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An Advanced Metaheuristic Approach For Network Energy Enhancement In Wireless Communication

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Abstract— *Wireless Sensor Network is communication network which is consists of more than one tiny sensor nodes that are interlinked to each other to perform communication between source node and destination node. The performance of the wireless network depends upon various factors that are distance, energy factor. If the nodes consumes higher amount of energy then the network's performance will be degraded as the lifetime of the network is decreased and if the energy consumption of the node is lower, the network will be quite effective and efficient and have a long lifetime. Routing is implemented to form a path from sensor nodes to sink node. The clustering was introduced to improve the energy consumption of the nodes. And the node with highest amount of energy is elected a cluster head and represents all of the nodes of its cluster. In this study a new proposal (Modified Position-PSO (MPPSO)) is represented which elects the CH on the basis of energy as well as distance of the nodes. Then an energy model is used to dissipate the energy of the nodes. The comparison is done with proposed and traditional work to prove the proficiency of proposed work.*

Keywords—*Wireless Sensor Nodes, Routing, Cluster Head Selection, LEACH, Particle Swarm optimization. MPPSO, PSO*

I. INTRODUCTION

Wireless sensor networks (WSNs) were initially developed for defense field applications in order to track the activities of enemy from remote area. The data gathered from all the sensor nodes in WSN is transmitted to the Base stations. Wireless sensor networks come under the category of Ad Hoc networks. Due to the small size of sensor nodes, the amount of energy stored in the nodes is limited. Therefore, these networks undergo energy limitation. Wireless sensor network falls under the subset of Ad Hoc network but the protocols implemented in the Ad Hoc networks cannot be used in WSNs and it is because of following circumstances:

a) Count of sensor nodes in WSNs is comparatively greater than the Ad Hoc network. Therefore the WSNs require unique and highly adaptable protocols.
b) The sensor nodes in WSNs contain limited amount of energy and therefore have limited power supply as compare to Ad Hoc network. Practically, the sensor nodes in WSNs can be charged again as they are implemented in different distant locations.

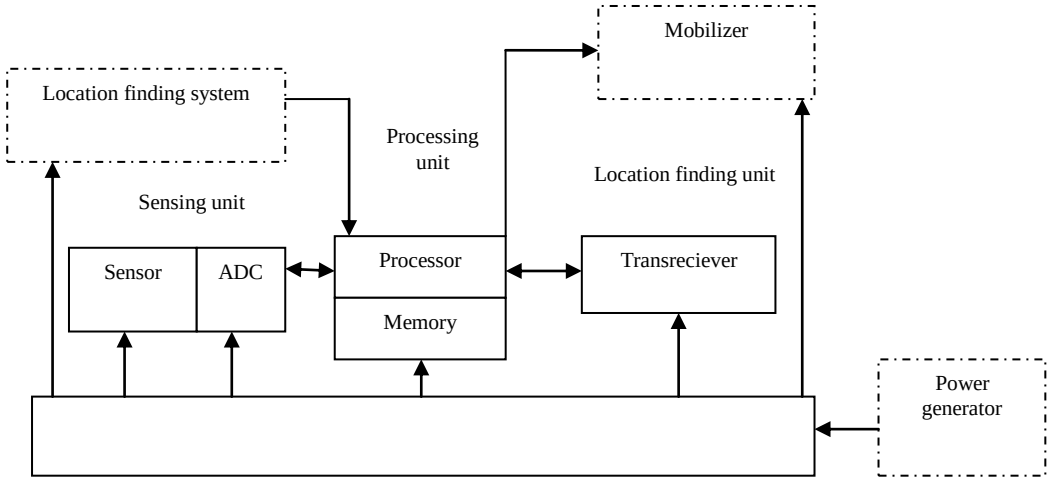

Figure 1 Block diagram of sensor networks

Hence the WSNs may be described as a network which is comprised of geographically distributed sensors that are used to monitor both physical and environmental parameters such as temperature, sound, pressure etc. and after gathering the information it is transmitted towards the location of users". Wireless sensor network is comprised of thousands of sensor nodes and all the nodes are interlinked with each other. The Source node is linked with the central gateway. With the help of various communication channels the Central gateway forms the connection with the whole world. For instance:

internet, WI-Fi, WI-Max, wired LAN etc. Figure 1 depicts that the information is gathered from various sensor nodes and this information is further processed and examined.

