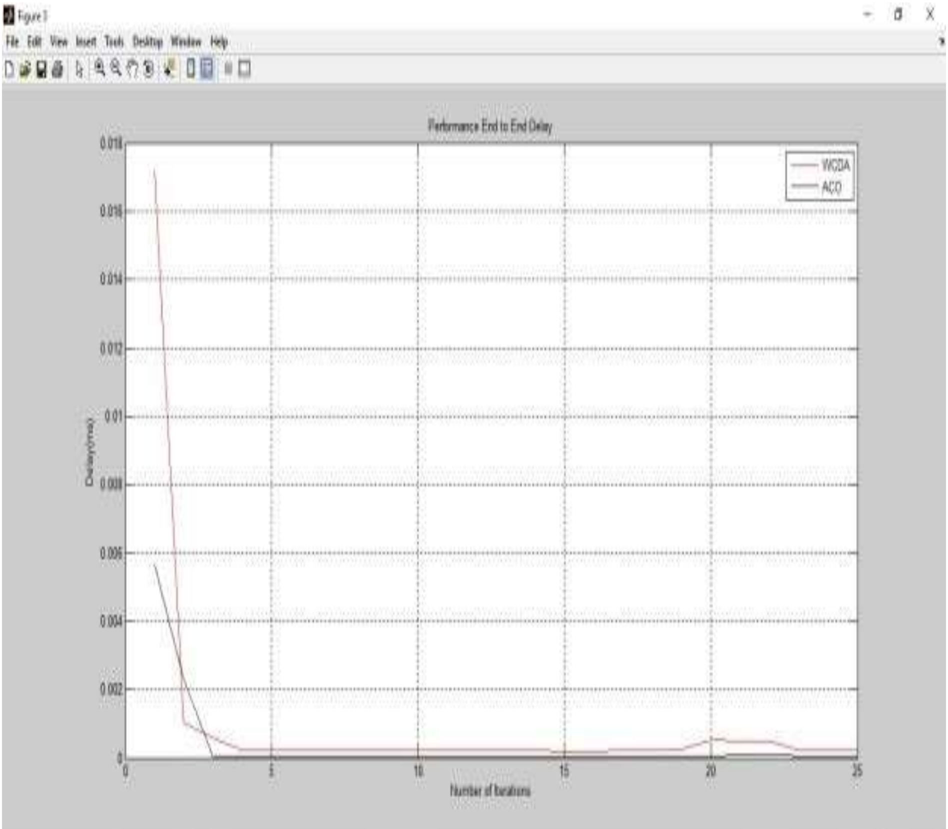

Fig 3: Shows X axis as Number of Iterations and Y axis as Delay(ms).It shows the delay comparison between WCDA and ACO.From the figure it is evident that the ACO has less delay in comparison with WCDA

