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Improving the Lifetime of WSN by Optimal Cluster-Heads Election Using Genetic Algorithm

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Abstract*: Wireless sensor network is collection of sensors. Sensor nodes gather the sensory information and communicating with other nodes in networks. Key challenges in wireless sensor network are saving energy and extend the network life time. Routing protocols are used in two types of network: homogenous and heterogeneous. Heterogeneous wireless sensor network comprises of sensor nodes with distinctive capability, for example, diverse computing power and sensing range. Though, each protocol is not appropriate for heterogeneous WSNs. In this paper, we test stable leach and genetic algorithm optimized stable leach under a few distinctive situations holding* **high level heterogeneity to low level heterogeneity.**

Keywords: Wireless Sensor Network (WSN), Stable LEACH, Genetic Algorithm (GA), Energy Clustering, Network Lifetime, Throughput.

I Introduction

The key encounter in setting up and legitimate operation of WSN is expanding the lifetime of the system by minimizing the consumption of energy. Since from last few year mixed bag of progressions have been made to point of confinement the energy necessity in WSN, as principally energy dispersal is more for wireless transmission and reception [1]. Principle methodologies till proposed were centring at rolling out the improvements at MAC layer and network layer to minimize the energy dissipation. Two more real difficulties are the manner by which to place the cluster heads over the network and what number of clusters would be there in a framework. In the event that the cluster heads are accurately situated over the network and sufficient clusters are displayed, it will help to lessen the dispersal of energy and would help to expand the lifetime of the system to handle with all the aforementioned difficulties clustering have been discovered the effective procedure [2] [3]. Clustering is dependably been alluded as a compelling technique to improve the lifetime of WSN. Wireless communication among mobile users is getting more common than at any other time previously. Due to current technological advances in laptop computers and wireless data communication devices, for e.g. wireless modems and wireless LANs. Due results in lower prices and advanced data rates, which are the main reasons why mobile computing continues to enjoy rapid growth. Due to recent technological advances, the actual production involving small along with inexpensive sensors evolved into theoretically along with economically achievable.

Some execution measures that are used to ascertain the execution of clustering conventions are recorded underneath.

- Network lifetime: It is the interval (time) from beginning of operation (of the sensor network) until the passing of the first alive node.
- Number of cluster heads for every round: On the spot measure reflects the amount of nodes which would send straightforwardly to the base station, data totalled from their cluster members.
- Number of dynamic nodes for every round: This prompt measure reflects the aggregate number of nodes and that of each one sort that has not yet consumed the majority of their energy.
- Throughput: This incorporates the aggregate rate of information sent over the network, the rate of information exchange from cluster heads to the base station and also the rate of information sent from the nodes to their cluster heads. Figure 3.1 demonstrates the heterogeneous framework for wireless sensor network.

II. Material and Methodology

A. Literature Survey

Brahim Elbhiri et al. [4] proposed and assess a clustering system called a Developed Distributed Energy-Efficient Clustering technique for heterogeneous WSNs. This system is focused around changing progressively and with more proficiency the cluster head election probability. Simulation results demonstrate that this protocol performs superior to the Stable Election Protocol (SEP) by about 30%.
Parul Saini et al. [5] proposed EDEEC for three sorts of nodes in delaying the lifetime and network stability. Subsequently, it builds the heterogeneity and energy level of the network. Simulation results demonstrate that EDEEC performs superior to SEP with more solidness and successful messages.

Parul Saini et al. [6] proposed an energy effective cluster head technique, for heterogeneous WSNs, by changing the limit estimation of a node focused around which it chooses to be a cluster head or not, called TDEEC (Threshold Distributed Energy Efficient Clustering) protocol. Simulation results demonstrate that proposed algorithm performs better as contrasted with others.

Jun Wang et al. [7] **i**n this paper, the authors proposed a novel mixture circulated energy productive heterogeneous clustered protocol for wireless sensor networks (HDEEHC). The

HDEEHC protocol occasionally chooses cluster heads as indicated by a cross breed of an essential parameter and an auxiliary parameter.