II. PROBLEM FORMULATION

LEACH is a clustering routing protocol using probabilistic method to elect channel head of a node using energy and threshold conditions. Here selection of a node is not done based on amount of energy, which could cause problem in selection process to give priority to a low power node. If low power node is not used efficiently, more number of nodes has to be taken to form a cluster. Leach uses single hop clustering routing and cannot be used for larger networks. Different amounts of initial energy cannot be considered in LEACH since CH rotation is performed at each round. Nodes with low energy, elected as CH could cause energy holes and coverage problems. To overcome these difficulties, energy considerations were done in the previous work. But we focus on main requirement the need of system is to enhance the energy and distance that is not only parameters that affects the performance of the network. So it can be further extended with improving the CH selection approach for proposed work.

III. PROPOSED WORK

As in problem it was discussed that the CH selection was the major issue in the network due to which the energy was introduced in the present work, but only energy factor is not a point to add on to the performance of the network other parameter as distance can also be considered because the main effect of this will be the energy model that is used in the EEP are directly proportional to distance also. So there will be major effect of considering the distance and the packet delivery ratio in CH selection.

Only this concept will be not a major change in present work considering this the proposed work will also have some other changes that are the use of optimization algorithm for the CH selection not directly but on optimized selection of Ch will be for the an advanced version of PSO will be used named as **MODIFIED POSITION PSO** (MPPSO) which will lead to save the energy by the nodes in the network which is major concern of the study.

The methodology of the proposed work is defined as below:

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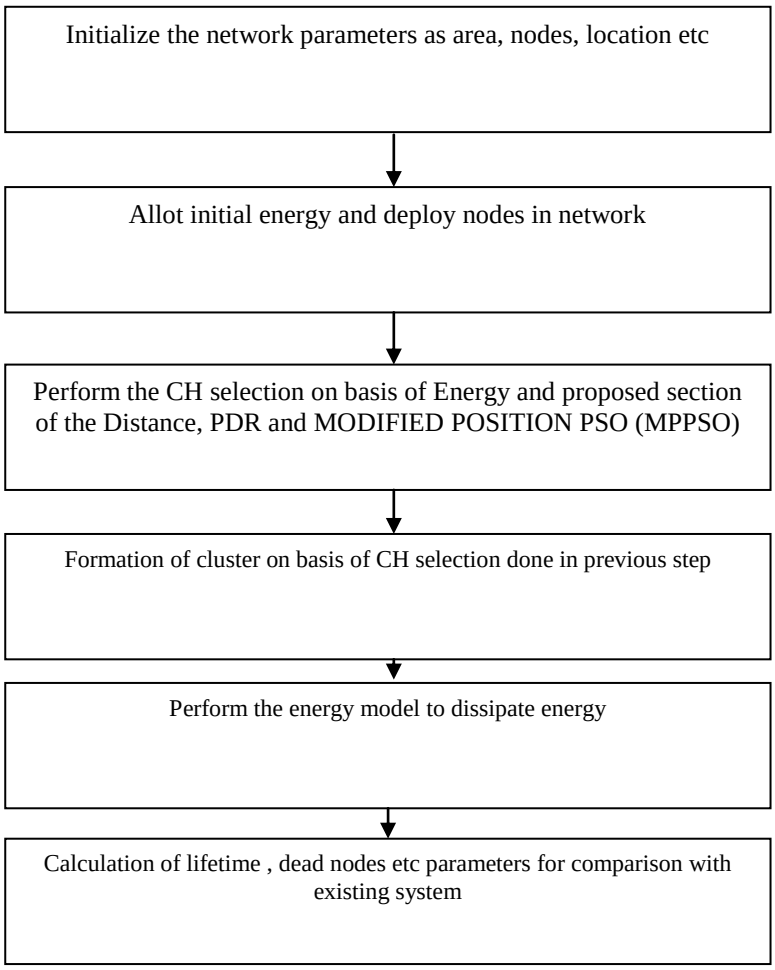

