ENERGY EFFICIENT AND INCREASED THRESHOLD SENSITIVE STABLE PROTOCOL FOR WIRELESS SENSOR NETWORK

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Abstract
Wireless sensor network(WSN) have a major issue in developing an energy efficient routing protocol. Energy Conservation, stability and throughput of nodes and networks are major Challenges. Our Proposed algorithm is reactive routing protocol using three levels of the heterogeneity. A significant role plays by the routing protocol which efficient in a cluster in stability & energy saving of the cluster and its nodes in networks. The nodes which are randomly distributed are sensor node totally based on the election probability of dynamically changing cluster head. The energy level remaining in nodes and a round per minimum number of clusters helps to the cluster heads selection . At last, demonstrate the results of simulation by which our projected clustering of heterogeneous approach is more effective.
Keywords: Stable Election Protocol , Energy-efficiency WSN, Heterogeneous environment , Routing of Clustering

I. INTRODUCTION

Wireless sensor networks can be considered as the network of several spatially distributed sensor nodes for environmental monitoring by tracking data from the middle location. As the size or the price of the sensors are diminishing with the technological advancement, the widely used applications in the military , health ,industrial, and traffic sectors [2-7]. These sensors can get hold of the environment conditions through different measurements. Now, the signals can be converted by measurements which can without problems unveil various of the features of the phenomenon of environmental of the specific area all the way through these sensors. The WSN comprises a Micro electro mechanical systems (MEMS) which is based on large number of sensor nodes and help in communicating by means of the external world via sink/Bs [1]. The applications which is used in WSN can be broaden throughout a broad range like measurement of temperature , sound and light, and forecasting and monitoring the weather conditions, military activities, as well as disaster management [7]. For some of the conventional wireless networking problems, researchers have been working to meet the energy conservation requirements. These are referred to as: finding energy-efficient solutions to WSN problems. A large amount number of higher nodes of sensor as compared to ad-hoc networks content by the networks of sensor which deployed compactly in the network and its a prone to failures. If the sensor nodes are considered as mobile, then for specific applications the topology of a sensor networks changes and that too very frequently. Nodes of sensor consist the huge amount of a sensor and an overheads . SN have limitations of three are as follows: memory , power , and their ability of estimation. Thus, the model by the sensor nodes in WSNs is mainly a communication via broadcast unlike as P2P communications based in nearly all of the networks of ad-hoc. Mainly at the network layer, individual needs to develop some novel routing which have energy efficient schemes that offers consistent communication of data amongst the nodes of sensor deploy external BS to broaden the survival or lifespan of the network. The

obliteration of this incompetence at all protocol stack layers of WSN communication is required..

MS (Mobile Sink): Mobile Sink [18] traverse through the entire WSN to collect data from the sensor nodes. A mobile sink move across a sensing field. It can either use the data autonomously or can send it to remote stations or to users via wireless communication. The route between source and MS is through multi-hop but the path is dynamic since the MS keeps changing its position. The convention of sink (mobile) in the WSN reduces the consumption of energy of the nodes and to prevent the energy holes formation in WSNs. Sink node collects data from the sensor nodes as shown in fig.1.

