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Hybrid ACO-PSO Based Energy Efficient Clustering Protocol In WSN

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ABSTRACT
The clustering in the Wireless Sensor Networks (WSN) is one of the most important investigation areas. There are many cluster head selection algorithms which were developed before today. Hybrid ACO-PSO based algorithm is developed to reduce the energy consumption and enhanced the WSN life-time. The comparison is done among the MSEEC and Hybrid ACO-PSO based MSEEC in the wireless sensor network. The planned technique has the flexibility to beat the constraints of the MSEEC routing protocol. The comparisons has been done upon the following parameters number of alive nodes, dead nodes, packets transferred and average consumed energy. This comparison will show that the planned technique outperforms over the market techniques.

Keywords :— Wireless sensor network (WSN), Hybrid ACO-PSO, alive nodes, dead nodes and packets transferred and total average energy.

I. INTRODUCTION

Wireless sensor networks (WSN) is formed by collection of sensor nodes, which are small energy constrained devices. Due to the limitation of small energy in nodes, the energy efficiency is considered to be a very important factor in wireless sensor network. Wireless Sensor network is consists of many small distributed sensor nodes offering the reliable monitoring in several environments such as battlefield sensing, disaster management, wildlife monitoring and civil applications. In WSN every sensor nodes have specific hardware receiving hardware, memory, processing unit, which are required. With the aid of networking tiny sensor nodes, it becomes easy to get the information about physical phenomena that was quite difficult with conventional methods. These node process data and send it to base station called as sink. For communication of data between nodes and sink many routing technologies are used such as single hop which is called direct communication and multi hop data transmission. But due to limited battery life of nodes these techniques were not so much effective due to early death of some nodes in single hop and multi hop communication. These techniques were failed to achieve the network stability periods. A WSN contains a wide array of nodes which can be tightly or arbitrarily deployed in a location by which they have interest. There is Base Stations (BS) situated to sensing area. The bottom station having major function in WSN as sink send queries to nodes while nodes sense the asked queries and send the sensed information in a joint way reverse to Base station. Base station also serves as an entrance for outer surface system i.e. Internet. And so the number of information and send only relevant data to customer via internet is performed by Base station. Because it is known nodes have little batteries which are hard to change or recharge. So to check out such structural design (having a lot less transfer and concentrated communication space) to improve power saving. You will find positive structural design like flat-network architecture and hierarchical network architecture.

1.1 Clustering

Clustering algorithms are classified based on two main criteria: according to the stability and energy efficiency. Selection of CH in energy-efficient techniques generally depends on the initial energy, residual energy, average energy of the network and energy consumption rate or combination of these. The properties of cluster are following:

1) Cluster count
2) Intra-cluster topology
3) Connectivity of cluster head to base station.

II. RELATED WORK

Liu, Li et al. introduced clustering routing protocols proposed in the literature for WSNs. We outline the advantages and objectives of clustering for WSNs, and develop a novel taxonomy of WSN clustering routing methods based on complete and detailed clustering attributes. In particular, we systematically analyze a few prominent WSN clustering

routing protocols and compare these different approaches according to our taxonomy and several significant metrics.

Gautam, Navin et al. proposed a fresh hierarchical routing protocol, distance aware intelligent clustering protocol (DAIC), with the important thing notion of dividing the network into tiers and selecting the high energy CHs at the nearest distance from the BS. They have observed that a large amount of energy can be conserved by selecting CHs at the nearest distance from the BS. Also, how many CHs are computed dynamically to prevent the selection of unnecessarily large number of CHs in the network?

Xunbo, Li et al.introduced a function which uses the relative distance between nodes and base station and the round number as its parameters. Hence, the distribution of cluster head can be symmetrical through changing parameters of the event, and. With the increasing of running time, every node in the network has the opportunity to be a bunch head, that is, the power consumption might be balance. The simulation result implies that the lifetime of Wireless Sensor Network (WSN) has been prolonged about 14%.

Wang, Xu et al.proposed an energy-efficient clustering protocol for wireless sensor networks (WSNs). Unlike LEACH and other existing clustering protocols, the proposed clustering protocol considers both the remainder energy of an indicator node and the exact distance involving the sensor node and the sink in electing a bunch head and an indicator node with an increase of residual energy and nearer to the sink features a higher probability to become cluster head.

Fifi, Rawyaet al. presented two energy efficient clustering protocol which uses the optimum number of powerful nodes that achieves the minimum energy consumption of the network. The M-SEEC is a heterogeneous protocol and prolongs the stability period, more energy efficiency and higher average throughput.

Alnuaimi, Mariam et al. highlighted the challenges in clustering a big scale WSN, discuss a few of clustering protocols, and classify them based on the clusters technique formation and just how that data is aggregated to the bottom station.