Figure 2 Block diagram of proposed work

1. First step is to initialize the network on the basis of given value of area of network, number of nodes. For the purpose of proposed work we have initialized the network which covers the area of 50×50 and the total number of nodes in the network is 100.
2. Second step is to assign the initial energy to the each and every node in the network. A fixed amount of energy is allotted equally to all the sensor nodes in the network. After assigning the energy to the nodes next step is to distribute the nodes uniformly in the network instead of random distribution.
3. Then MPPSO (Modified Position PSO) mechanism is used to elect the cluster heads from the given set of nodes in the network. The CHs selection is done on the basis of various parameters such as energy, distance from adjacent nodes etc.
4. In this step the proposed energy model is applied to dissipate the energy and to perform data transmission from cluster heads to sink node.
5. Last step is to evaluate the performance of the network on the basis of various parameters such as number of dead nodes, number of alive nodes. These parameters depicts the lifetime of the network

IV. RESULTS

The proposed work aims to improve the traditional technique for CHs selection. The experimental analysis acquired from the simulation is shown as:
The figure 3 shows the number of alive nodes in the network for control nodes 12. The x axis of the figure represents the number of rounds whereas y axis shows the number of survival nodes in the network. Considering this fact, several traditional techniques and proposed technique has been compared and from the comparison performed it has been concluded that proposed technique outperformed. There are large number of nodes are alive till number of rounds in comparison with other techniques. Consequently, proposed technique achieves better performance over LEACH and NWPSO.

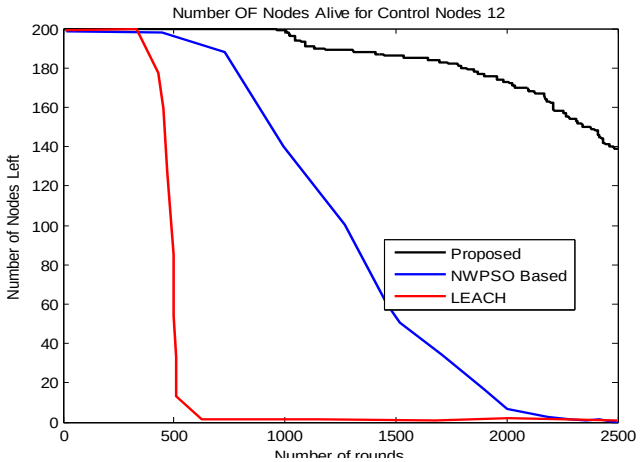

Figure 3 Number of alive nodes for control nodes 12

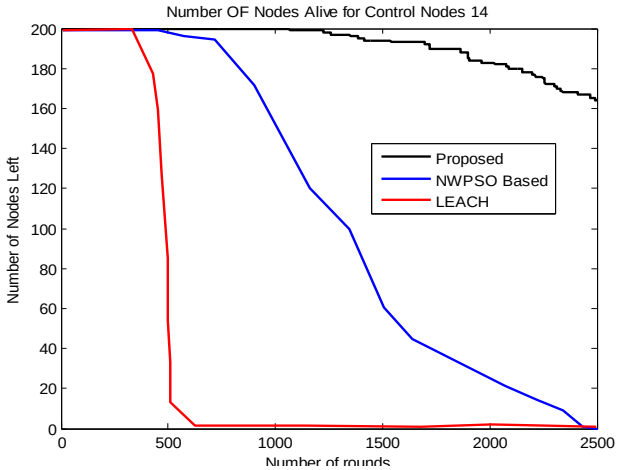

Figure 4 Number of alive nodes for control nodes 14

Likewise, figure 4 shows the number of alive nodes with respect to number of rounds in the network. For the simulation, different control nodes are considered. The below figure shows results for control nodes 14. In the proposed technique, the more number of nodes are alive and survive longest in comparison with LEACH and NWPSO based approach.