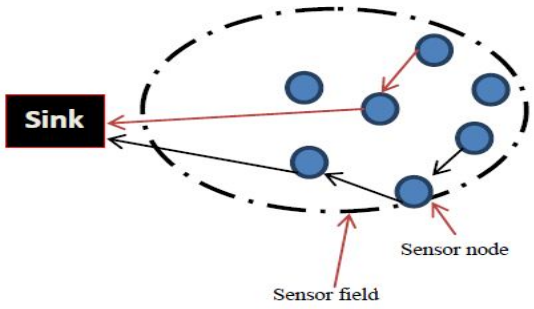

Fig.2 : Multi Hop Transmission

II RELATED WORK

The LEACH [8], Heinzelman, et al. introduced a clustering algorithm of hierarchical for WSNs, known as Low Energy Adaptive Clustering Hierarchy (LEACH). Protocol LEACH is mainly based on a clustering scheme that selection randomly a least number of nodes of sensor as cluster heads (CHs) that energy dissipation been reduced, and then rotates periodically. For an even distribution of load an energy amongst the nodes of sensors in the network, the function of CHs. In LEACH protocol, the Cluster heads nodes aggregate and collects the data from nodes of member of the relevant cluster and BS/sink receives an aggregated data with an purpose to shrink the amount of information and redundancy. LEACH uses a CDMA/TDMA based scheme of MAC to diminish inter-cluster and its collisions. This protocol ensures periodic data transmission and constant monitoring by WSN. Yet, periodic transmission of data might be worthless and may result in the rigid energy of the sensor nodes decreases. The LEACH jobs is divided into two phases steps. The Set-up phase involves in the formation of cluster and selection of CH. Steady state phase involves in data transmission to BS/sink from CHs. In the setup phase, a preset fraction of the total member nodes, p, select themselves as CHs. A node of member of the sensor network at random chooses a number r among 1 and 0. The node member's choose itself for the current round as a CH when the value of the number which is random r, is less than a value of threshold T(n). An equation calculates the threshold value and integrates the current round, the required percentage to become a CH, and the set of member nodes that have not been CH been selected in the last rounds(1/p) which is represented as:

$$T(n) = \frac{P}{1 - P(r \bmod \frac{1}{P})} \quad \text{If } n \in G$$

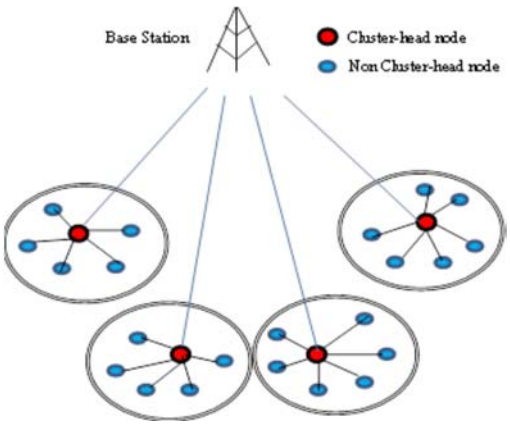

Fig. 3 Wireless sensor network based on Cluster

Where member nodes G that in the last 1/p rounds have not a cluster heads. The broadcast of advertisement message by all non CHs nodes from all the CHs that new CHs are elected . This advertisement message received, which cluster they must belong that all the non CH nodes decides . The non CH node informs the appropriate CH that they want to become the member of the respective cluster. The TDMA schedule generated by CH generates and allocates a fixed time slot to transmit data for each member node, basis of the no. of member nodes in a cluster,. Within allocated time slot, the member node data sends to respective cluster heads. The data fusion, aggregation and transmit it to base station performed by cluster head. This protocol enhances the energy consumption because the transmission is directly performed by only cluster heads rather than the direct

transmission by all the nodes of sensor. In homogeneous network LEACH performs better but in heterogeneous network not suitable.

LEACH-C [9] , a new algoritm is proposed by the author to reimburse the cited inefficiencies that requires to send the information about their location and energy by all deployed nodes to BS where appropriate clusters forms by them and elects cluster-heads centralized using annealing algorithm simulated. Moreover, the presumption by LEACH-C that every node has an adequate amount of transmission power to communicate with the base station. Nonetheless, A very unrealistic assumption in most of the cases.

Raghvendra Lindsey ,and Next presented PEGASIS(Power-Efficient Gathering Analysis in Sensor Data Systems) [10] that was the LEACH protocol to an up progression . PEGASIS is a ideal closely based on chain convention. The necessary thought of the gathering is that so as lifetime enhance of system, communication of nodes of sensor with just their closest neighbors is required and they take alternately in communication with the BS. On way, information of power transmit desirable in per round is condensed which is as the dissipated energy is consistently spread all over the nodes of sensor. Therefore, Fundamental goals two in PEGASIS. One of them, the increment in lifetime of every node by utilizing collaborative methods. Other is to permit neighborhood coordination among close together sensing node so that devoured the data transfer capacity in association is diminished. Unlike LEACH, PEGASIS dodges formation of cluster and in its place of several nodes uses immediately a singular node in chain to the BS (transmit information). In PEGASIS, find the nearby node in neighbor, the strength of signal used by every node to measure the separation with all nodes in neighbor & in order to listen in only node once, the strength of signal is accustomed. A path to the base station consisting of sensor nodes lying closest to each other is considered to be a path in PEGASIS. The collected information in aggregated form by any one node sends to BS and every other node in the chain takes part alternately in this transmission. The chain development is performed in a voracious manner. After obtained results, demonstrated simulation which PEGASIS had the capacity to expand the system lifetime twice as compared to the LEACH convention. HEED proposed by O. Younis [11], to achieve well-disseminated clusters which manipulate the energy-efficiency. In Hybrid Energy-Efficient Distributed Clustering, cluster-head selection is focused around two parameters, node residual and its average distance from neighboring nodes / node degree. Based of their energy remaining, the set of cluster head nodes preliminary is prepared initial. At the side of this, the nodes degree utilize for tie-breaking and also to well-distributed clusters structs which gives collateral of a distribution of cluster-heads welled.