III. M-SEEC PROTOCOL

3.1 Multi-level stable and energy efficient clustering protocol

In this section, reveal description of energy efficient routing protocol is given. To the most effective of knowledge, M-SEEC depends on the network structure that is divided into the clusters. In SEEC protocol, each cluster has an advanced nodes and normal nodes which deployed randomly in this cluster. In M-SEEC, the most powerful supper nodes are assigned to cover the distant sensing areas. Each type of nodes has its role in the form of sensing, aggregation or transmission to the sink (Base Station).

1. Nodes are deployed randomly in the field with a different group of energy values.
2. The Network is divided into clusters and each cluster has a powerful super nodes, advanced nodes and normal nodes.
3. The positioning of a BS isn't fixed and it may be either within or beyond your sensor field.
4. In M-SEEC, M_{SN} is the percentage of the total number of nodes equipped with β times more energy than the normal nodes (NN), called as a super nodes (SN). The rest nodes n are the normal nodes with initial energy E_0. **N=N1+N2**, Where N1 is the total NNs attached to ANs and N2 is the total NNs attached to SNs.

Total initial energy of the 3 level heterogeneous networks is given by:

$$E_{total} = n.E_0 + M_{AN}.(1+\alpha).E_0 + Msn.(1+\beta).E_0$$

Therefore, the three-level M-SEEC has $(\alpha . M_{AN} + \beta . M_{SN})$ times more energy.

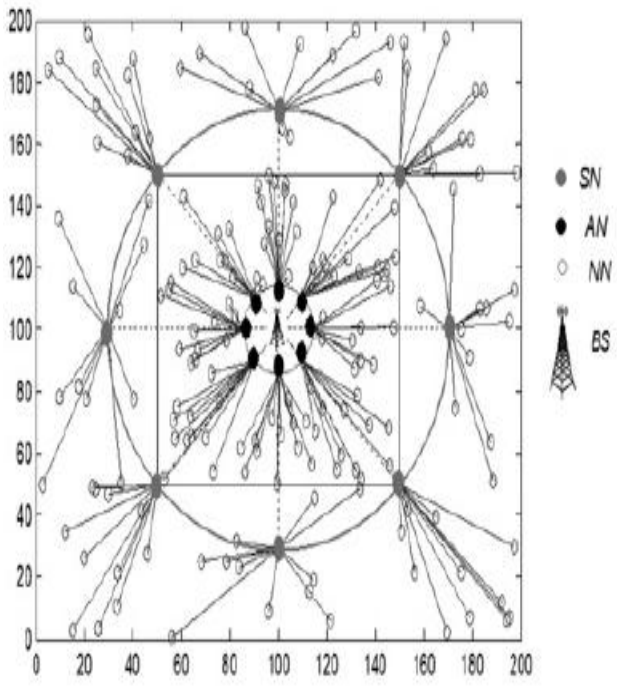

Fig 1. Network Model of M-SEEC

IV. EXPERIMENTAL SET-UP

In order to implement the proposed technique and implementation has been done. Table 1 has shown a variety of

constants and variables required to simulate this work. These parameters are standard values used as benchmark for WSNs. The simulation environment for wireless sensor network is 200 *200 meter and the base station position is (100,100).

Table1:- Simulation Parameters

Parameters	Value
Area(x,y)	200*200
Base Station(x,y)	X(sink)=100,Y(sink)=100
Number of nodes	200
Probability	0.1
Initial Energy	0.5J
Transmitter Energy	50 nJ/bit
Receiver Energy	50nJ/bit
Free space Energy(amplifier)	1.0nJ/bit/m^2
Multipath Energy	0.0013nJ/bit/m^2

V. SIMULATION SCENARIO

This is the environment where area is 200*200 meter. Here, the environment of simulation is at the mid, where all the rectangles are normal nodes and green diamond shaped nodes are super nodes and diamond pink shaped nodes are advanced nodes and blue star is the base station .

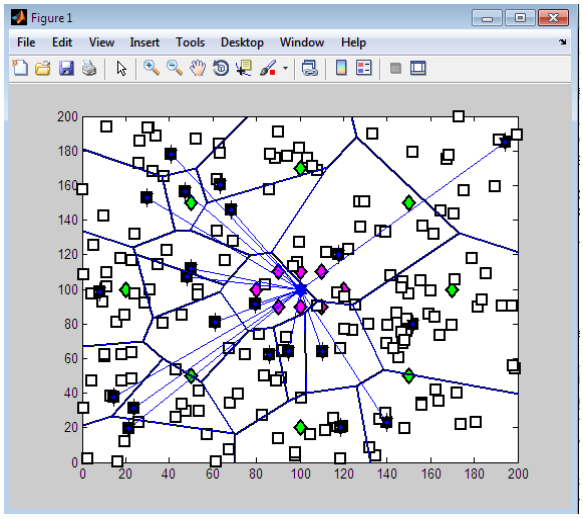

Fig 2 Simulation Enviornment

Here, the graph shows the simulation when all the nodes are dead. So all the red diamond shape nodes are die and again blue diamond shaped is the base station.

