Hybrid Energy Unequal Layered Data Aggregation Technique in Wireless Sensor Networks

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ABSTRACT
Wireless sensor networks in Current research trends mostly focuses on energy, storage and types of data due to random nature of field deployment of sensor nodes and broad area of applications such as monitoring different kind of systems, medical patient monitoring, many others areas where data will occur static, dynamic or in any form. With the applications areas, the interest of sensor networks with balanced energy, reduced link traffic and handling of different types of data with the storage efficient wireless sensor network is required. Form this Hybrid energy node layered data aggregation technique in wireless sensor networks is proposed for unequal distant region according to communication distance region with the unequal distributed energy among the sensor nodes in the field that minimizes number of dead nodes with average energy of the nodes and maximizes number of packets transferred to the sink.

Keywords
WSN, Hybrid, Layered, energy Data aggregation, region-based.

1. INTRODUCTION
All among in the working areas of the wireless sensor areas data gathering and data aggregation is a primary function on which efficient sensor network is based. Data gathering is key technique to collect the event data on which processing will be performed. However, Sensors working areas are vast and sensor nodes are tiny, the need of data aggregation is required. Data aggregation extends the lifetime of network by reduces redundancy of data that will be Capable in providing less data traffic to the links, less energy consumption for data receiving and transmitting [1]. With the data aggregation partial results of sensed data are combined at intermediate node and aggregated so as to significantly reduce the amount of communication and hence the energy consumption and link traffic as to reduce redundant data. The earlier approaches uses hierarchical network structure such as tree-based and cluster-based and chain-based network data aggregation for static data and some others proposes structure free network aggregation [2].

Moreover, a WSN should of timely fulfilling its mission without losing important information in event-critical real time applications. In the emerging area of sensor-based systems, significant challenge is to develop scalable, fault tolerant methods to extract useful information from the data the sensors collects and safely transmission to the base-station for further processing [3]. With the dynamic data, constraints such as energy, lifetime, data priority, data deadline, and storage space and link traffic are not easy to maintain but these take an important role for a successful wireless sensor network.

Proposed data aggregation technique in wireless sensor networks for the data networks, non-uniformly distributed nodes are divided into different regions using the unequal and concentric rings and the same size quadrant angle sectors for the modularized energy efficient regions. In addition to energy efficient modular network structure, robustness is achieved using limited multi-hoping of the data transmission, that reduces the chances of packet loss as well as also reduces extra traffic burden on the network link so that interference, and congestion may be less in network [4].

The remainder of the paper is organized as follows. In section II, we discuss several existing work on data aggregation of structured and structure-free network. Section III presents working principle stages of proposed Hybrid Energy Unequal Layered data aggregation technique in wireless sensor networks. Section IV presents theoretical analysis of the proposed scheme. Finally, Section V concludes the paper defining futuristic interest of area.

2. RELATED WORK
In this section, we first review a wireless sensor networks survey schemes proposed earlier then we will enter in the modes or types of enhancements in the network made as protocols for making long lifetime network and at finally, we will briefly discuss some of core data aggregation algorithms for WSNs.

Sensor networks are distributed event-based systems that differ from traditional communication networks in several ways: sensor networks have severe energy power and data transmission constraints, redundant low-rate data, and many-to-one flows [1]. Data-centric mechanisms that sensors collect and economically perform in-network aggregation of data are needed in this setting for energy-efficient and liable information processing [2]. To achieve all the needs past research areas used many structured networks such as tree based, cluster based, grid based and hybrid structure based network also [3]. Some of the researchers proposes structure free network also.

LEACH [4] is one of the most hierarchical clustering algorithms for homogeneous environment provides control of energy in the network. LEACH uses Localized coordination and control for random rotation for cluster set-up and operation. In LEACH every node has even probability to become a cluster head. However, LEACH is not work well for heterogeneous environment. Advancement in LEACH as SEP [5] fits in heterogeneous environment with with two types of nodes, normal nodes and advance nodes. Advance nodes have more energy than normal nodes. In SEP normal and advance nodes have weighted probability to become a cluster head. Advance nodes have more chances to become cluster head than normal nodes because of their energy level. But SEP does not guarantee efficient deployment of nodes. Enhanced Stable Election Protocol (E-SEP) [6] was proposed with three level hierarchies. ESEP introduced one more intermediate node

