Energy Efficient Cluster Based Data Aggregation Technique In WSN

Naina Boricha[1], Prof. Vaseem Ghada[2]

[1]*Computer Engineering, B.H.Gardi College of Eng. and Tech, Rajkot*
[2]*Computer Engineering, B.H.Gardi College of Eng. and Tech, Rajkot*

Abstract — Wireless sensor network is used for health monitoring, environment monitoring and controlling applications. Sensor nodes are very small devise and it has limited functional capabilities. Limited battery power is the major constraint because if sensor node die, it will decrease network lifetime. So to increase network lifetime, must think about less energy consume by sensor nodes. It is possible using data aggregation which reduced redundancy from data and less no of data transfer to the base station, it increase network lifetime. In this paper we proposed a technique which use residual energy and location to the base station to select the CH and also use AVG (AVERAGE) function for data aggregation. Also check than size of cluster be almost similar. We compare experimental result of proposed algorithm with LEACH protocol.

Keywords- Wireless sensor network (WSN); Data aggregation; Redundant Data; Energy; Clustering.

I. INTRODUCTION

Wireless sensor network (WSN) acquire more attention for research area now a day, because word is going to become smart, people wants to control all the things remotely. There are wide ranges of application of WSN like home automation, e-agriculture, health-care monitoring, pollution control and monitoring etc [1]. A sensor devise has four units sensing, processing, communication and power supply. The sensor nodes are very tiny devise with limited functional capabilities. It has limited power, limited computing resource and processing unit. Sensor nodes are used to sense the field, collect information like temperature, pressure and humidity and pass it to the base station [2]. There is no possibility of recharge or replace battery. Sensor nodes are arrange close to each other in sensing field, that's why values sensed by them also approximately same and the 70% of sensor node's energy consumed by transferring those similar values at the base station directly. To increase the network lifetime, must require to decrease numbers of transactions between sensor nodes, for that data aggregation becomes crucial thing. Data aggregation is a technique which used to reduce transactions by removing redundancy from data. Data aggregation algorithms in WSN used to reduce the numbers of packets and combines packets from different sensor nodes. Aggregation can done through different mathematical functions SUM, AVG, MIN, MAX and MEDIAN [3]. Using this functions tries to minimize Energy Consumption, transmission cost and communication bandwidth, Increase network lifetime. There are several aggregation techniques like In-network Aggregation which divides sensor field different structure ex. grid for data aggregation. It gives improvement in energy if nodes are stationary, but not work efficiently with mobile nodes [4]. In Tree based approach data aggregation done at every parent node, through this network lifetime increase, but disadvantage is if parent node fail, cause data loss [5]. Chain based approach performs aggregation in route. Better for energy consumption but limitation of intermediate node failure. Cluster based aggregation more suitable because if any CH fail, it doesn't affect the functionality of network [5]. In this papers we used Cluster Based data aggregation, in which nodes are arrange in cluster and one CH is selected for every cluster, CH collect data from member nodes and transfer to base station. The remaining paper is organized as follows. Section - II deals with the literature review. Section – III Present the details of proposed algorithm. In section - IV, we discuss the simulations. Finally we conclude this paper with section – V.

II. LITERATURE REVIEW

Cluster based data aggregation is introduced by many researchers. It is one of the best solutions to manage the energy efficiency in sensor networks. Sensor nodes are arrange into clusters, each cluster have one "Cluster Head". The communication insides a cluster travel through the cluster head, which is then transferred to a neighboring cluster head until it reaches its destination which is known as the base station.

Low Energy Adaptive Clustering Hierarchy (LEACH) [7] is first and popular cluster based data aggregation algorithm. LEACH algorithm operates in two phase: Setup phase followed by Steady state phase. In setup phase nodes organized into clusters and one CH is selected for every cluster. CH selection is based on the threshold value, calculated based on probability to become a CH (Pi). Nodes generate random values between 0 and 1, the nodes which having random value less than threshold becomes a CHs. At steady state phase actual transmission of data occurs. All nodes send their data to respective CH according to their allocated TDMA time slots and then CHs aggregate the data and send it to base station. However, LEACH algorithm has drawback numbers of nodes becomes CH can't be predicated and clusters are not evenly distributed because of random no generation.