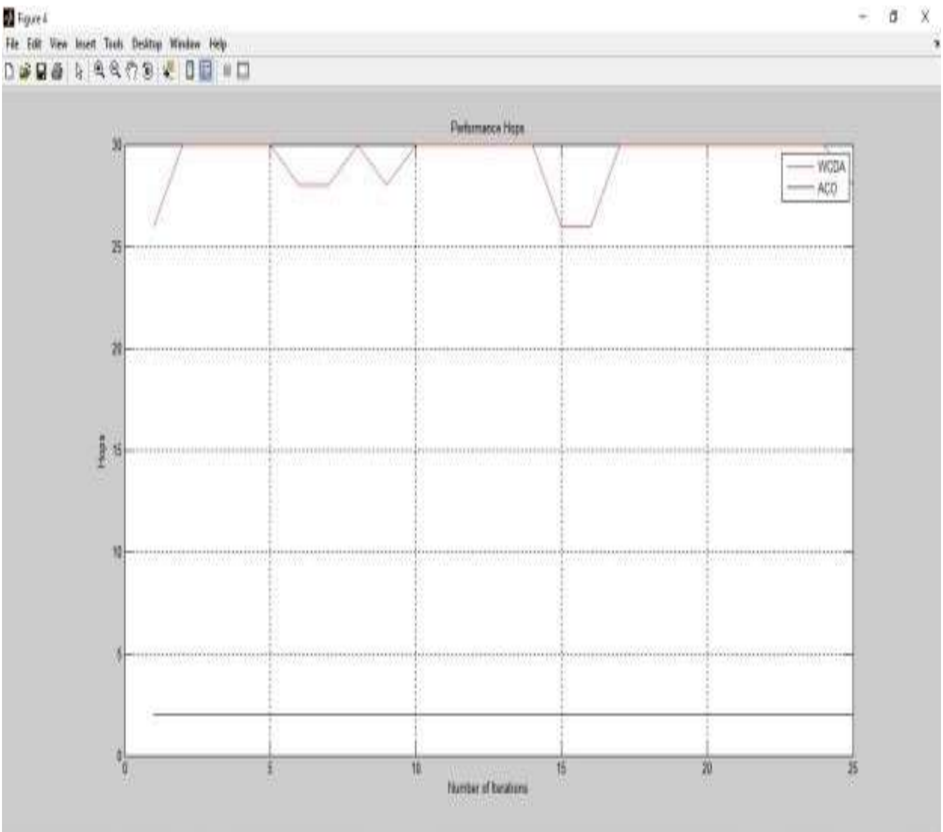

Fig 4: Shows X axis as Number of Iterations and Y axis as Hops.From figure it is clear that the number of hops needed in ACO is lesser than that of WCDA.It is because back and forth propagation between source and the base node is avoided in ACO

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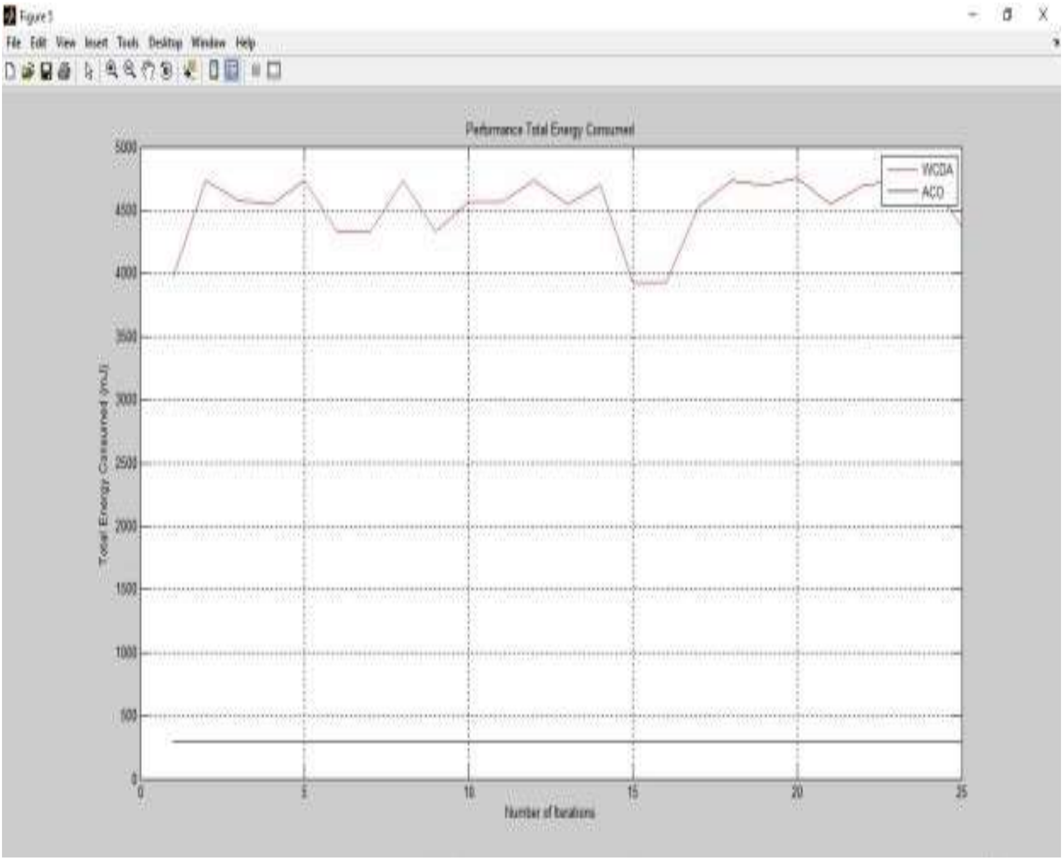

Fig 5: Shows X axis as Number of Iterations and Y axis as Total Energy Consumed(mJ) .Total energy consumed is more in WCDA than in ACO.

