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AN EFFICIENT CLUSTER (H-LEACH) BASED ROUTING SCHEME FOR WIRELESS SENSOR NETWORKS

Sugan J*, Isaac Sajan R**
*(PG Student, Department of Computer Science and Engineering, Ponjesly College of Engineering, Nagercoil, Tamilnadu)
** (Associate Professor, Department of Computer Science and Engineering, Ponjesly College of Engineering, Nagercoil, Tamilnadu)

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Abstract:

In Past year WSN network is used in many real time applications. The real time applications raise various fundamental problems like limited energy resources, network life time, etc. The growth of the WSN is increase day by day. In WSN has a plenty of sensor nodes. Sensor nodes are deployed to monitor the real worlds which are transmitting the sensed data to Base station. The main problem in WSN is the sensors are having limited lifetime and more energy consumption to transmit the data to Base station. This is the one of the challenge in WSN. To improve the network life time and reduce energy consumption to use clustering technique. Clustering is a process of grouping the sensor nodes into cluster. The objective of clustering is to increase the network scalability, energy efficient, etc. In this paper we propose Heterogeneous LEACH protocol we present architecture schemes and evaluate. It's performance using analytical study and simulations. The evaluation is based on the most critical metrics in WSNs such as network lifetime, dead node, Alive node, Energy-Efficient (Energy Consumption). The evaluation and comparison with existing solutions show that our proposed Heterogeneous LEACH exhibits a reduction in energy consumption over CH-LEACH.

Keywords **—WSN, Cluster, LEACH, Lifetime**

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I. INTRODUCTION

In recent years WSN is an emerging area. WSN is an interconnection of devices in wirelessly. The WSN has been used in various areas like military and civilian application. Sensor nodes are randomly deployed in an environment and sense the real world. These sensor nodes are having limited capability such small power unit, small memory, low computation and low processing. The important parameter of sensor is lifetime. The sensor nodes are generates an enormous amount of data. Sensor nodes send the sensed data to base station to further operation. These sensor nodes are grouped often into cluster. Sensors are used to monitor the real world environment and transmit the sensed information to base station. If each and every sensor starts to communicate and engage in data transmission in the network the great data congestion and collision will be experienced.The clustering is method to overcome these problems.WSN having some algorithms to solve these routing problems. Some of routing algorithms are try to increase the network lifetime and reduce the energy consumption.

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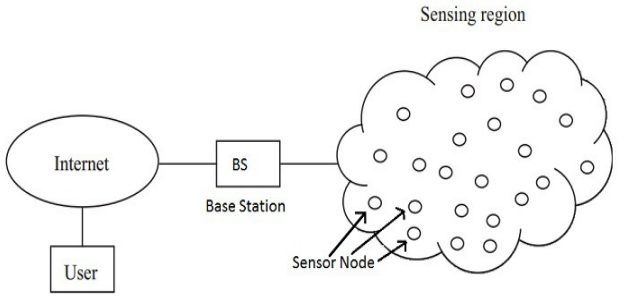

Fig 1. WSN Structure

The routing algorithms are LEACH, HEED, PIHASIS, DEEC, SEP, LCA, TASC, etc. These algorithms have the goals to increase the network energy and provide scalability.

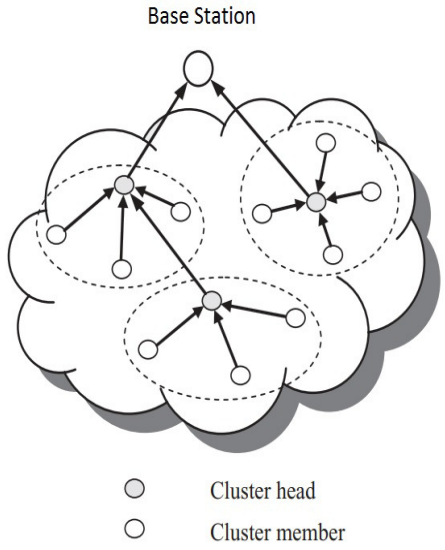

Fig 2. WSN Clustering

In clustering concept each cluster has a coordinator referred to as a cluster head and a number of member nodes. The WSN contain two types of communication such as inter-cluster communication among the nodes in a same cluster and the intra-cluster communication among the nodes in a different cluster. But the intra clustering reduces the battery drainage of a node.

