

Optimizing the Clustering Process using Relay Nodes to Improve the Lifetime of the WSN

Mandeep Sidhu* and Manpreet Singh

Department of ECE, BGIT Sangrur - 148001, Punjab, India;
mandeep.sidhu180887@gmail.com, manpreet4panesar@gmail.com

Abstract

The nodes in wireless sensor networks are usually deployed in the areas where human approach is very difficult. In such cases, the deployment of the nodes tends to be random from topological point of view. The main thing that needs to be given importance in such kind of networks is their lifetime which tends to be very less as the nodes are battery operated nodes. So if any of the sensors dies out because of energy drainage it is very difficult to come up with their replacement. The replacement of the drained out sensor nodes tends to become a costly affair. In such scenarios the focus must be given on reducing the energy consumption of the sensor nodes so that they can transfer the data over a longer period of time. The solution to this is clustering of the nodes in groups based on some rules that would eventually increase their working time in the network. The rules laid out for clustering is usually defined in LEACH protocol that tends to form the clusters and select their leaders randomly using threshold criterion. However, the clustering of the network results should be optimal enough such that all the nodes are included in the cluster. This paper explores the clustering protocol and aims to optimize the clustering process to improve the lifetime of the network. The proposed scheme has shown better performance in terms of energy consumption, packet delivery ratio and throughput.

Keywords: Clustering, Packet Delivery Ratio, Throughput, LEACH

1. Introduction

Wireless Sensor Networks (WSN) have increased overall consideration as of late because of the advances made in remote correspondence, data advances and hardware field. The idea of wireless sensor systems depends on a straightforward condition: Sensing + CPU + Radio = Thousands of potential applications. It is a detecting innovation where small, self-governing and minimal gadgets called sensor nodes sent in a remote territory to recognize events, gather and process information and transmit detected data to clients. The advancement of minimal effort, low-control, and a multifunctional sensor has gotten expanding consideration from different commercial ventures. Sensor nodes in WSNs are little estimated and are fit for detecting, assembling and handling information while speaking with other associated nodes in the system, by means of radio. WSN term can be extensively detected as gadgets reach from portable workstations, PDAs or cell telephones to

extremely little and basic detecting gadgets. At present, most accessible remote sensor gadgets are significantly obliged as far as computational force, memory, productivity and correspondence abilities because of financial and innovation reasons. That is the reason the vast majority of the exploration on WSNs has focused on the configuration of vitality and computationally productive calculations and conventions, and the application space has been bound to basic information situated checking and reporting applications. In the event that WSNs nodes are all the more capable or mains-fueled gadgets in the region, it is helpful to use their calculation and correspondence assets for complex calculations and as doors to different systems¹

Clustering sensor nodes is a successful topology control technique to reduce energy consumption of the sensor nodes for maximizing lifetime of WSNs. Clustering the nodes has many advantages, such as scalability, energy efficiency and reducing routing delay. Cluster based routing involves the creation of clusters,

* Author for correspondence

election of cluster heads and routing through the Cluster Heads (CH). The energy can be conserved more by the CH by collecting the data in the cluster, compressing it and then transmitting the aggregated data to the base station. The two imperative steps in clustering scheme are CH determination and cluster formation. Improperly designed clustering algorithms can cause nodes to become isolated from CHs as shown in Figure 1. Communication of these isolated nodes with the sink will consume more energy. If the sink is far away from these isolated nodes, then isolated nodes cannot directly communicate with the sink. If these isolated nodes are not in the range of nearby current cluster heads, then isolated nodes cannot communicate with the current cluster head also. This paper presents the brief study about past researches that have been by various authors in Section 2. Further, Section 3 represents the proposed work and finally section 4 and 5 represents results and conclusion part.