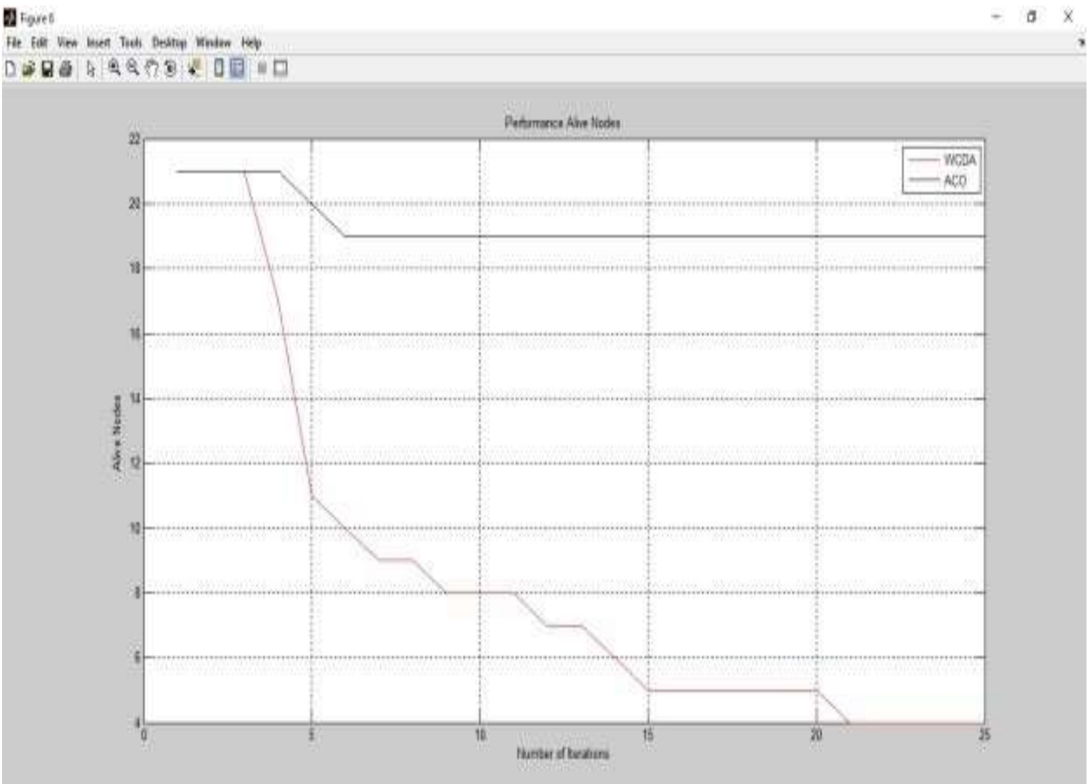

Fig 6: Shows X axis as Number of Iterations and Y axis as AliveNodes. From the figure we can understand the number of alive nodes in ACO is more than WCDA after 25 iteration.