II.RELATED WORK

LEACH is the most popular significant cluster based protocols. In WSN more cluster based protocols are proposed to improve the network lifetime and reduce the energy consumption.

A.LEACH (Low Energy Adaptive Clustering Hierarchy)

The main aim of this LEACH protocol is to minimize the global energy consume by the nodes and increase the network lifetime. The loads are distributed to nodes over a period of time. LEACH is one of the hierarchical routing protocols in terms of energy efficient. The LEACH works with various rounds. The functions of LEACH are divided into two types of loop. One is setup phase and another one is steady phase. Setup phase performs a clustering and select cluster head. During the steady phase the sensor nodes are communicate to Cluster head. In setup phase making a cluster and the sensor nodes are distributed onto some cluster dynamically.

The cluster heads are elected as randomly in a cluster node for each cluster. If making cluster an integer in the series of 0 to 1 is elected randomly and same linked with the threshold t(h). This node is make it as a cluster head for the current round. When chosen value <t(h) else the nodes act as a child or cluster member. The threshold t(h) equation is

$$t(h)\begin{cases} \dfrac{p_b}{(1 - p_b * \left[r_n \bmod \left(\frac{1}{p_b}\right)\right])} & if\ h \in G1 \\ 0 & otherwise \end{cases}$$

Where p_b is amount of the CH nodes between all the nodes, r_n is the number of round, G_1 is the group of nodes not yet have been CH node throughout the first $\frac{1}{P_b}$ rounds.

After forming cluster and chosen of cluster head the CH will broadcasting and send advertisement message to all other nodes. In steady phase the nodes are communicate to CH for sending their message. The communication is based on the

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TDMA Signal. After that the CH will communicate to Base station to send and receive the information.

B. DEEC (Distributed Energy Efficient Clustering)

DEEC is one of the heterogeneous wireless sensor network protocols. In DEEC cluster head selection is based upon the probability of remaining energy of each nodes and average energy of the network. The nodes which having high energy has a high probability to become a cluster head. Less energy nodes are referred as a cluster member. The DEEC protocol is based on the LEACH but the cluster head selection is different. As we know the SEP protocol we have two types of node such as normal node and advanced node. Which helps in selection of cluster but it fails in multi-level heterogeneous network environment.
In DEEC uses a probability based ratio between residual energy of the node and the average energy of the system. The DEEC having got limitation that the advanced nodes always get penalize as when the residual energy reduced and become equal to that of the normal nodes. The advanced node will die fast than the other nodes.

III. PROPOSED APPROACH

In this section discussed the proposed work model. In this present explain the concept of proposed network model. Assume the network is formed with randomly deployed a sensor in the environment. All the nodes are having same identical sensing, communication capabilities and same initial energy.

A.Heterogeneous LEACH

LEACH is Low Energy Adaptive Clustering Hierarchy and it is self-organizing clustering protocol that uses randomized select the clusterheads to distribute the energy load among the sensor nodes. The main features of LEACH are:

i. Localized coordination and control for data transfer,
ii. Randomized, self-configuring and adaptive formation of clusters,
iii. Low energy media access, and
iv. Data processing, such as data aggregation to reduce global communication.

The operation of LEACH is divided into two rounds, where each round begins ith setup phase in which cluster formation takes place, followed by steady state phase in which data transfer to sink takes place. In order to reduce overhead, steady state phase is kept longer than the setup phase.

1). Set-up Phase

For cluster formation, each node initially decides whether to become a CH or not for the current round. This decision is made by the node by choosing a randomly a number between 0 and 1. If the number is less than a threshold, the node becomes a CH for the current round. The threshold equation for CH formation is given by

$$t(h)\begin{cases}\dfrac{p_{opt}}{(1-p_{opt}*\left[r \mod \left(\frac{1}{p_{opt}}\right)\right])} & if\ h \in G1 \\ 0 & otherwise\end{cases}$$

Where p_{opt} is the desired percentage of cluster heads, r is the current round and G is the set of nodes which have not become cluster heads in last ($1/ p_{opt}$) rounds. Using this threshold, each node will be cluster head at some point within rounds. This ($1/ p_{opt}$) number of rounds during which each node has become cluster head once is called epoch.
Each node which selects itself as a CH broadcasts an advertisement message to all non- CH nodes. The receiver of non-CH should be kept on to hear the advertisement message from all the CH nodes. The non-CH on the basis of received signal strength decides which CH to join. After each node has decided which cluster to join, it should confirm the CH for its status as cluster member. Each node sends a join-request message to their respective CHs. At this time all the CHs must keep their receivers on.