Zhanyang Xu et al. [8] in this paper, a Density-based Energy-Efficient Clustering Heterogeneous Algorithm (DECHA) is proposed for routing. Taking after the contemplations of LEACH, the election probability of nodes to wind up cluster heads is assessed. Simulation results demonstrate that aggregate energy utilization is lessened and lifetime of the network is delayed contrasted and LEACH.

C. Divya et al. [9] in this work, LEACH is altered and created the new idea called MLEACH. This protocol is energy proficient for heterogeneous network. The execution was broke down by considering the time period and it demonstrates that the amount of alive nodes was less. Since the alive node is less the energy utilization is likewise less and in this way expanding the energy proficiency of the network. The relative examination was made between the current and the proposed technique. Simulation result demonstrates that the proposed strategy is more energy effective than the current protocol.

Nilima Rani Das et al. [10] showed that Wireless Sensor Networks (WSNs) were at first intended to encourage military operations yet its application has since been stretched out to wellbeing, movement, and numerous other customer and modern ranges. Various researches have been carried out to augment the life span, adjust the heap and enhance the energy proficiency of the WSN with insignificant extra overhead. This requires the effective association of the system topology. This paper examined the underlying outline standards and goals of some current energy proficient clustering algorithms.

M. Jagadeeswara Reddy et al. [11] proposed convention primarily concentrate on the key parameters of the sensor nodes which are delay the network lifetime, for example, average remaining energy of the each one cluster head keeping in mind the end goal to expand the network lifetime, energy dispersal of the sensor nodes.

Afroz Mansoori [12] studied about the WSN, a developing engineering for observing physical world. The energy obligation of Wireless sensor networks makes energy sparing and prolonging the network lifetime turn into the most vital objectives of different routing protocols. Distinctive energy effective clustering protocols for heterogeneous WSN and thinks about these protocols on different focuses like, clustering technique, position awareness, heterogeneity level and clustering attributes. It has been connected to address WSN issues, for example, ideal organization, node limitation and clustering &information accumulation.

D. Kumar et al. [13] proposed a novel Energy Efficient Clustering and Data Aggregation (EECDA) algorithm for the heterogeneous WSNs which joins the plans of energy productive cluster based directing and information total to attain a finer execution regarding lifetime and strength. EECDA convention incorporates a novel cluster head election system and a way would be chosen with greatest aggregate of energy deposits for information transmission rather than the way with least energy utilization. Simulation results demonstrate that EECDA equalization the energy utilization and draws out the system lifetime by a component of 51%, 35% and 10% when contrasted with LEACH, EEHCA and EDGA individually.

Ashok Kumar et al. [14] highlighted the energy productive operation of sensor node which is a key issue in WSN. Clustering is a successful technique to delay the lifetime of energy compelled WSNs. Be that as it may, clustering in WSNs confronts a few difficulties, for example, determination of an ideal gathering of sensor nodes as cluster, ideal choice of cluster head, energy adjusted ideal technique for pivoting the part of head in a cluster, keeping up intra cluster integration and ideal information routing in the network. This paper proposes an algorithm supporting an energy effective clustering, cluster head choice/revolution and information routing strategy to delay the lifetime of sensor network. Simulation results show that the proposed convention delays network lifetime because of the utilization of proficient clustering, cluster head choice/turn and information routing.

Vinay Kumar et al. [15] explored to augment network lifetime in WSNs the ways for information move are chosen in such a way, to the point that the aggregate energy devoured along the way is minimized. To help high versatility and better information conglomeration, sensor nodes are frequently gathered into disjoint, non-covering subsets called clusters. Clusters make progressive WSNs which consolidate productive use of constrained assets of sensor nodes and consequently grows network lifetime. The goal of this paper is to present an overview on clustering algorithms reported in the writing of WSNs. This paper displays a scientific classification of energy proficient clustering scheme in WSNs.