whose energy lies between normal node and advance node. Nodes elect themselves as cluster head on the basis of their energy level. The drawback of ESEP is same as in SEP. Distributed Energy-Efficient Clustering Protocol (DEEC) [7] shows multilevel heterogeneity with introduction of the residual energy of node and average energy of the network as cluster head formation. TEEN [8] is time constraint data aggregation protocol for time critical applications for homogeneous network .In TEEN the selection of cluster head is same as in LEACH, TEEN works on hard and soft threshold to minimize the number of transmissions thus saving the energy of nodes as result life span and stability period of the network increases. In SEP normal nodes and advance nodes are deployed randomly so most of the energy drain by the nodes far away from base station it consumes more energy while transmitting data which results in the shortening of stability period and decrease in throughput as they dead earlier. To enhance uses of SEP network field divided in regions as sectored direction as well as rings as the sign of communication distance from the base station. As border are most distant areas in the field, where nodes need more energy to transmit data to base station So nodes with high energy known as advanced nodes deployed randomly on border areas performs event sensing and transmitting data on clustered technique to base station. Normal nodes are deployed on communication range of base station and they transmit their data directly to base station

3. PRELIMINARIES

In this section, we present some assumptions and define some terminologies that are used in designing the proposed scheme.

A. Assumptions

We make the following assumptions to design and implement Hybrid Energy Unequal Layered data aggregation technique in wireless sensor networks.

- Sensor nodes are considered pre-allocate and defined coordinates at deployment time.
- Sensor nodes are aware with the nearby neighbours of same ring.

B. Terminologies

We listed some of important terminologies those used in the paper are:

 Stability Period: Life time in terms of interval from installation on network to the complete energy depletion of the first sensor node.

 Instability Period: Life Time interval from the energy depletion of the first node to the depletion of energy of the last sensor node.

 Throughput: Its performance of the network that total rate of data transmission over the network, the rate of data transfer from cluster head to base station as well as the rate of data sent from the nodes to base station.

 Network Lifetime: Time interval from the start of the network to the death of the last alive node.

 Epoch: Number of waiting rounds after that a node becomes eligible for cluster head.

 Data Aggregation: Data collected at sensor node on events, passes from common procedure so that nodes in an event area usually shares similar information. For increasing network performance, life time and reduce energy consumption is data aggregation.

.Hybrid nodes: In WSN, hybrid nodes is mean a system with deferent energy nodes in a field during lifetime of network and the ability of a system to resist change without adapting its initial ring.

4. NETWORK STRUCTURE AND WORKING

The proposed scheme consists of following stages:

- Network model design
- Energy efficient cluster head selection
- Data aggregation and transmission

N nodes are non-uniformly deployed in a region and Using unevenly spaced rings and evenly spaced sectors, the network is divided into many different regions with different area. Sensed event triggered data and send to the base station named sink placed at the centre of the network using the intermediate aggregation node named cluster head. The region is now distributed in the three unequal radius circular ring region such that Ist region covers all the nodes those have direct communication range with the base station.

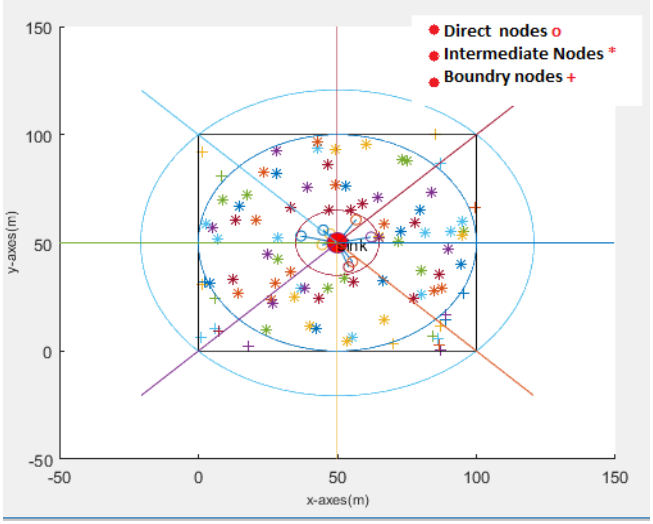

Fig.1 network design of proposed scheme

The IInd ring region covers all the intermediate area nodes. IIIrd region is the border nodes region. Advanced energy region is the region for fulfilling the requirement of the advanced distant border nodes in diverse and critical wireless sensor networks. Field is also divided into the four directional quadrants for management of the directional data.

A. Energy efficient cluster head region selection

The major approach is leach that uses the cluster head selection in leach, based on the remaining threshold energy such that

$$Tn = \begin{cases} \frac{p}{1} - p\left(r \bmod \frac{1}{p}\right) & if\ n \epsilon G \\ 0 & otherwise \end{cases} \qquad (1)$$

Where p is the desired percentage of CH's, r current round and G is the set of nodes that have not been elected CHs in the last 1/p rounds.

This measure is somewhat insufficient for WSNs those require distinct number of cluster heads. The major problem with cluster head formation based on sector id is that the CH may be at a corner of the sector and there may be a CH in the adjacent ring or sector which is more nearer for the member node.