Based on the number of cluster member in a cluster, CH node sets up a TDMA schedule to ensure that there are no collisions during data transmission and this also allows non-CH nodes, to

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turn off the radio at all times except during their transmit time, thus minimizing the energy consumption by the individual sensors. This schedule made by CH is broadcast back to all the members in the cluster.

*2).*Steady State Phase

Once the cluster formation takes place and TDMA schedule is fixed, data transfer can take place. Steady state operation is broken into frames. Nodes send their data to the CH at mot once per frame during their allocated time slot. The time of a frame of data transfer depends upon the number of cluster members in the cluster. To reduce energy consumption, each node uses power control to set the amount of transmit power based on

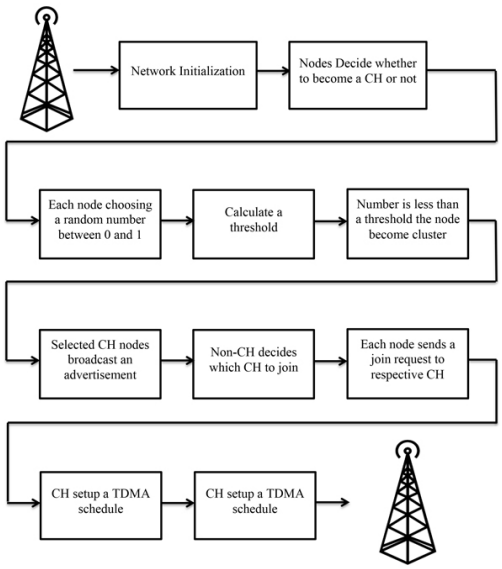

Fig 3. System Architecture

RSS of the CH advertisement. Further, the radio of each node is turned off until its allocated transmission time. The CH must keep its receiver on to receive all the data from the cluster members. When all the data has been received, the CH node process the data to compress the data into a single signal and this compressed signal is then sent to the BS.

IV. SIMULATION RESULT

A.Working Environment

In this section we provide an illustration of proposed protocol algorithm capabilities using Matlab R2007b simulator compare its performance with LEACH and CH-LEACH. The parameters used in the simulation are summarized in the Table1.

Table -1: Simulation Parameter

Parameters	Values
Network Grid	(0,0)x(100,100)
Base Station	(50,50)
εelec	50 nJ/bit
εfriss amp	10pJ/bit/m2
εtwo ray amp	0.0013pJ/bit/m4
d0	87 m
Initial energy per node	0.2 J
Number of nodes	100, 200
P	0.05

B. Simulation Result

The proposed clustering algorithm is simulated by Mat lab 2007b. Performance of proposed protocol is measured in terms of network lifetime, Energy consumption, alive nodes and throughput. By using proposed protocol Heterogeneous LEACH sensor nodes consume less energy as compared to existing protocols as shown in figure 4. As shown in figure performance of proposed protocol is better than existing protocol. In this section red line represented existing protocol and green line represented a proposed heterogeneous Leach.

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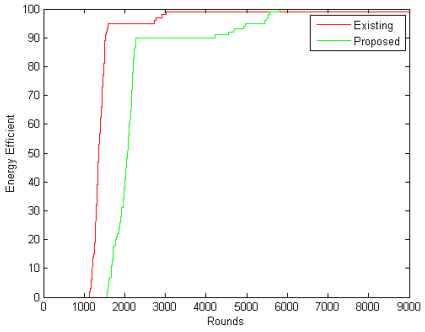

Fig 4. Energy Consumption v/s No.of Rounds

V. CONCLUSION

In this paper, we focus on the problem of unbalanced energy dissipation in cluster-based and propose a novel cluster-based data aggregation protocol. The proposed method has been tried by a heterogeneous distribution of node energy consumption of nodes and network partitioning becomes more balanced and their lifetime is quite similar to that carried out this evaluation was realized. By creating a hierarchical structure, we optimize and minimize the energy consumption of nodes. Finally, when the new approach is used in the MATLAB simulation of the proposed method, we are able to obtain acceptable results.

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