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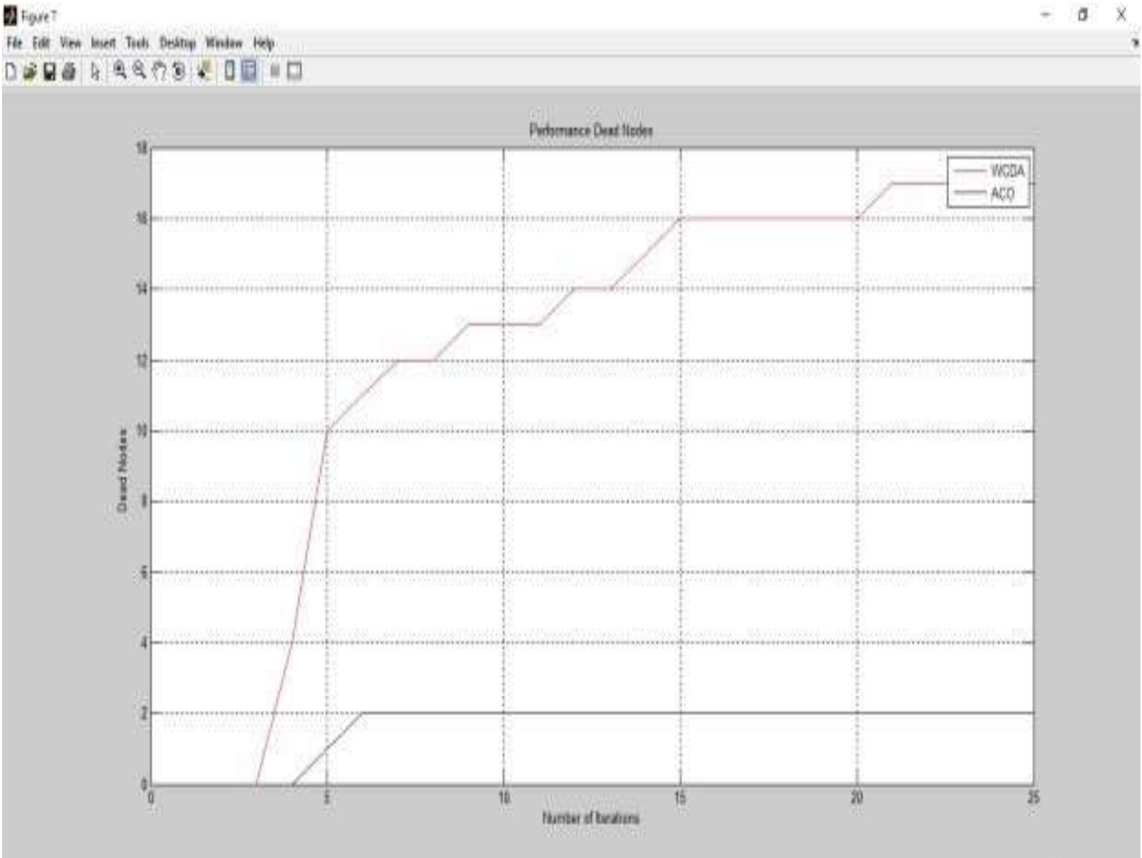

Fig 7: Shows X axis as Number of Iterations and Y axis as Dead Nodes.From the figure we can understand that after 25 iterations number of dead nodes are less in ACO than in WCDA.