Similarly, if the member node selects the CH in its own region, the energy used by it will be more than required.

The proposed cluster head region with an energy efficient region that will use of the cluster head technique for only the dense and distant portion of the network otherwise it will make direct transmission of the data for the sake of energy. The selection of cluster head for the intermediate region and border area will be as the LEACH. Form the advanced energy based border nodes region the problem of depletion of the distant nodes is significantly very low.

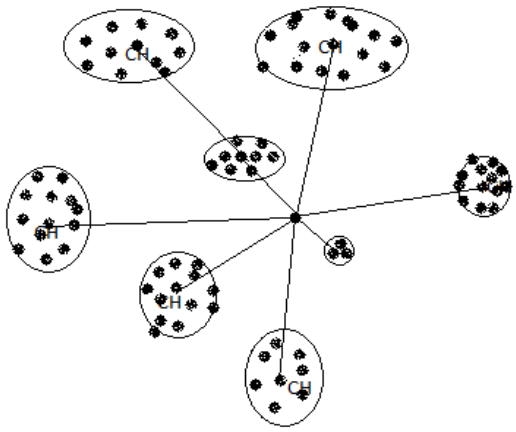

Fig: 2 cluster head to sink data communication

B. Cluster head election

This phase elects cluster head of region that is a member of nodes in the energy efficient cluster head region using the remaining residual energy as the threshold energy value.

One node whose threshold energy value is maximum will selected as the cluster head for the round.

As the numbers of the rings with the network size increases the size of energy efficient region is increases provides an opportunity for large size network.

C. Cluster head advertisement

The selected cluster advertise a declaration message to all its nodes using broadcast containing node ID, type of node, location of the CH node, energy threshold value for current round and it also send a energy status bit request to each receiving nodes that replied by the node after comparing cluster head node threshold energy value and its own threshold value.

The nodes threshold energy value is less than the CH threshold value will send bit 0 with the Acknowledge packet, otherwise it will send bit 1.

D. Nodes to cluster head shortest path setup

The nodes senses declaration message of CH and comes in active mode from the ideal mode, calculates the path cost from the received signal strength by the CH, these cost is assigned to links joined to the node with another nodes of the region and using these cost for the computation of shortest path to the cluster head. The scheme uses n-ry tree path for transmission as n will equal to the depth of the tree in other words in fact we are using d-ry try with decreases d, as if one node sense data it will send it to the n=no. of depth parents and then those n nodes will transfer packet to the n-1 other nodes.

E. Nodes acknowledgement

Node compare the energy threshold bit with the energy threshold value The nodes threshold energy value is less than the CH threshold value will send bit 0 with the Acknowledge packet, otherwise it will send bit 1. The node then send the Acknowledge packet using first some limited n-ary tree path such as first n short paths containing node ID, energy status bit, location information.

The energy status bit is aggregated at the CH with summing all bit 1 for alive nodes and send to the sink at each round, that periodically updates the network information about the alive and dead nodes for a particular time and more other issues such as nodes re-deployment.

5. SIMULATION AND RESULT

Simulation of proposed protocol in a field with dimension area 100m×100m deployed with randomly 100 nodes deployed in *rings* with their energy on according to their respective distance. Base station is placed in the centre of the network field. We are using

The first order radio model as used in SEP. MATLAB is used to implement the simulations. Specifically, we have following settings. Let nodes in the field divided in ring with the range of the base-station first and secondly distant much to border from the base-station, and rest in middle portion. Since *Popt* is 0.1 for per sector so we have 1 cluster heads per sector in a round on occurrence of the event.

Other simulation parameters are shown in Table 1.

Parameters	value
Initial energy *Eo*	0.5%
Initial energy of advance nodes	*Eo(1+α)*
Energy for data aggregation *EDA*	5 *nJ/bit/signal*
Transmitting and receiving energy	***Eelec*** 5 *nJ/bit*
Amplification energy for short distance	***Efs***10 *Pj/bit/m2*
Amplification energy for long distance	***Eamp*** 0.013 *pJ/bit/m4*
Probability	***Popt*** 0.1/sector

Table 1: PARAMETERS FOR SIMULATION

The benefit for selection of cluster head of this type will increase the performance of the network. Cluster head once selected on the basis of their remaining energy and then remains in passive mode until any event will occur if network type is not so active. If network type is too active, then the entire process of selection of cluster head selection and aggregation process by cluster head will take less consumption of energy due to directional data processing and more on event.

6. RESULT AND DISCUSSION

Here, we compare the results of our protocol HNLSEP with SEP and LEACH. When we run simulation of SEP protocol for 1000 rounds in conducting simulation are

1. To examine the stability period in terms of average energy for LEACH, SEP and HNL-SEP and showing the result in figure 3.