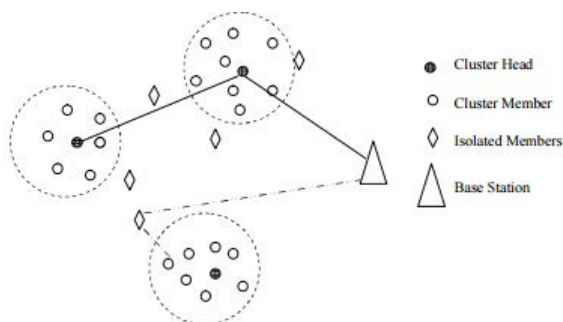


Figure 1. Wireless sensor network with isolated nodes².

2. Existing Work

A reasonable clustering algorithm for gathering sensor nodes can build the vitality productivity of WSNs³. Notwithstanding, clustering requires extra overhead, for example, cluster head choice and task, and cluster development. This paper proposes another provincial vitality mindful clustering technique utilizing detached nodes for WSNs, called Regional Energy Aware Clustering with Isolated Nodes (REAC-IN). In REAC-IN, CHs are chosen in view of weight. Weight is resolved by leftover vitality of every sensor and the territorial normal vitality of all sensors in every cluster. Dishonorably planned circulated clustering algorithms can make nodes get to be detached from CHs. Such detached nodes speak with the sink by devouring abundance measure of vitality. To drag

out system lifetime, the provincial normal vitality and the separation amongst sensors and the sink are utilized to figure out if the detached node sends its information to a CH node in the past round or to the sink. A WSN is a blend of remote correspondence and sensor nodes. The system must be vitality proficient and stable, and have a long lifetime. The REAC-IN convention displayed in this paper enhances the cluster head determination handle and takes care of the issue of node isolation. The outcomes uncovered that the execution of the algorithms utilized as a part of REACIN to enhance the lifetime and dependability of a system is more good than that of the algorithms utilized as a part of different conventions.

Author in⁴ proposed proper organization of nodes becomes one of the major techniques to expand the life span of the whole network through aggregating data at the Cluster Head (CH). LEACH (Low Energy Adaptive Clustering Hierarchy) and PSO (Particle Swarm Optimization) are applied for producing energy-aware clusters with optimal selection of cluster head. The determination of a group head utilizing PSO minimizes the intra cluster separation between group head and the cluster part, and the improvement of vitality administration of the system. From the recreation results, it is seen that Vitality Mindful Optimal cluster head choice utilizing PSO approach builds the system lifetime of the group in such a route by diminishing the aggregate vitality utilization than Drain execution.

In this paper, they inspect at present proposed clustering algorithms for Wireless Sensor Networks⁵. They examine the operations of these algorithms, and also draw correlations on the execution between the different plans. The present state of proposed clustering conventions, particularly as for their energy and unwavering quality necessities. In remote sensor systems, the vitality confinements of nodes assume a significant part in outlining any convention for execution. Likewise, Nature of Service measurements, for example, delay, information misfortune resistance, what's more, system lifetime uncovers dependability issues when outlining recuperation systems for clustering plans.

Author in⁶ proposed technique in which they join the enhanced molecule swarm grouping calculation with the between bunch directing calculation to shape a versatile vitality proficient grouping directing convention, alluded to as AECP. Reenactment results demonstrate that this convention not just adjusts the vitality utilization of the

general system, postpones the demise time of the nodes, and additionally gives more dependable information conveyance.

Author in⁷ proposed improvement in leach protocol using a novel algorithm to select cluster heads with highest and balanced energy in wireless sensor networks and choose the cluster heads with highest energy. Cluster head collect the data and send it to base station without considering security. Here RSA algorithm is used to secure the packets during send to both cluster head and base station.

Author in⁸ proposed the self-knowledge technique in which SCHP (Sub Cluster Head Protocol) is used to reduce delay occurs in link stability problem in SCHP. Each node knows about its neighbors by using its self-knowledge. Receiver will send its receiving capacity and sender will send data according to that capacity. So link becomes more stable. In Self-knowledge technique sender keeps the information regarding its one hop neighbors. All-important parameters like delay, threshold, packet size, energy are considered before sending data to the next node. A minimum criterion is set for all the parameters, among all the neighboring nodes the nodes satisfying this minimum criterion are considered for the candidates of relay node. Among these nodes the node with lowest delay and maximum energy is chosen as relay node. If this node dies after sometime then the next eligible candidate is chosen as relay node and attempt is made to reconfigure the dead node. This technique provides a better link stability than simple SCHP by avoiding congestion in the link because the sender sends the data according to the receiving capacity of the receiver. So the time and energy wasted in reestablishing the link that can be lost due to congestion is saved that accounts in increasing the lifetime and reducing the delay.

