Threshold Based Stable-LEACH in wireless sensor network

Vinay Bhardwaj[#1], Prof. Sandeep Wraich[*2]

[#]Guru Nanak Dev University*

Amritsar, India

Abstract

Clustering is a key routing technique used to reduce cont**energy consumption. Clustering sensors into groups, so that sensors communicate information only to cluster heads and then the cluster-heads communicate the aggregated information to the base station, saves energy and thus prolonging network lifetime. In this paper we propose an energy efficient cluster-heads selection algorithm through thresholding. Threshold Based Stable-LEACH model is extension of LEACH's algorithm. TS-LEACH concentrates on cluster-heads selection by applying the threshold. So only those nodes will become cluster heads who's energy is more or equal to the threshold and then after normal nodes are selected as a cluster heads. Simulation is done in matlab which show that our proposed model is better and prolong the lifetime of the network.**

Keywords : Clustering based algorithm, Energy efficiency, threshold, LEACH protocol, lifetime, wireless sensor networks.

1. INTRODUCTION

Wireless Sensor Networks (WSN) are networks of typically small, battery-powered, wireless devices equipped with on-board processing, communication, and sensing capabilities. These are also called self configurable networks, building and maintaining huge and diverse network topologies requiring little or no human intervention[7].

Sensor nodes can networked to gather sensor data and each sensor will performs two main responsibilities, namely, sensing activities, and routing the data to the base station or controller[1]. An inefficient use of the available energy leads to degrade the performance and reduce life cycle of the network. To this end, energy in these sensors is a scarce resource and must be managed in an efficient manner[8]. In recent years, the observation and rol of physical phenomena have been made possible due to the emergence of wireless sensor networks (WSNs).

In addition, it is difficult, even impossible toreplace the batteries of sensor nodes because the deployment environment is hostile or inaccessible or the network density is including thousands or more sensor nodes. It is therefore necessary to devise suitable routing protocol so efficiently of the valuable energy supplied by exhaustible batteries. Many routing algorithm have been proposed for wireless sensor networks. Each protocol is adapted to a specific situation and must take into account the type of the application, the data delivery model, the topology of the network and also improve the life time of the network etc.

The goal of most of hierarchical routing protocols is to optimize the consumption of energy in order to prolong the life to the network. However, some of the protocols are designed to improve the quality of service and to minimize the time of transmission to improve overall performance of the network[5].

2. RELATED WORK

The main task of a sensor network is to forward the sensored data gathered from the nodes to the base station or controller. One of the simple approach to the fulfillment this task is direct data transmission. In this case, sensor nodes communicate with the base station. However, if the base station is remote from the sensor node, the node will soon die due to excessive energy consumption for delivering data[7]. To solve this problem, some algorithms aimed at

saving energy have been proposed like clustering algorithm.

[1]. elaborate the extra transmission problem that can occur in LEACH. Data generated is redundant and highly correlated and usually enormous for the BS (Base Station) to process. To solve these problem, they use data aggregation in sensor node because this technique involves the fusion of data from multiple sensors at intermediate nodes and transmission of the aggregated data to the BS. This technique can eliminate redundancy, minimize the number of transmissions and thus save energy. The result will show that the energy consumption of the network decrease and also increase in network lifetime for LND(Last Node Dies).

[2]. Discuss about improving the energy efficiency to prolong the network lifetime. Clustering is an effective topology control approach in wireless sensor networks, which can increase network scalability and lifetime. They have discuss a novel clustering schema EECS for wireless sensor networks, which better suits the periodical data gathering applications. In this they elects cluster head with more residual through local radio communication while achieving well cluster head distribution. The result will show the network lifetime prolong with 35% than LEACH.

[3]. Discuss about an improvement on the LEACH Protocol by dividing cluster into 7 subsections that are called cell. Also every cell has a cell-head. Cell-head communicate directly with cluster-head, also computation of threshold value for selecting cluster-head are change in this algorithm. A Cluster and cell based routing protocol will consider the residual energy of nodes to extend the lifetime of sensor network The result using JISM simulator show that cell-LEACH perform better than LEACH and LEACH-C.

[4]. Discuss about improvement in LEACH protocol by reforming Clusters named C-LEACH in Wireless Sensor Networks LEACH (Low Energy Adaptive Clustering Hierarchy) protocol randomly selects a few nodes as cluster heads based on a probability model. The probabilistic approach leads to the formation of unequally sized clusters which leads to imbalance in energy consumption across the network and thereby reduces the efficiency and network lifetime. They propose an improvement of LEACH algorithm called Equalized Cluster LEACH(C-LEACH) which initializes and maintains uniformly sized clusters located uniformly across the network

[5].In this paper they discuss about the extend network lifetime and minimize additional overheads in energy limited sensor networks, they propose CH selection algorithm which selects CH by utilizing only its information. And also evaluate the performance of this scheme by using simulation, and show that the proposed scheme considerably improves network lifetime in WSN. The Proposed scheme is the ECS (Energy efficient Cluster header Selection) algorithm which selects CH by utilizing only its information to extend network lifetime and minimize additional overheads in energy limited sensor networks.