2. Examine the dead nodes of LEACH, SEP and HNL-SEP showing the result in figure 4.

3. We also examine number of packets to base-station

In 1000 rounds in SEP, LEACH, and HNL-SEP that showing in figure 5.

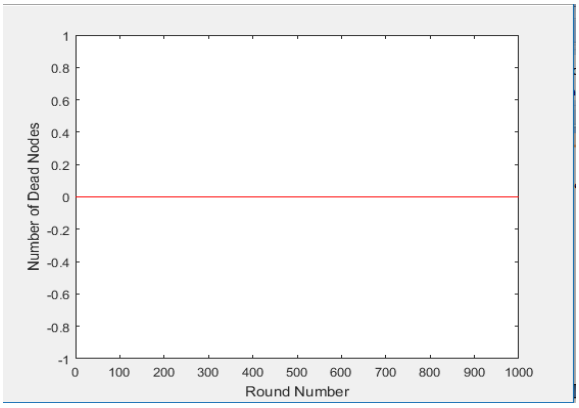

Fig:-3 number of dead nodes in HNL-sep

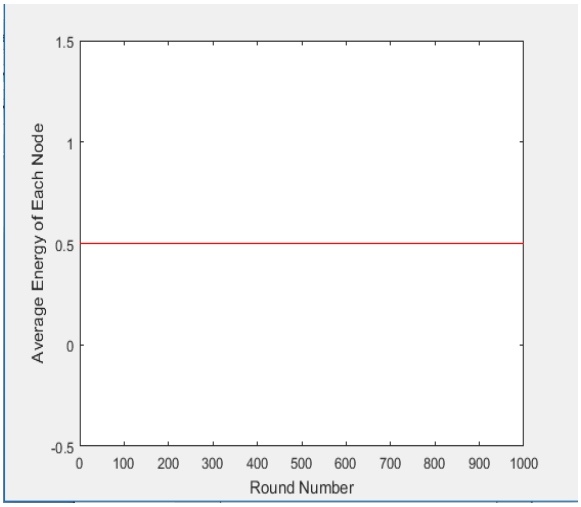

Fig:-4 Average energy of each node in HNL-sep

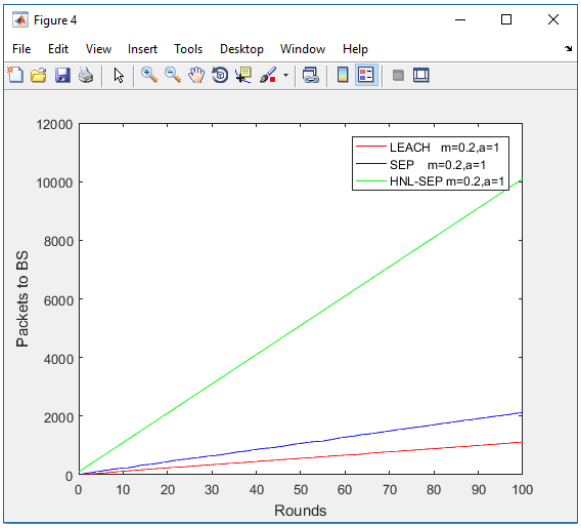

Fig:-5 Packets to Base station in HNL-sep

Fig.3, Fig.4 and Fig.5 shows result for the case when *m*=0.2 and α=1.This means that there are 20 advance nodes out of total nodes which are 100. According to Fig.3 shows the number of dead nodes against rounds. Fig.4 clearly shows that our protocol is enhanced from SEP and LEACH in terms of average energy. As LEACH is very sensitive to heterogeneity so nodes die at a faster rate. SEP performs better than LEACH in two level heterogeneity, because SEP has weighted probability for selection of cluster head for both normal nodes and advance nodes and also not stable for border nodes. HNL-SEP performs better than LEACH and SEP, because nodes in ring 0 (normal nodes) communicates directly to base station while nodes in ring1 and ring 2 communicate via cluster head to base station: As in clustering technique, cluster head consumes energy in the form of data aggregation and also by receiving data from nodes in the cluster. So this energy is conserved in normal nodes as they do not have to aggregate data and receive data from other nodes, so energy is not dissipated as that of cluster head, results the increase of stability period. In Fig.5, we can see that network lifetime is also increased because of the advance node. Advance nodes have α time more energy than normal nodes so advance nodes die later than normal nodes. So this increases the instability period.

7. CONCLUSION

The scheme provides efficient way of energy and link

Consumption with limited multi-hoping in comparison to previous algorithm and energy efficient advanced energy border nodes with benefits of ancestor cluster head region schemes provides a setup for get a long life and efficient sensing nodes network. As the numbers of the rings with the network nodes behaviour provides an opportunity for large size network.

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