# Boltzmann Learning to Improve Lifetime of Wireless Sensor Networks

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**Abstract -** Wireless sensor network is the self-configuring networks; any sensor node can join or leave the network when they want. In Wireless sensor network no central controller is present, wireless sensor node are responsible for data routing in the network. Wireless sensor network is used to monitor the environmental conditions like temperature, pressure etc. we focus to reduce the battery consumption of the sensor nodes. In this work, a new technique is proposed to reduce battery consumption. It will be based on the dynamic clustering using neural network. Before data transmission sensor nodes form the cluster dynamically using Boltzmann learning of the neural network and weights are adjusting according to the situation and it also enhance the efficiency of the dynamic clustering. Experimental results show that new proposed technique is more efficient, reliable and provide more throughput as compare to the existing technique.

**Keywords -** WSN, Energy Consumption, Boltzmann learning

## I. INTRODUCTION

A wireless sensor network consists of a substantial number of nodes spread over a particular zone where we need to care for at the progressions going on there. A sensor hub by and large consists of sensors, actuators, memory, a processor and they do have communication capacity. All the sensor nodes are permitted to convey through a wireless medium. The wireless medium may both of radio frequencies, infrared or some other medium, obviously, having no wired connection. These nodes are sent in a random fashion and they can convey among themselves to make an ad-hoc network. Distributing sensing permits the nearer for positions the sensing nodes than a solitary sensor hub would allow. Appropriated sensing is done for finding the careful location if the location is obscure. To identify the environmental hindrances like obstructions, line of sight constraints and so on here multiple sensors nodes are utilized. As a rule, the environment to be monitored does not have a current framework for either energy or communication. It gets to be basic for sensor nodes to get by on little, limited wellsprings of energy and convey through a wireless communication channel. Distributed preparing ability is another prerequisite of sensor network. This is imperative since communication is a noteworthy consumer of energy it implies because of communication energy is more required than different operations. In incorporated frameworks, a portion of the sensor nodes are utilized for communication over long a separation that leads to more energy depletion and some sensor nodes are utilized for different operations. It would be a smart thought to handle locally however much information as could reasonably be expected keeping in mind the end goal to minimize the total number of bits transmitted. In sensor network engineering, we can convey in greatly substantial number of sensor nodes or devices. Sensor network consist of a sensor field, where the sensor nodes are conveyed that is physical environment, which is appeared in figure1.1. Sensor nodes ought to have an ease.

A minimal cost of device along these lines can be relied upon to have genuinely constrained computational and communication capacities, considering the way that sensing abilities are likewise to be incorporated into the device. Sensor nodes are sent in numerous applications, where human intervention is difficult to keep up the sensor hub. These sort of sensor nodes where human intervention is impractical there sensor nodes are work on constrained battery power. These batteries are not effectively supplanted. Sensor nodes have a restricted power, so they must be composed in such a way, that sensor nodes utilize the power proficiently. Sensor nodes naturally close down when they are not being used.

### 1.1 **Clustering of Sensor Nodes**

For sparing the energy of sensor nodes one of the clustering methodology is utilized. Through productive network organization every one of the nodes in sensor network can be partitioned into little groups is called clusters. In every cluster has a cluster head and rest nodes are individual from that cluster. Clustering results in a two-level order in which cluster heads shape the higher level while part nodes frame the lower level. The clustering includes grouping nodes into clusters and choosing cluster heads periodically such that individuals from a cluster can speak with their cluster heads and these cluster heads send aggregated data received from its individuals to a base station. Since the cluster head regularly transmit data over longer separations, they lose more energy compared to

part nodes. The clustering procedure is utilized to minimize the energy consumption. By utilizing clustering, it reduces the packet collision and channel contention it increases the network throughput under high load. Clustering enhance the network lifetime of the sensor networks. Lifetime is the essential element to assessing the execution of the sensor networks. The clustering approaches can't directly apply to wireless sensor networks, in light of the fact that these networks has one of a kind deployment and operational qualities. Wireless sensor networks are sent in ad hoc way they have a bigger number of nodes. In ad hoc networks nodes are unaware of their locations. Hence, distributed clustering protocols that rely only on neighborhood information are preferred for WSNs (in any case, most studies in this area still expect that the network topology is known not centralized controller).

## II. LITERATURE SURVEY

**R. Zhu, et al. [1]** suggested a Delay-aware and Collision-free MAC (DC-MAC) algorithm depending upon a game theory. A mixed transmission technique was employed which allowed nodes to dynamically adjust their access likelihood according to network size, and mitigate the collision possibility. Besides, the concept of Cluster Head (CH) degree was employed relied on number of CHs available in broadcast range of node. Additionally, the CH was assisted in scheduling collision-free data on received data information, CH degree, and propagation delays. A handshake cycle was employed to transmit the collision-free data among several nodes. The experiments depicted the supremacy of suggested algorithm for alleviating end-to-end latency (EEL) of 98% and enhancing packet delivery ratio (PDR) by 20%.