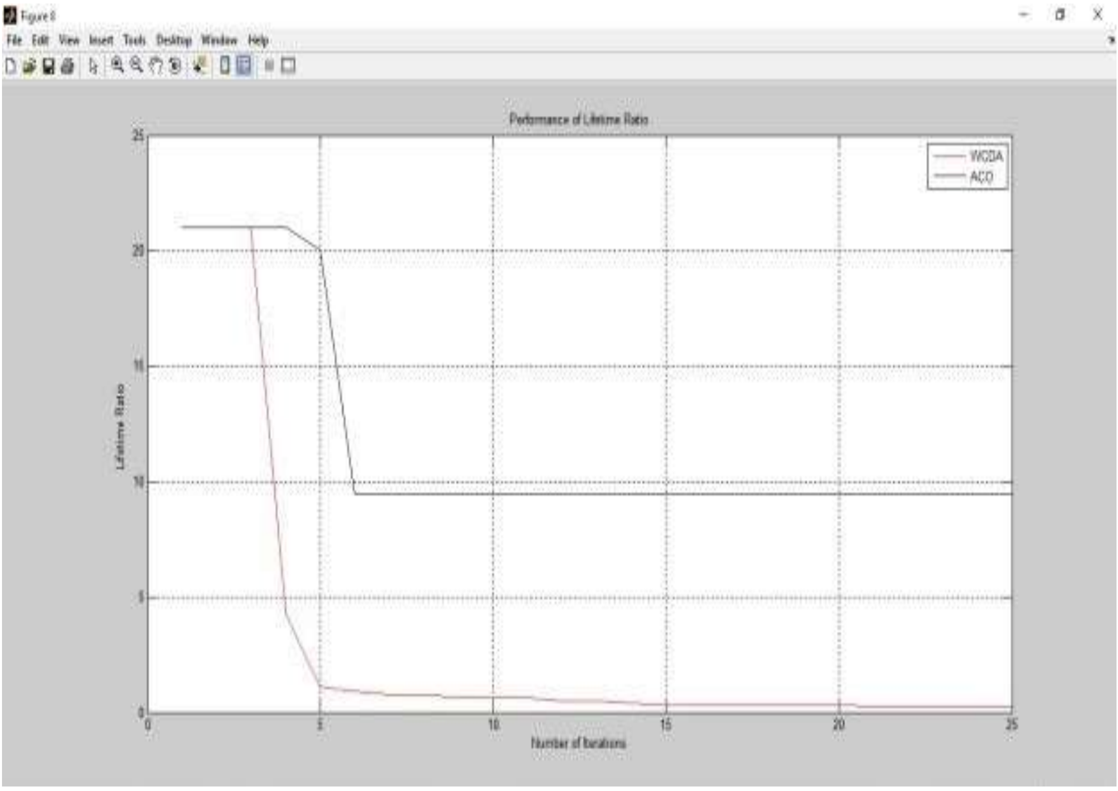

Fig 8: Shows X axis as Number of Iterations and Y axis as Lifetime Ratio. From the figure we can understand that the lifetime ratio of ACO is higher than that of WCDA.

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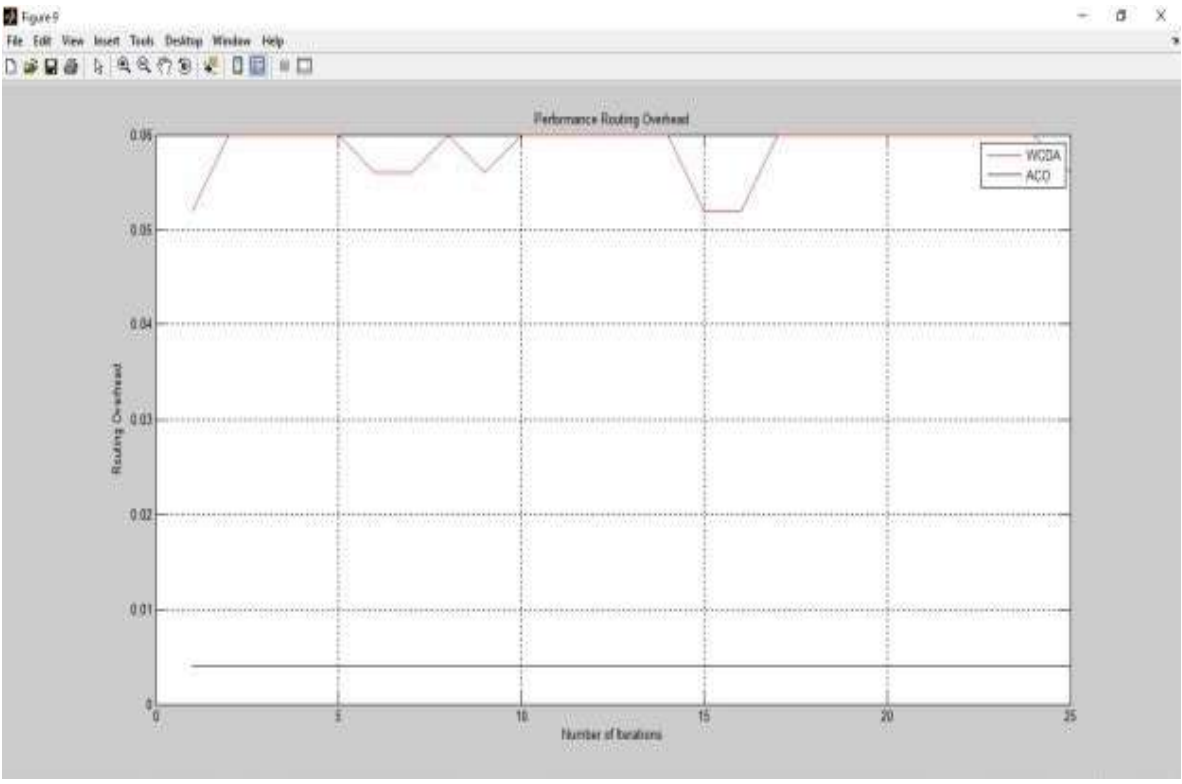