[6]. This paper elaborate the energy efficient clustering algorithm for WSN based on Low Energy Adaptive Clustering Hierarchy (LEACH) which will remove some of the drawbacks of LEACH, And also focuses on the Energy-efficient hierarchical routing protocol which will eliminate redundant data transmission, utilize resource more efficiently there by increasing the lifetime of the WSN. Another level of aggregation is also added which not only saves energy by eliminating redundancy also distribute the work load evenly by utilizing the energy of the least overloaded CHs

3. PRELIMINARIES

The operation of LEACH is divided into rounds. Each round begins with a set-up phase when the clusters are organized, followed by a steady-state phase when data are transferred from the nodes to the BS. During the set-up phase, each node n chooses a random number between 0 and 1. If the number is less than a threshold *T(n)*, the node becomes a cluster head for the current round.

The threshold is set as:

$$T(n)= \begin{cases} \frac{P}{p*\left(r \bmod \frac{1}{p}\right)} & if\ n \in g \\ 0 & otherwise \end{cases}$$

Where P is the desired percentage of cluster heads, r is the current round, and G is the set of nodes that have not been cluster head in the last 1/P rounds. After the cluster heads are selected, the cluster heads

advertise to all sensor nodes in the network that they are the new cluster heads. Then, the other nodes organize themselves into local clusters by choosing the most appropriate cluster head (normally the closest cluster head). During the steady-state phase the cluster heads receive sensed data from cluster members, and transfer the aggregated data to the BS

A. Network Model

For our proposed model, we adopt a few reasonable assumptions of the network model as follows[10]:
(i) The base station is fixed at a far distance from the sensor nodes.
(ii) Nodes are homogeneous which contain uniformly energy.
(iii) No mobility of sensor nodes.

B. Energy Consumption Model

According to the radio energy dissipation model of Fig. 1,[7] the energy consumption of transmitting k-bit data over a distance d is

$$E_{Tx}(k,d)=\begin{cases}(Eelec * k) + \varepsilon fs * k * d) \; if \; d \leq do \\ Eelec * k) + \varepsilon mp * k * d4 \; if \; d > do\end{cases}$$

Where Eelec is the energy dissipated per bit to run the transmitter or the receiver circuit, ε_{fs} and ε_{mp} depend on the transmitter amplifier model we use, and d is the distance between the sender and the receiver. By equating the two expressions at $d=d_0$, we have:

$$d_0 = \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}$$

Where d_0 = denotes the threshold distance, *Eelec* represents the energy consumption in the electronics for sending or receiving one bit, The energy consumption of receiving k-bit data is

$$ERx\ (l) = lEelec$$

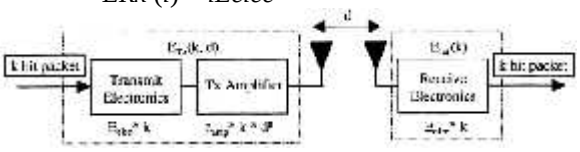

Fig. 1 Radio energy dissipation model

Here we use the typical values *Eelec* = 50 nJ/bit, *εfs* = 10 pJ/bit/m2 and *εmp* = 0.0013 pJ/bit/m4. As noted previously, the cluster heads are responsible for aggregating their cluster members' data. The energy for data aggregation is set as *EDA* = 5 nJ/bit/signal.

4. PROPOSED ALGORITHM

We proposed an algorithm Threshold Based Stable-LEACH(TS-LEACH) according to our protocol we will mainly concentrate on the Cluster head selection of the nodes using Threshold. As a result we get improvement on overall network life time.

In LEACH Algorithm CH selection is randomly, that does not take into account energy consumption. They don't consider energy consumption according to priority, it will randomly take nodes and make them cluster heads so if the node with low energy is taken as a cluster heads it will finally degrade the performance and reduce the lifetime of the network. LEACH Algorithm will also can't able to cover a large area. CHs are not uniformly distributed. Selecting of Cluster heads is a problem. However, nodes in the real networks hold different residual energy due to random events and differences in communication range, so then CHs are selected unfairly. To take these problems into consideration, We proposed algorithm that selects CH after looking through the threshold value of the node. We will select the cluster heads according to threshold, in this if the energy of the node is greater than the threshold is selected as a cluster heads. After sometime when energy is start going down and there is no node whose energy is greater than threshold then after normal node are selected as a cluster heads whose energy is less. By doing this we will able to achieve our goal and able to prolong the life time of the network.