**H. M. Saleh, et al. [2]** introduced SG-IDS model that focused on utilizing machine learning (ML) models: Gaussian Nave Bayes (GNB) and Stochastic Gradient Descent (SGD) to address the issues related to detect assaults in Wireless Sensor Network (WSN). The context awareness was considered for providing applicability to recommendation algorithms. The principal component analysis (PCA) and singular value decomposition (SVD) were deployed on the raw traffic data to diminish load. The simulations were conducted on WSN-DS and IoMT datasets. The results revealed that the introduced model yielded an accuracy up to 98%, recall around 96% and F1-Measure around 97% on initial dataset, and accuracy up to 87% and precision around 100% on second dataset to detect intrusions.

**W. Zhang, et al. [3]** devised a reliable framework which authenticated and made the information reliable, and computed the reliability of nodes while transmitting data. This framework was focused on computing D-S evidence theory (DST)-based trust, and the trust evaluation and trust decision were employed for summarizing it. This theory was adopted for handling the ambiguity of trust factors of nodes in the distributed networks and maximizing the detection rate (DR) of spiteful nodes. Besides, the devised framework was simulated, and its 2 modified versions were described. The results indicated that the devised framework was robust against trust problem in resource constrained sensor nodes and made an optimal decision in network.

**Chae-Seok Lee et al. [4],** purposed Reservation Aloha for No Overhearing that is utilized to inform the tag of its viable communication for eliminate overhearing issue. extensive of energy is reduced because of overhearing is ordinarily bigger than consumed powerful communication .to eliminate this issue creator reason calculation (RANO). A tag has information about the time and duration of communication advance since it maintain active mode for kept the sleep mode because of other transmission period. RANO Protocol spare the 60 times energy than another protocol.

**LI Jian-qi et al. [5],** proposed enhanced clustering routing calculation which need to energy efficiency. To begin with, generate cluster head by random competition in the nodes which have advantage in energy; next determine the internal structure of clusters by calculating dynamically snugness coefficient of every cluster, after that, upgrade transmission path between cluster heads through enhanced multi-objective particle swarm calculation.

**Yu Wang et al. [6],** proposed energy productive and delay tolerant cooperative transmission calculation which demonstrate simulations approve that EDTCT outperforms the store-hold up forward way regardless of in E2E sleep dormancy and E2E energy consumption. Specifically, our plan is adaptive to thick network and it works effectively in low-obligation cycled WSNs.

**Degan Zhang et al. [7],** proposed a technique forward aware component (FAF-EBRM).this strategy is utilized for the following hop node chose according to the forward energy thickness and link weight .The FAF-EBRM compared with LEACH and EEUC. The proposed technique adjusts the energy reduction, function lifetime and give great nature of service and reduces the likelihood of progressive node breakdown.

**Nicolas Gouvy et al. [8],** proposed PAMAL (PATH MERGING ALGORITHM) new topographies routing calculation for mobile node .the proposed first routing protocol which is found and uses paths crossing to adapt the topology to reduce the network traffic thusly while still upgrade energy efficiency. The protocol makes the

intersection to move far from the destination, getting nearer to the sources, allowing higher data aggregation and energy saving. It enhances the network life time 37% than exiting.

## III. RESEARCH METHODOLOGY

Reclustering the grids with the help of neural networks in the main concern of our proposed work. In the existing technique the clustering of grids is static but in our proposed work, the clustering of grids is dynamic. The situations arising can change and adjust them accordingly. According to the situation and the calculations made on the basis of battery consumption the node data sent is easily adjustable. The major concern here is to avoid the battery wastage. The cluster head selection is also done on the basis of minimum battery consumption through election algorithm.

For instance, let us consider a network which has number of batteries placed in it each having the data send capacity in milliampere. Each battery available in the network forwards the data from source to destination with the help of AODV algorithm. There are three clusters and so their respective cluster heads are also present. The maximum sensing capacity and minimum battery consumption factors help in selecting the cluster heads. So the battery with both the mentioned factors is chosen as cluster head. Let us assume that the three batteries available in the network have the capacity of sending the data of 8 milliampere, 12 milliampere and 12 milliampere respectively. Now the cluster head is to be selected to send full data after it is dead. If the 12 milliampere battery is chosen as a cluster head, it will send our data successfully but is not sufficient for any other data transmission after it and thus proves to be wastage there. If the 10 milliamapere battery is chosen, there is wastage of 2 milliampere and so it cannot be used in the transmission of another data packet. When we chose battery of 8 milliampere capacity as a cluster head, the data can be sent through it completely. There is no wastage in it. For chosing the best path or route the mimimum battery wastage and minimum hop count factors are also to be kept in consideration. After the transmission of the data, battery will die. The reclustering of grid starts again in the network.