Fig 9: Shows X axis as Number of Iterations and Y axis as Routing overhead. Here we can see the routing over head value of ACO is lesser than WCDA as more number data packet is sent for less number of control packets.

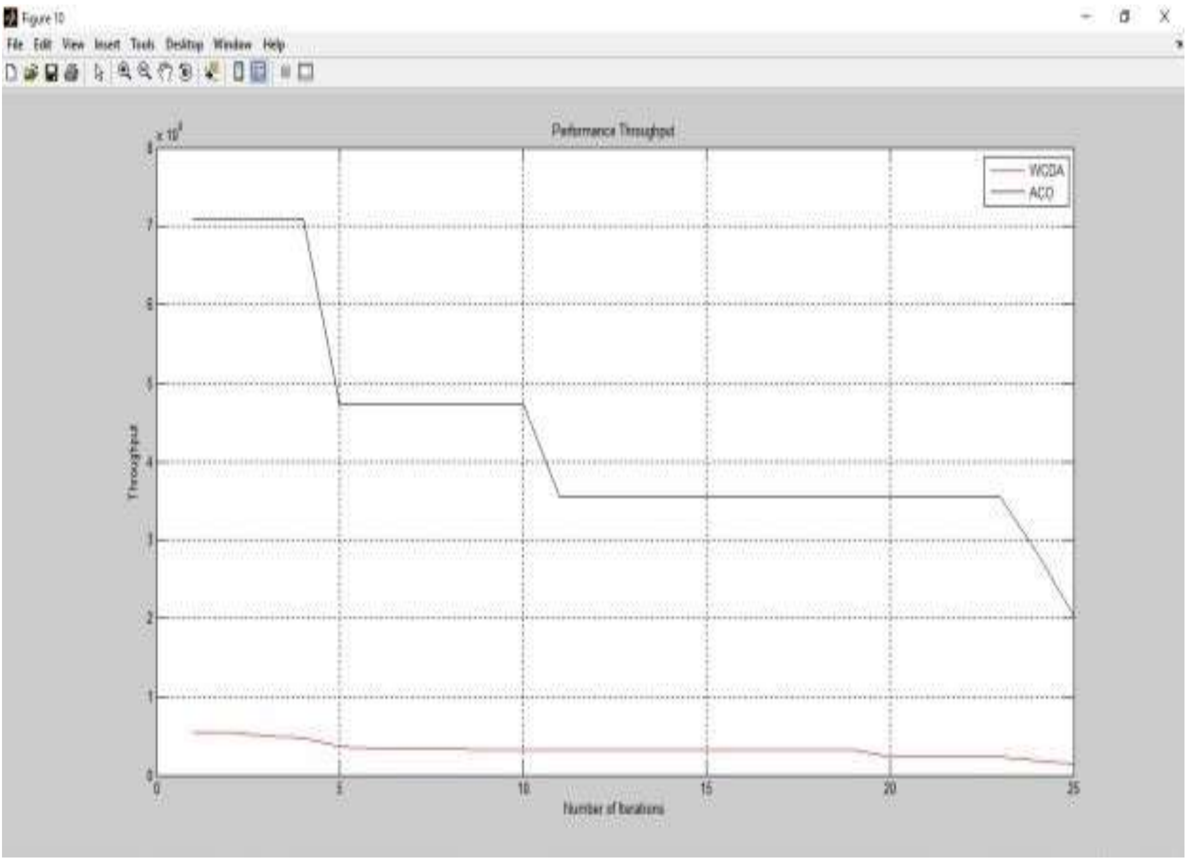

Fig 10: Shows X axis as Number of Iterations and Y axis as Throughout. From the figure it is evident that throughput value of ACO is higher than WCDA.The value decreases during the 25 iterations but still ACO is higher than WCDA.