In our protocol we will utilize the energy effective way and by doing this we prolong the lifetime of the network, and first node dead is later than in normal LEACH. In our protocol we firstly select the Advance node as a clusterheads because in energy in the advance in is greater than normal node and continues check side by side threshold and compare the energy with node while selecting nodes as a clusterheads. When energy of Advance node is start going down then after we take normal node as a cluterheads. The protocol is stable until first node dead so that's why we name it Threshold Based Stable-LEACH. . As the name suggest stable LEACH means that until first node dead the whole network is stable, the after the network become unstable.

4.1 FLOWCHART OF PROPOSED ALGORITHM

This flowchart will describe the work flow of the algorithm, firstly we divide the nodes among Normal and Advance nodes because the advance nodes are those nodes whose energy is more than normal nodes. And our main concentration is on nodes whose energy is more. In second step we calculate the threshold of the network by the formula.

$$Th= \sum_{i=0}^{n} node.energy/n$$

We continuously check the threshold as when clusterheads changes every time. In third step we will compare the node energy with threshold, if the node energy is greater than threshold then further check the node type. If node type is 'N' which means the node is non-clusterhead node in 1/p round then select that node as a clusterhead and give that node type 'C' which means that the node is clusterhead for that round and the same node will not able to become clusterhead for same round. And if node energy is less than threshold means that all become dead. In our protocol we continuously check the threshold and compare it with node energy, so if nodes have no energy means all nodes dead.

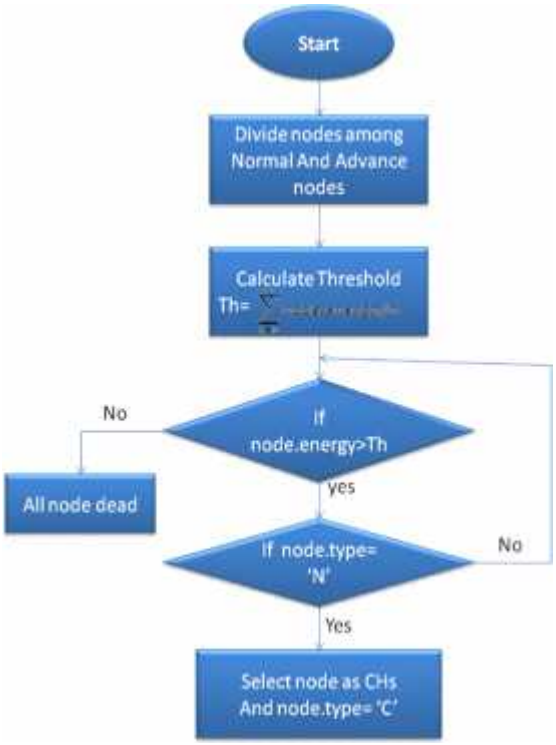

Fig.2 Flow chart of Proposed Algorithm

The parameters used in our simulations shown in TABLE I. When a node uses energy down to its energy threshold, it can no longer send data and is considered as a dead node. We compare our proposed model with the LEACH in terms of network lifetime and dead node. Network lifetime is defined as the round number when the first node runs out of energy. To maximize the network lifetime, it is required to prolong the time of first node dies as far as possible.

Parameter	Value
Simulation Time	2683
Topology size	100 * 100 m^2
Initial node energy	0.5 Joule
Numbers of Nodes, N	100
Number of clusters	Randomly Based
The energy of aggregation (E_{DA})	5 *nJ/bit/signal*
Free space (*Efs)*	10 *pJ/bit/*m^2
Multipath fading (*Emp)*	0*:*0013 *pJ/bit/*m^4
Node distribution	Randomly distributed
Location of BS (Base station)	50,50

Table 1.Summary of the Parameters

5. SIMULATION AND RESULTS

We simulated the proposed algorithm using MATLAB and simulate TS_LEACH algorithm and getting the results. We found results that by giving the priority to those nodes whose energy is more than threshold give improvement in the result. We also calculated the threshold side by side and also compare the energy of the nodes for selecting a clusterheads. We also compare the number of packets send from Clusterheads to the base station and from nodes to the clusterheads.

In this section, we evaluate the performance of our proposed algorithm through the simulations. We compare our proposed algorithm with LEACH based on two performance metrics: first dead node and network lifetime

For the simulation experiments, following parameters were used: The reference network of our simulations consists of 100 nodes distributed randomly in an area of 100 m × 100 m.

The BS is located at position (50,50). The initial energy of all nodes assumed as 0.5 J. P is set to 0.1 about 10% of nodes per round become cluster heads.