LEACH uses the distributed algorithm for clustering so it gain the low clustering and low performance. So, the same authors have introduced the LEACH centralized (LEACH –C) algorithm. In this protocol, cluster formation is performed in a centralized approach. All the nodes send their details on remaining energy and location to the BS. The BS uses the simulated annealing algorithm for the set up phase. Steady state phase is similar to LEACH protocol [8].

In paper [9] author proposed Clustered Aggregation (CAG) technique, it is based on Spatial and Temporal correlation. Cluster formation is based on the spatial correlation means the nodes which sense similar values join same cluster and those clusters remains unchanged whenever the sensor values stay within a threshold over time it call temporal correlation. CAG operates in two phase: interactive and streaming. In the interactive mode CAG give a single set of responses for a query. In the streaming mode, periodic responses are generated in response to a query. The interactive mode of CAG use only the spatial correlation of sensed data. The streaming mode of CAG takes benefits of both spatial and temporal correlations of data. CAG can reduced a significant number of transmissions by discarding global communications and organizing clusters only using local communications.

In paper [10] author present K-means algorithms which is available method to form clusters. Many of existing algorithms used centralized algorithms to form K clusters but it takes more time. But K-means algorithm is better to form equal size clustering in efficient time.

III. PROPOSED SYSTEM

In existing cluster based techniques CHs send data directly to the base station it consumes more energy. Also the drawback is various size of clusters, some have large no of nodes and some have few nodes only 5% compare to others. Proposed algorithm work in three phase: Cluster Formation, Data Transmission and Aggregation Phase.

1) **Cluster Formation:**

   Step: 1 CH selection is based on 1) Residual Energy > 15%, 2) Location of the nodes.

   Step: 2 CH send advertisement message to member nodes.

   Step: 3 Member nodes send join message to the CH according to the signal strength. CH accept only limited numbers of join message (based on no nodes) because we used equal size clustering schema.

   Step: 4 CHs generate TDMA schedule for member nodes

2) **Data Transmission:**

   Step: 5 Member nodes send data according to their time slot to the respective cluster head.

3) **Aggregation Phase:**

   Step: 6 CHs used AVG (Average) function for aggregation.

   Step: 7 CHs send data to the BS.

From this technique improves the energy efficiency and network lifetime.

IV. SIMULATION STUDY

In this section we discuss the simulation study and performance evaluation of the proposed technique. Wireless sensor network simulator NS-2.27 is used to evaluate our proposed method. In our simulation model, 100 sensor nodes are randomly deployed in a field with dimensions 1000m x 1000m. Remaining parameters are listed in TABLE 1.

TABLE 1. Simulation Parameter

PARAMETER	VALUES
Initial Energy	2 J
Base Station Location	(50, 175)
Probability of numbers of Cluster heads	0.05
Communication Using	TDMA

We have compared our results with LEACH protocols. Energy is one of the major issues in wireless sensor network. Fig.1 shows the energy consumption of the network. In LEACH protocol, clusters are not evenly distributed so the cluster members spent more energy to transmit a packet to its cluster head. But in our algorithm, CH selection is done based on energy and location to based station and also used equal size clustering schema. Thus all the clusters are evenly distributed so that all the cluster members are closer to its cluster head. So the energy consumption for proposed algorithm is less than the energy consumption for LEACH protocols.
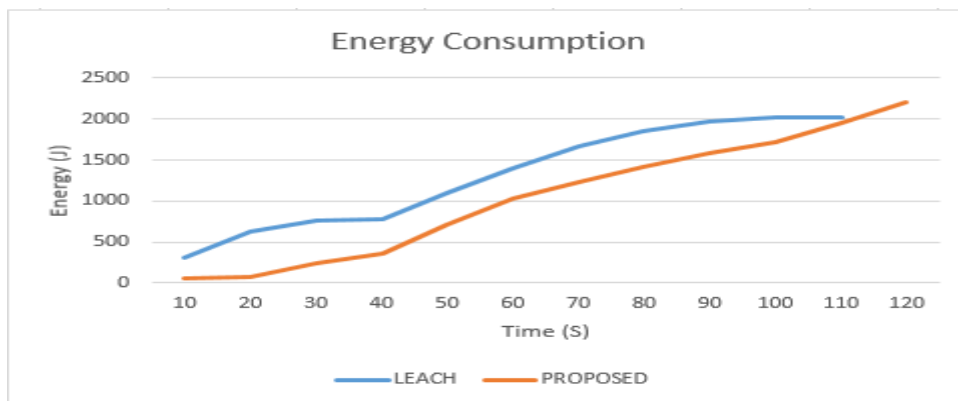