N. Sharma et al [16] proposed algorithm has shown a significant improvement over LEACH, E-LEACH, SEP and Extended SEP. The only difference among existing protocols and proposed algorithm is that proposed algorithm selects a node as cluster head only if it has maximum energy among other nodes in cluster during run time. The proposed algorithm is seems to be justified as heterogeneity of WSN nodes is also considered by introducing the normal, advance and intermediate nodes. The comparisons of proposed algorithm with existing algorithm are better in with respect to packets sent to cluster heads, when the first node dies and when all node become dead i.e. network life time.

B. Methodology

Selection of cluster-heads plays an important role while simulation and analysis of network model. The proposed work shows the optimal selection of cluster-heads based on weight values and considering various parameters like residual energy, average energy and shortest path. As the optimal probability is function of spatial density when nodes are distributed uniformly over the field, optimality will be achieved when energy consumption of nodes will be uniform over the area and overall

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energy consumption is minimum resulting in enhance network lifetime. This probability p_{opt} is further optimized by Genetic Algorithm. a weight value 'w' is calculated from Genetic fitness function which will be further utilized to calculate the optimal election probability. Flow diagram is shown below for cluster-heads election:

The steps in the run of the genetic algorithm for discovering an answer for an issue are recorded underneath:

1. Create a starting solution population of a certain size arbitrarily
2. Evaluate every result in the current generation and dole out it a fitness value.
3. Select "great" results focused around fitness value and toss the rest.
4. If adequate solution(s) found in the current generation or greatest number of generations is surpassed then stop.
5. Alter the solution population utilizing crossover and mutation to make another generation of solutions.
6. Go to step 2.

III. Results and Tables

Simulation is carried out using MATLAB 2010a:

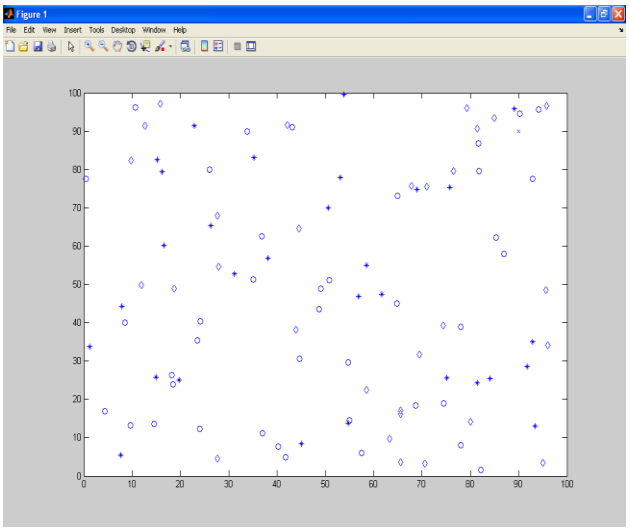

Figure 3.1: Network simulation for normal node, intermediate and advanced node

Figure 3.1 is representing the network simulation graph for normal node and advanced node. Where, the circular (o) shape represents the normal node and the star (*) shape represents intermediate nodes and diamond (◇) shape represents advanced node.

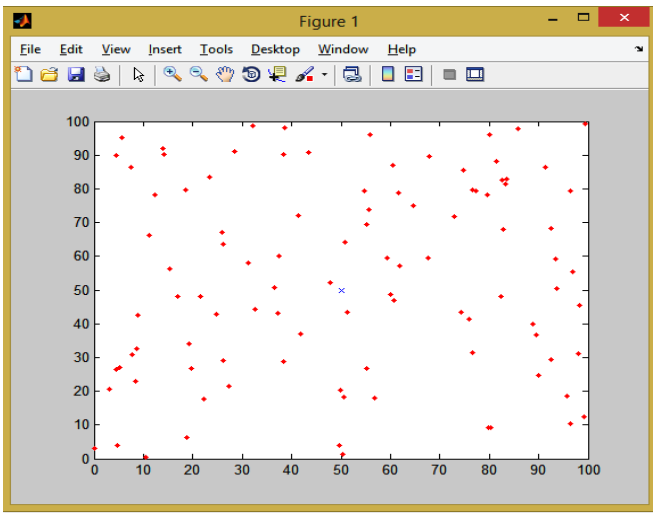

Figure 3.2: Number of dead nodes

Figure 3.2 representing all dead nodes represent by red diamond. Figure 3.2 also shows the dimension area of 100*100, there are 100 nodes and red diamonds shows node dead so far during the life cycle of wireless sensor network.