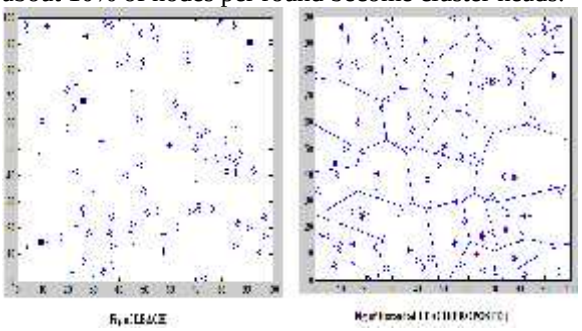

Fig.2 LEACH AND TS-LEACH COMPERISION

This fig.2 show the difference between LEACH and our proposed algorithm in simple leach there is no cluster formation is there the cluster heads will change randomly cluster formation is not visible or cluster region is not visible but in our proposed algorithm there is proper visibility of the cluster are there and there is only one cluster head in a cluster.

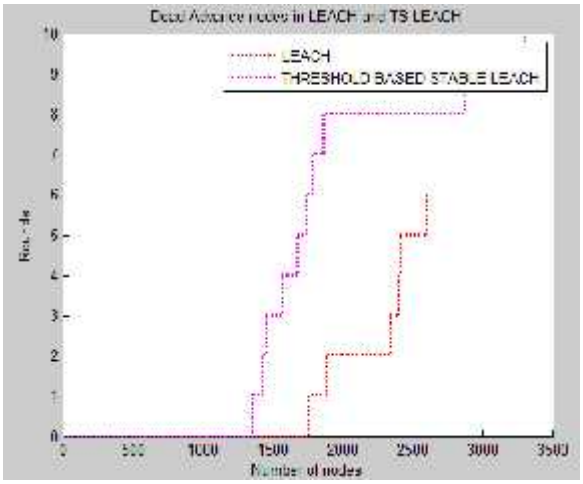

Fig.3 Dead advance nodes in LEACH AND TS- LEACH

As fig.3 show the compression between LEACH algorithm and TS-LEACH. Its observe that the first advance node dead in TS-LEACH is early but last advance node dead later than LEACH which prolong the life time of the network.

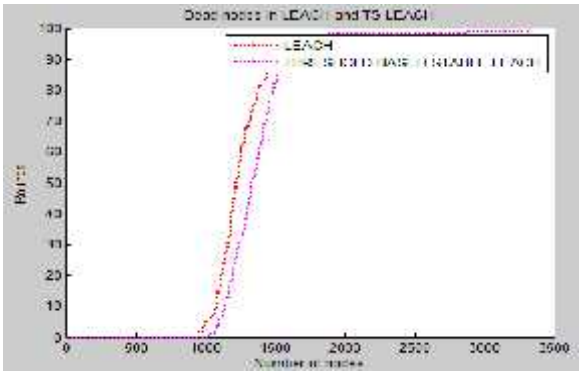

Fig.4 Dead nodes in LEACH and TS- LEACH

As Fig.4 show, we have compared proposed algorithm with LEACH algorithm in relation to the Dead nodes. It can be observed that the energy consumption in proposed algorithm decreases and the network lifetime increases.

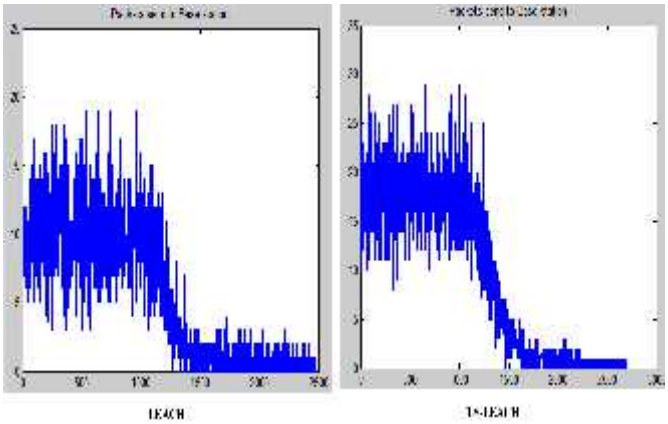

Fig.5 Compression of Packets sends Base Station

This fig.5 show the data transimation in both algorithm in leach the packet send to base station is lesser than the packet send to base station by proposed algorithm, which shows that there is increase in network life time of sensor nodes.

5. CONCLUSIONS AND FUTURE WORK

In this paper, we propose a modification of the LEACH's Algorithm. The proposed algorithm is seems to be significant as it provide better result then LEACH. It seen in the experimental result that Dead node time is increased in TS-LEACH as well as the overall life time of the network. It is found that network become unstable , when first node dead so in near future we will extend TS-LEACH to reduce this problem.

6. REFERENCES

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Author profile

Vinay Bhardwaj is M.Tech Student at G.N.D.U. Amritsar in Computer Science Deptt. Email:- vny07@yahoo.com

Prof. sandeep wraich is Assistant Professor in Computer Science Deptt. at G.N.D.U. Amritsar. Email:- sandeepwraich@gmail.com