Author in⁹ the creator has proposed a tree structure established at the sink is characterized. Contingent upon different components, including the WSN topology and the accessibility of assets, the vitality utilization of nodes in various ways of the information accumulation tree may differ to a great extent, in this way influencing the general system lifetime. This paper addresses the issue of lifetime amplification of WSNs in view of information accumulation trees. we propose a novel furthermore, proficient algorithm, called Randomized Switching for Augmenting Lifetime (RaSMaLai), that goes for developing the lifetime of WSNs through load adjusting. Given an introductory information accumulation tree,

RaSMaLai arbitrarily switches some sensor nodes from their unique ways to different ways with lower stack. We demonstrate that, under fitting settings of the working parameters, RaSMaLai joins with a low time many-sided quality. In light of the idea of limited adjusted trees, our algorithm arbitrarily switches the information sending ways of nodes. We have given a basic yet compelling exchanging procedure that outcome in a quick merging. We have additionally introduced a disseminate usage of our plan that has a low overhead. A broad study through both recreations and investigations on a genuine WSN test affirmed that our approach can altogether increment the system lifetime with a lower time intricacy than the present cutting edge in a wide range of working conditions.

3. Proposed Work

According to the proposed scheme the network will be first grouped into clusters. The process followed will be the one defined in traditional clustering protocol LEACH but here the probability for each node will be driven by their residual energies as described in³.

Once the clusters have been formed, the nodes which have not received advertisement message from the cluster will be provided with the relay nodes in a centralized manner by the base station. The base station will check on the unconnected nodes, and will find the closest cluster member to them. Once closest member is found within the range of the unconnected node, base station informs it to become relay node for the unconnected node. Thus, the unconnected node can relay the data through the newly connected member node.

4. Results

The whole scheme has been implemented in NS2.35. The parameters used for simulation has been shown in the table below:

Table 1. Simulation parameters

Parameter	Value
Channel	Wireless
Propagation Model	Two Ray Ground
Mac	802.11
Number of nodes	100
Queue	Drop Tail
Antenna	Omni Directional
Initial Energy	10 J
Area	600 * 600 sq. m

The comparison was done on the basis of energy consumption, throughput, packet delivery ratio and number of uncovered nodes.

The energy consumption signifies the network lifetime, as lesser is the energy consumed in the network more is the lifetime and vice-versa.

Packet delivery ratio is the percentage of the packets successfully delivered in the network. Mathematically it is ratio of number of packets received to the number of packets sent in the network.

Throughput is defined as the amount of data received at the base station per unit of time.

The graphs shown below represent the values of these parameters achieved by simulation of the network under existing scheme and the proposed scheme.

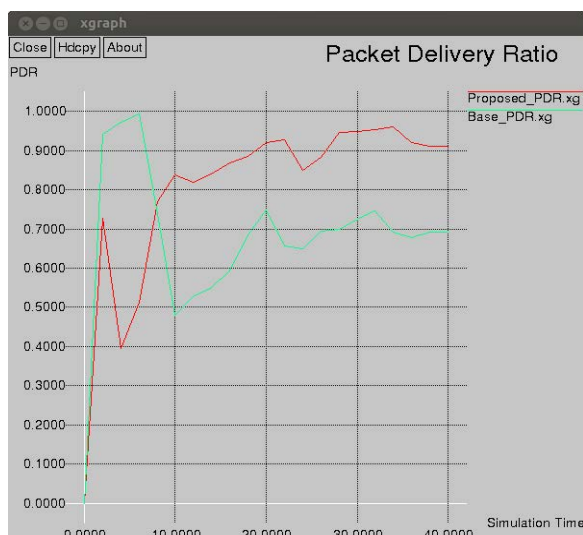


Figure 2. Packet delivery ratio comparison.