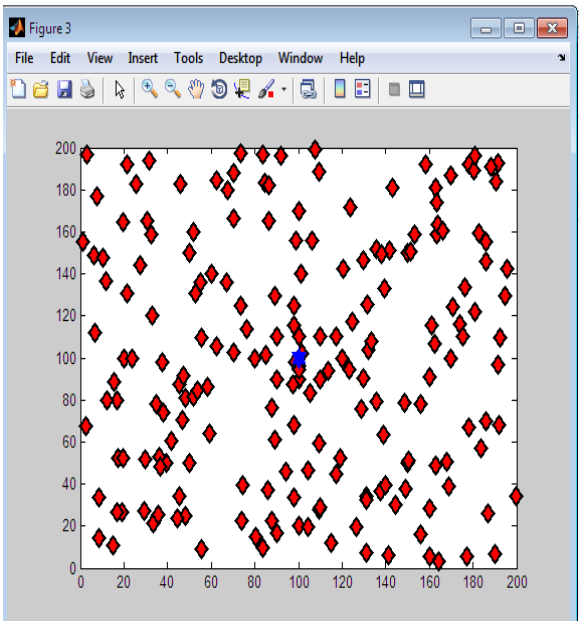

Fig 3. Simulation Enviornment at the end

In the simulation environment, all the simulation is done under the MATLAB. In the EMSEEC, the 200 nodes are taken in the environment of 200*200 m. The number of AN is 8% of the total nodes and also the number of SN is 8%. AN is having three times more energy than normal nodes and SN is having four times more energy than normal nodes. Here, the performance metrics are alive nodes, average consumed energy, dead nodes and packets transferred.

Alive nodes:-it is the total number of the nodes that has not expended their energy. This particular metrics also indicates the network lifetime and also gives the idea of the area coverage of the network over time.

Average Total Energy:- it tells the total average energy is consumed over the rounds.

Dead nodes:-it tells the how many nodes are dead according to the rounds.

Packets Transferred:-it is the total number of the packets or we can say messages that are received by the base station.

In the simulation environment, all the simulation is done under the MATLAB. In the EMSEEC, the 200 nodes are taken in the environment of 200*200 m. The number of AN is 8% of the total nodes and also the number of SN is 8%. AN is having three times more energy than normal nodes and SN is having four times more energy than normal nodes. The cluster head selection is done through the hybrid ACO-PSO optimization technique. Here, the performance metrics are alive nodes and packets transferred.

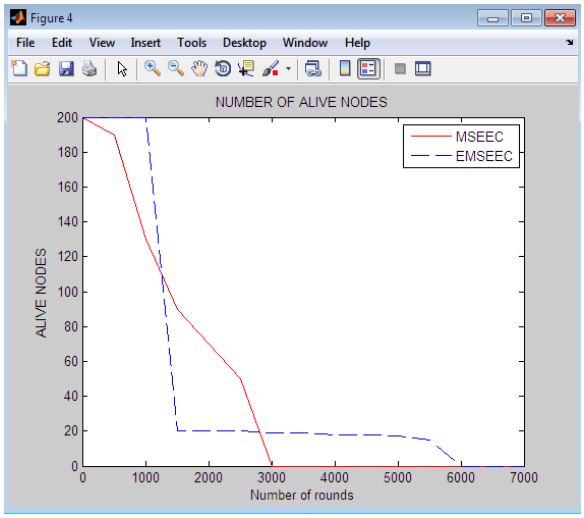

Fig 4 Number of Rounds V_s Alive Nodes

Figure is showing the graph of alive nodes where X-axis is representing the rounds and Y-axis is representing the number of nodes become alive .The red dotted line represents the performance of MSEEC protocol, while the blue dotted line represents the EMSEEC protocol. From the figure, we observe that in case of the MSEEC all nodes are dead at 3000 rounds and in case of EMSEEC all nodes are dead after 6000 rounds. The numbers of alive nodes are more in case of EMSEEC protocol.