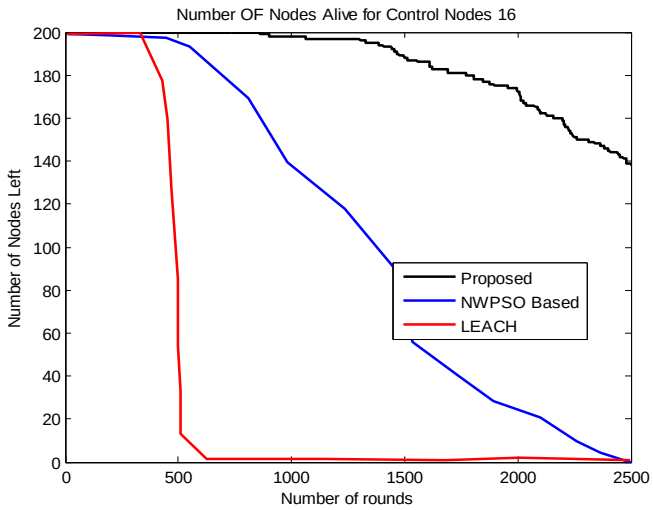

Figure 5 Number of alive nodes for control nodes 16

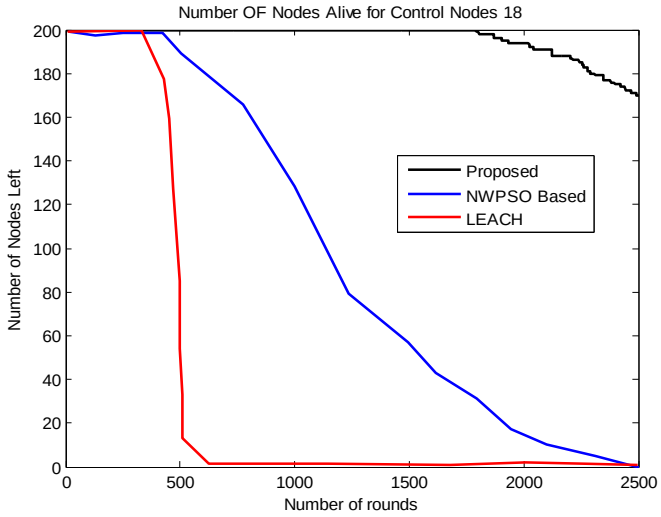

Figure 6 Number of alive nodes for control nodes 18

The control nodes are varying from 12 to 18 and their results are shown in the above figures 5 and 6. From the results acquired, it has been concluded that with the increase in number of control nodes, the consumption of energy has been reduced. Moreover, an optimum number of control nodes are required to be considered in view of maximizing the efficiency of the network. The simulation performed confirmed that 18 control nodes achieve better results.

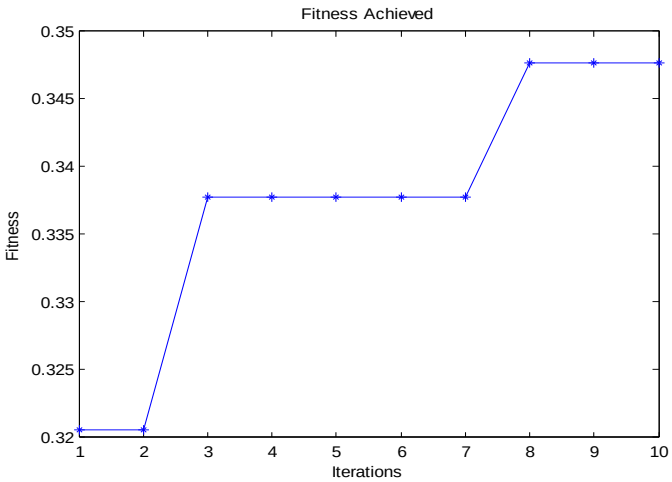

Figure 7 Achieved fitness with respect to number iterations

The figure 7 defines the fitness value achieved for individual iterations. The process continued until an optimum fitness value is not acquired. From the figure, it has been concluded that fitness value converge after iteration 8.