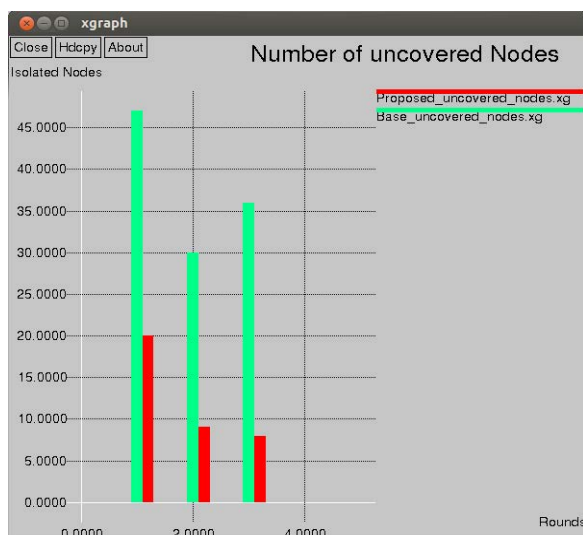


Figure 3. Comparison of number of uncovered nodes.

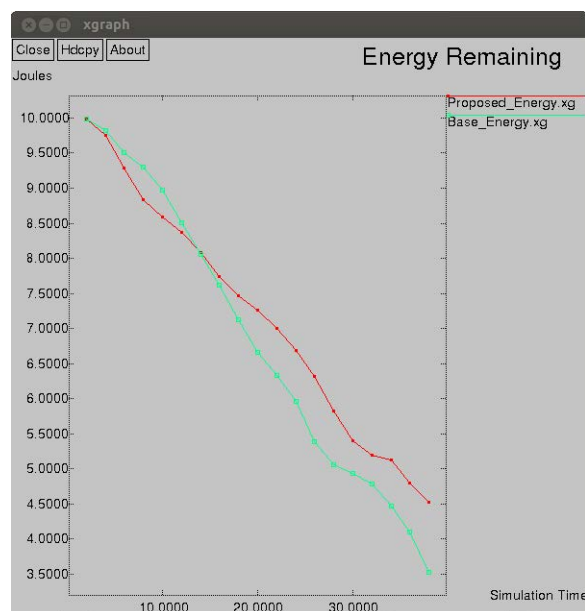


Figure 4. Energy remaining comparison.

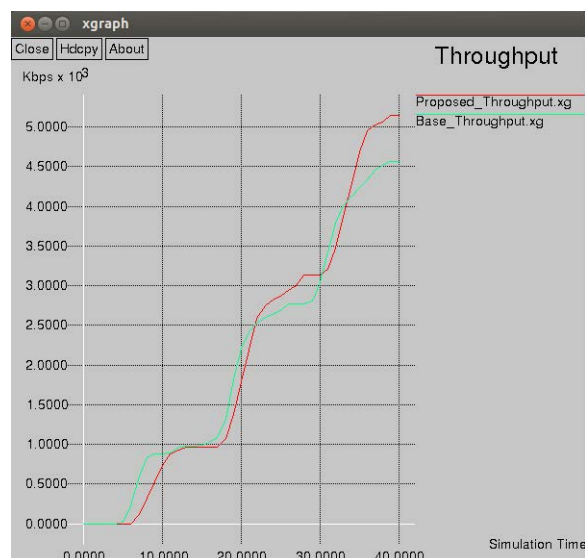


Figure 5. Throughput comparison.

5. Conclusion

The comparison was done on the basis of four parameters; all these showed an improvement over the existing scheme. Figure 3 shows that number of unconnected nodes in the proposed work has been less. Thus it can be fairly concluded that more and more number of nodes have been provided connectivity by the relay nodes to forward the data. This eventually reduces their communication distance with the base station. This results in lesser energy consumption in the network. Also, over a shorter range

communication the packets are transmitted correctly, thus leading to improvement in packet delivery ratio as well as throughput of the network.

In future, this scheme can be analyzed against various security attacks that wireless sensor network is prone to.

6. References

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