**Algorithm**

START ()

1. Deploy sensor network with fixed number of sensor nodes
2. Apply location based clustering to cluster sensor nodes
3. Select cluster head in each cluster using LEACH protocol
4. If (link failure occurred in the network)
   {
   1. Apply Boltzman learning to rate sensor nodes
   2. Recover path through sensor nodes which has higher rating

   }
   Else
   {
   1. Start communication from source to destination

   }

## IV. RESULT AND DISCUSSION

Figure 1: Cluster heads start communicating

As illustrated in the figure 1, deployment of finite number of sensor nodes is observed in the wireless sensor network. The information is sensed and passed to the sink by the sensor nodes. Fixed size clusters are formed in whole of the network and the clustered data will be aggregated to the cluster head. The information is passed to the sink through the cluster head. The data communication starts between the cluster heads. The data from its near cluster head is received by the sink. Further the cluster heads are changed. The new cluster heads are selected, and cluster heads start communicating with each other.

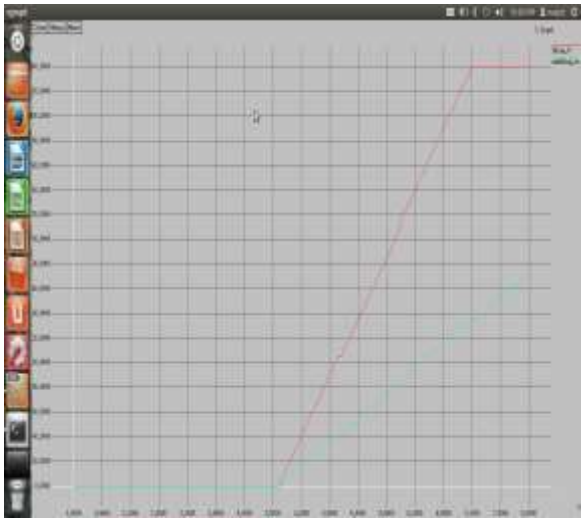

Figure 2: Delay graph

As illustrated in figure 2, the Delay graph has been plotted. This graph shows the delay of previous method and the delay observed in the new proposed work. The performances are compared. The results show that the delay in the new proposed work is reduced by 30% due to fault removal in the network.

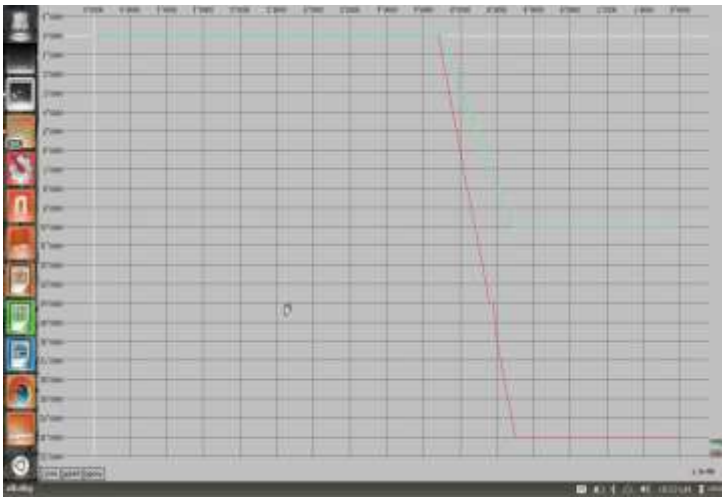

Figure 3: Energy Graph

As shown in figure 3, the energy consumption of the previous and new proposed work is compared. Due to the more fault in the network, the graph clearly shows that the energy consumption is more in the previous network. When fault is removed from the network, energy consumption is reduced from the network.

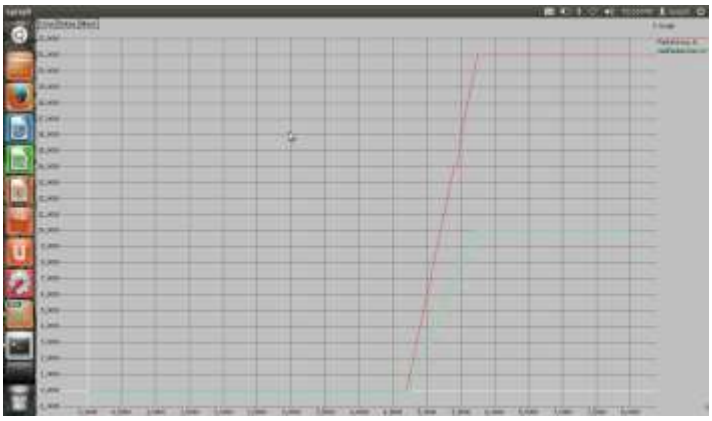

Figure 4: Packet loss Graph

As shown in figure 4, packet loss for the previous and new proposed work is compared. It is clearly seen in the graph that the packet loss in the previous work is more. It is due to the fault in the network and when this fault is removed from the network, the packet loss also gets reduced.