Figure 1. Energy Consumption

Large numbers of redundant data transfer from one sensor node to other which consumes most of energy of sensor nodes. In LEACH protocol CH combine member nodes data and forward directly to the base station which require more energy. But in our algorithm data are first aggregated at CHs and only a small aggregated data is forwarded to BS. For aggregation we used AVG (AVARGE) Function. . Fig.2 shows the no of packet transfer to the base station is less than LEACH protocol because of aggregation.
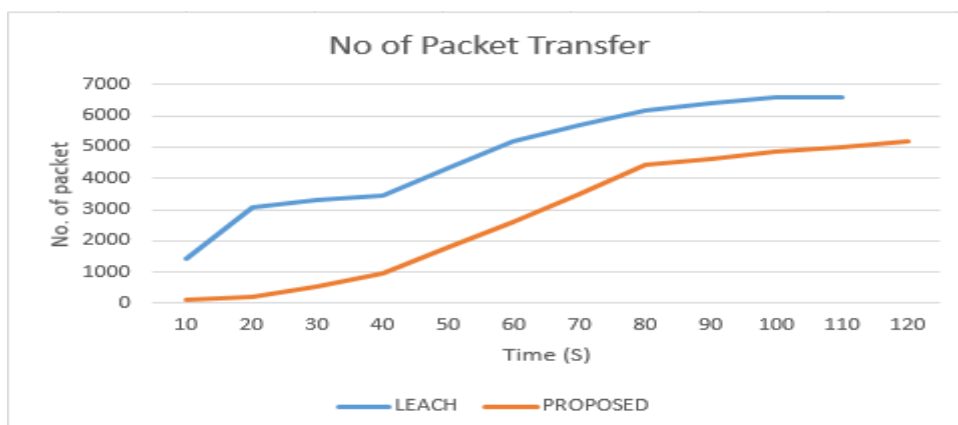
Figure 2. No of packet transfer

If any node drain out his energy than he is no more in the network and if large no of nodes dies in the network than network lifetime is decrease. For that we used data aggregation technique to increase network lifetime. Fig.3 shows the no of live node at particular time is less in LEACH protocol but in our approach more live nodes at particular time.
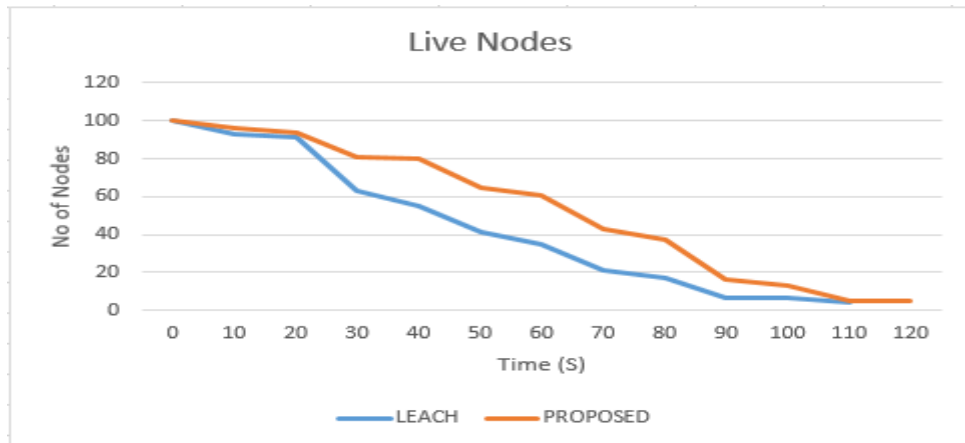
Figure 3. No of live nodes

V. CONCLUSION AND FUTURE WORK

In this paper we proposed the cluster based data aggregation algorithm using AVG aggregation functions to reduced number of packets generated by the nodes in the network. The proposed algorithm also create approximately equal size clusters. Aggregation is necessary for increase network lifetime. Simulation results show that by changing average energy consumption reduces. Also seen that packet count reached to the base station reduces with aggregation as compared to without aggregation which indicates the improvement in bandwidth utilization and communication cost. Also the no of live nodes is more in proposed algorithms than LEACH protocol. The future work is used different aggregation technique than aggregation functions.

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