The lifetime of network has been shown in the figure 8. The lifetime of network can be identified through the number of dead nodes. Nodes that stay longer in the network ensures maximum lifetime of that network. For the comparison

purpose, different techniques are taken into consideration. The simulation analysis has performed between proposed, HEED, Hausdorff, PSO based and NWPSO based approach. Among different techniques, proposed technique outperformed traditional techniques as nodes are started dying after round 600 whereas in the traditional techniques at round 600 almost all nodes are dead. Therefore, the lifetime of the proposed technique is increased.

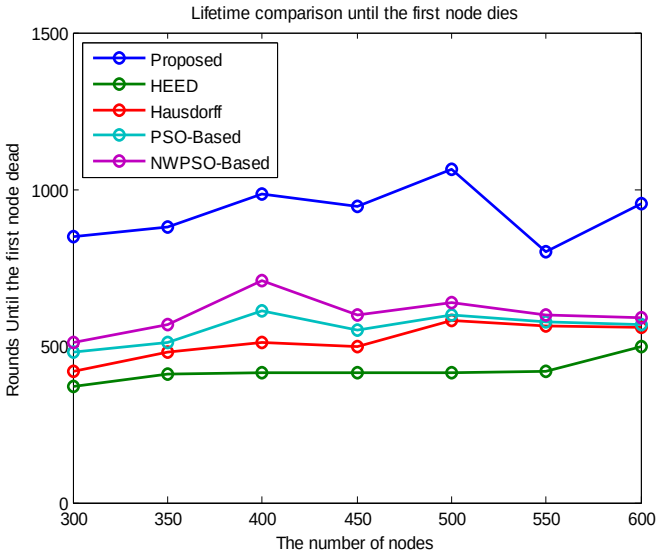

Figure 8 Lifetime of different existing and proposed technique

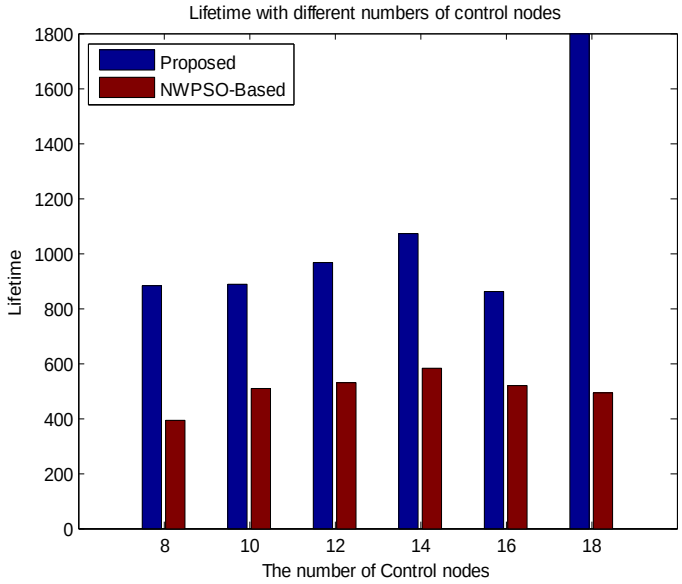

Figure 9Lifetime with different number of control nodes

In the above figure 9, lifetime of the whole network using proposed work is analyzed. Next, lifetime of the network with respect to different control nodes are taken for simulation. The control nodes have been varying from 8 to 18. The results acquired ensured that control nodes 18 provides significant results as it achieved maximum lifetime in the network in comparison with other control nodes for proposed work.

V. CONCLUSION

This study provides a novel approach (MPPSO) for improving the traditional cluster head selection technique. In order to improve the working of traditional CH selection mechanism, this study enhances the cluster head selection parameters. In this the cluster head selection is done on the basis of the energy of the nodes and the distance of the node from its adjacent nodes. The results proves that the MPPSO (proposed work) is much better as compare to the traditional techniques in the terms of alive nodes and it is also capable to enhance the lifetime of the network.
In future more enhancements can be done to improve the quality of services parameters as traditional work was only implemented either for enhancing the energy efficiency of the network or for efficient CH selection mechanism.

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