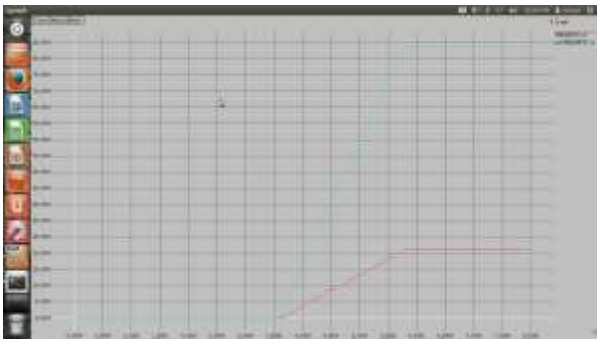

Figure 5: Throughput Graph

As shown in the figure 5, the throughput of the new and the previous work is compared. The throughput of the old scenario is reduced due to the fault in the network. If the fault of the network is recovered, the throughput of network increases accordingly.

## V. CONCLUSION

Wireless Sensor Network is one of the categories of infrastructure less network. Wireless Sensor Network is an application based network. It is used to monitor environmental conditions like temperature, humidity etc. But in this research work, clustering of grid is dynamic. It can be adjustable and changeable according to the situation. In this node data which is send can be easily adjustable according to the situation and calculation made on the basis of battery consumption. Here main concern is to avoid battery depletion. The cluster head is also choosing according to the minimum

battery consumption by applying election algorithm. Suppose there is a network in which number of batteries a replaced. Each battery has the data send capacity in mill ampere. It is considered that there are number of batteries available and each battery further forward data from source to destination. The routing algorithm which we have used in this work is AODV. There are three clusters having three cluster head. Cluster heads are chosen according to the maximum sending capacity and minimum battery consumption of the node. The implementation of this research work has done in Ns2 and simulation results show that novel technique has increased the network throughput and network lifetime.

## VI. REFERENCES

[1] R. Zhu, L. Liu, P. Li, N. Chen, L. Feng and Q. Yang, "DC-MAC: A Delay-aware and Collision-free MAC Protocol Based on Game Theory for Underwater Wireless Sensor Networks," in IEEE Sensors Journal, vol. 17, no. 4, pp. 16-24, 2024

[2] H. M. Saleh, H. Marouane and A. Fakhfakh, "Stochastic Gradient Descent Intrusions Detection for Wireless Sensor Network Attack Detection System Using Machine Learning," in IEEE Access, vol. 12, pp. 3825-3836, 2024

[3] W. Zhang, H. Sun, W. Fang, C. Zhu and G. Jia, "Trust Evaluation and Decision Based on D-S Evidence Theory: Early Models and Future Perspectives," in IEEE Access, vol. 11, pp. 16032-16041, 2023

[4] Chuan Zhu, Shuai Wu, Guangjie Han, Lei Shu and Hongyi WU," A Tree-Cluster-Based Data-Gathering Algorithm for Industrial WSNs with a Mobile Sink", 2015 IEEE, Volume 5, Issue 7, pp- 364-372

[5] Jiang, L., Bing Fang, & Li, "Energy optimized approach based on clustering routing protocol for wireless sensor networks", 2013, IEEE, volume 15, issue 7, pp- 331-342

[6] Wang, Y., & Guo, S., "Optimized energy-latency cooperative transmission in duty-cycled wireless sensor networks", 2013, Mechatronics and Automation (ICMA), IEEE International Conference, volume 11, issue 8, pp. 185-190

[7] Zhang, D., Li, G., Zheng, K., Ming, X., & Pan, Z. H., "An Energy-Balanced Routing Method Based on Forward-Aware Factor for Wireless Sensor Networks. Industrial Informatics", 2014, IEEE Transactions on, volume 10, issue 1, pp- 766-773

[8] Gouvy, N., Hamouda, E., Mitton, N., & Zorbas, D, "Energy efficient multi-flow routing in mobile Sensor Networks", 2013, Wireless Communications and Networking Conference (WCNC), volume 2, issue 18, pp. 1968-1973