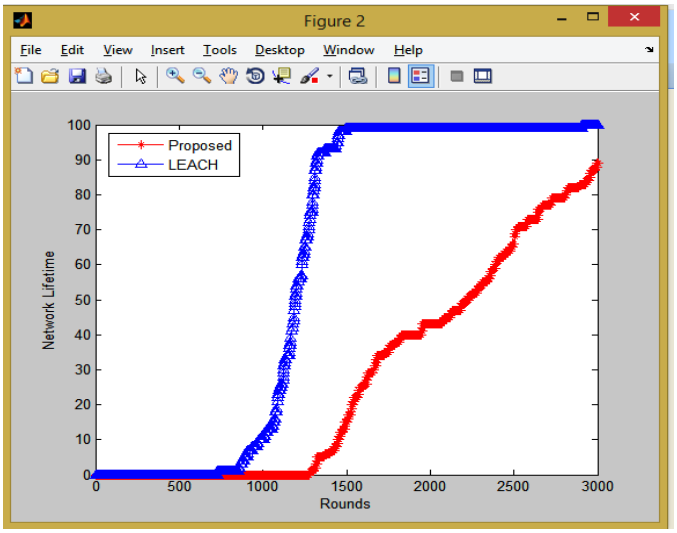

Figure 3.3: Network lifetime for GA-optimized Stable LEACH

Figure 3.3 is representing the comparison graph between Network lifetimes of LEACH algorithm and our proposed method. Where x axis shows the number of rounds used to send packets to the base station and y axis shows the number of nodes. In the figure we can see that our proposed method network lifetime has been improved.

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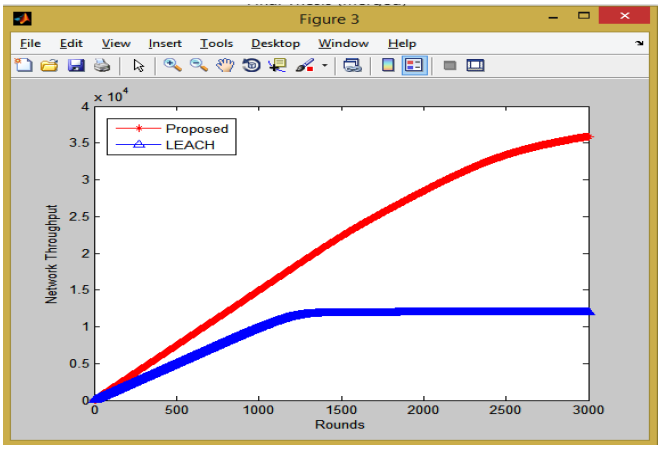

Figure 3.4: Throughput For GA-Optimized Stable LEACH

Figure 3.4 is representing the packets that are sent to cluster head. It illustrates the throughput from 0 rounds to 3000 rounds. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead. In the figure we can see that our proposed method network throughput has been improved.

Table 3.1: Performance comparison between S-LEACH and Proposed Method

Name of Algorithm	Nodes Dead			
	1%	20%	50%	100%
LEACH	720	1000	1100	2850
Proposed	1280	1500	2300	3000

Table 3.1 shows the comparison between result of S-LEACH and proposed method. Simulation performed on 100 heterogeneous nodes up to 3000 rounds.

IV. Conclusion

In this paper, we have inspected the existing state of proposed clustering algorithm, particularly concerning their power and reliability quality necessities. We have examined Stable LEACH and Genetic algorithm based Stable LEACH Protocol for heterogeneous WSNs containing different level of heterogeneity. Simulations prove that GA-optimized Stable LEACH performs well in all scenarios. We have examined Stable LEACH and Genetic algorithm based Stable LEACH Protocol for heterogeneous WSNs containing different level of heterogeneity. Hence we can say that the stable period of network is improved up to 15% and overall lifetime of network is increased up to 7% and Future work can be carried out to improve the ambiguity of this method using other optimization algorithms.

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