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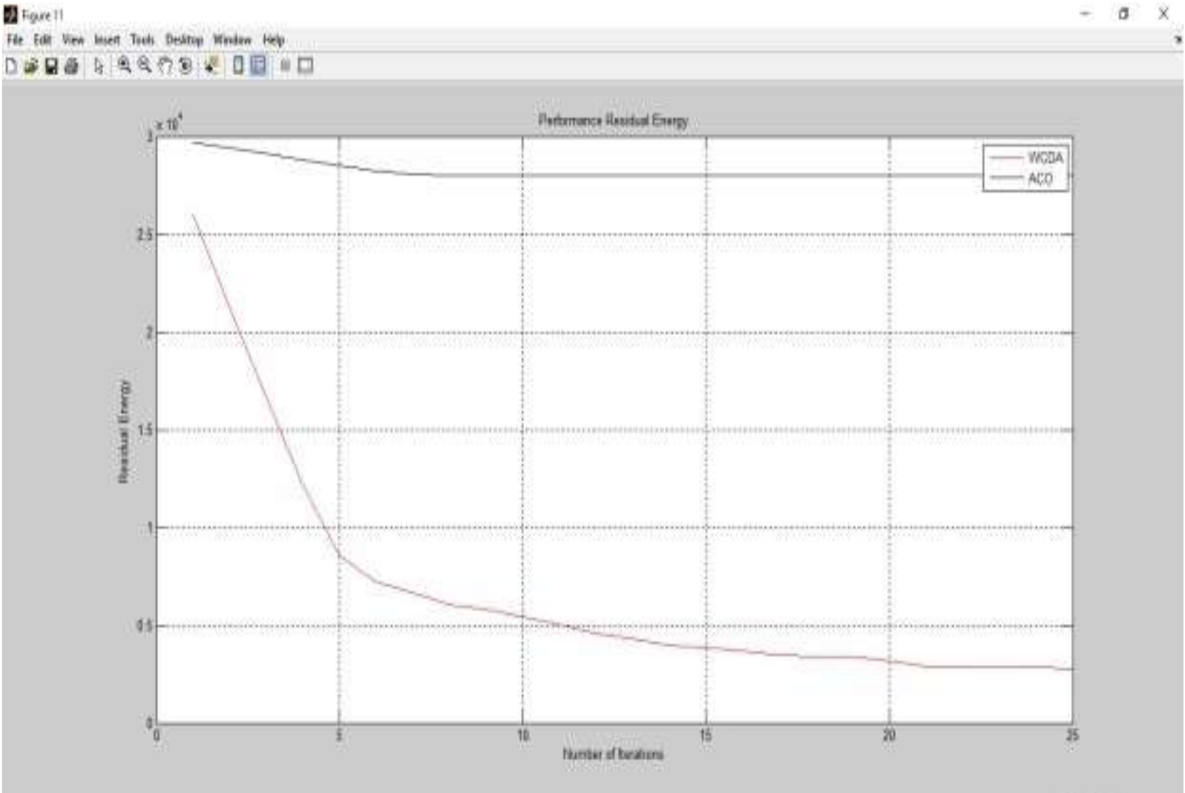

Fig 11: Shows X axis as Number of Iterations and Y axis as Residual Energy. It shows sum of residual energy of each node after the iteration. From the graph it is clear that the ACO has more residual energy in comparison with WCDA.

6. CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

In this project node deployment, cluster formation, cluster head election WCDA, cluster head election ACO, Route Discovery WCDA, Route Discovery ACO and Selection of corporative nodes have been implemented. The ACO is compared with WCDA and proved that ACO is the best with respect to delay, hops, energy consumed, number of alive nodes, number of dead nodes, life time ratio, residual energy and routing overhead.

6.2 Future Scope

[1] The project can be extended by applying node recovery genetic algorithm to improve the network life time even more

[2] The sleep node mechanism can be used in order increase the number of alive nodes future

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