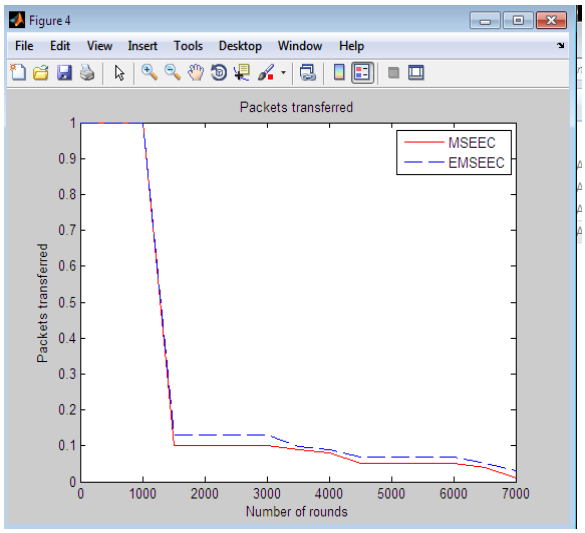

Fig 5 Number of Rounds V_sPackets transfer

Figure is showing the data received at the sink. X-axis is representing the number of rounds and Y-axis is representing the packets transferred in bytes. This figure shows that the amount of data received at the sink is higher in the EMSEEC protocol than MSEEC protocol. The result indicates that the EMSEEC can help data transmission to the sink in the entire network.

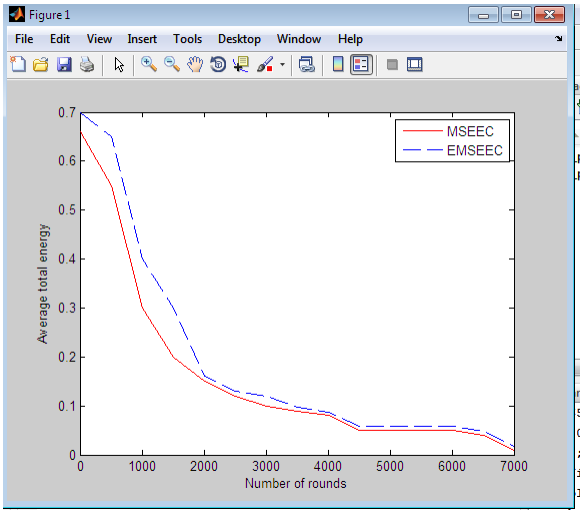

Fig 6 Number of Rounds V_sAverage total energy

Figure is showing the Average total energy. X-axis is representing the number of rounds and Y-axis is representing the energy. This figure shows that the average total energy is higher in the EMSEEC protocol than MSEEC protocol.

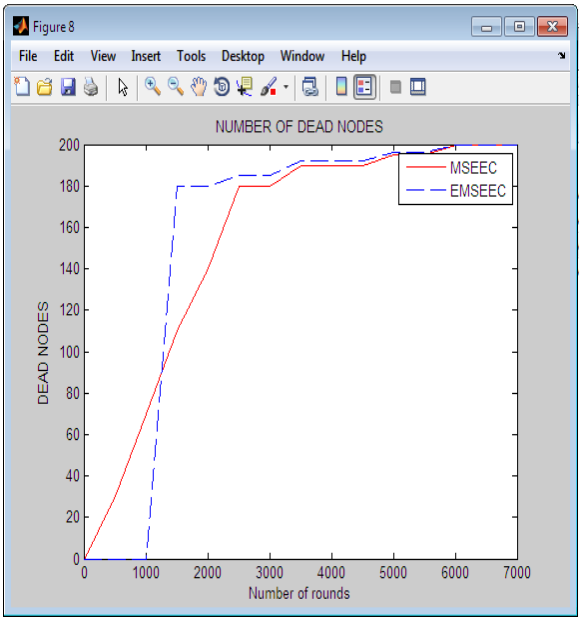

Fig 7 Number of Rounds $V_s$dead Nodes

Figure is showing the graph of dead nodes where X-axis is representing the rounds and Y-axis is representing the number of dead nodes.The red dotted line represents the performance of MSEEC protocol, while the blue dotted line represents the EMSEEC protocol. From the figure, we observe that in case of the MSEEC the nodes are dead at the starting and in case of EMSEEC the first node die at the round of 1000.

VI. CONCLUSION AND FUTURE SCOPE

Many routing protocols has been planned thus far to enhance the energy.MSEEC has shown quite vital results over the market WSNs protocols. However it's neglected

several constraints . so as to beat the constraints of the sooner work a brand new improved technique is planned during his analysis work . The planned technique has the flexibility to beat the restrictions of the MSEEC routing protocol .The planned technique is much better rather the previous one. Work is done within the MATLAB tool with the assistance of knowledge analysis tool case.The performance metrics shown that the hybrid ACO-PSO technique is much better than the previous one but this work has not taken into account the utilization of 3D WSNs, thus in future work we have a tendency to will extend the planned technique for 3D WSNs surroundings.

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