For the cluster-head selection, the complexityof time is the order of 1, i.e. O(1), which is free of topology or size of the network. When LEACH reduced the energy consumption uses hoped single, HEED embrace communication of multi-hop. The ETSSEP [12], Shekhar Kumar et al. projected a protocol based on cluster routing for WSN heterogeneous, known as Enhanced Threshold Sensitive Stable Election Protocol for Heterogeneous WSN. On the basis of level of residual energy of nodes and least round per number of clusters, ETSSEP selects cluster head .

Network Model and Its Assumptions

Reflect on a WSN consists N uniformly and randomly distributed sensor nodes in the M * M m2 region. We reflect on a WSN with the following properties [9-11]:

- All the deployed sensor nodes in the network are homogeneous and motionless with a fixed power supply a rigid battery power. The nodes are outfitted with capabilities of power control by which it vary their transmitted power.
- Sensor network follows continuous data flow model instead of event driven model.
- B.S been fixed and not located between sensor nodes.
- Their location do not known by sensor nodes in the network.
- Base station knows locations of all the sensor nodes deployed in the network.

Radio Model

The first order radio model [9] has been worn to use for dissipation of energy analysis in radios. According to the first order radio model shown in Fig. 1, the energy required for transmitting K-bits at a distance d is given as:

$$E_{Tx}(K,d) = \begin{cases} K \cdot E_{elec} + K \cdot E_{fs} * d^2 & if\ d < d_0 \\ K \cdot E_{elec} + K \cdot E_{amp} * d^4 & if\ d \geq d_0 \end{cases} \quad (1)$$

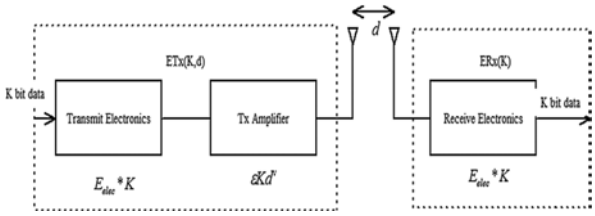

Fig. 1 Radio dissipation energy model

The energy required for receiving K-bit message is given as:

$$E_{Rx}(K) = K \cdot E_{elec} \quad (2)$$

Where, d refers to the cluster-member-node and cluster-head distance between them or between cluster-head and base station and $d0$ is threshold distance, $Eelec$ is the transmitter/receiver electronics' energy expense and Efs , $Eamp$ are transmitter-amplifier energy-expenses by a node when $d < d0$ and $d \geq d0$ respectively.

$$d_0 = \sqrt{\frac{E_{fs}}{E_{amp}}} \quad (3)$$

III. PROPOSED WORK

In this section, we present details about proposed protocol EEITSSEP. It is based on TSEP [9]. EEITSSEP is a cluster based reactive routing protocol with three level of heterogeneity. For three levels of heterogeneity, nodes with different energy levels are: advance nodes, intermediate nodes and normal nodes. The energy of advance nodes are greater than all other nodes and a fraction of nodes which have more energy than normal node and less energy than advance nodes are known as nodes of intermediate, while nodes remains the rest are known as nodes of normal. Normal nodes have 'b' times less energy than intermediate node , normal nodes have 'a' times less energy than an advance nodes and we suppose that value b = a/2. In EEITSSEP the total energy distributed over different types of nodes is computed as:

Protocol Architecture

EEITSSEP is also a self-organizing, static scheme of clustering in which clusters formed only once during the action of network (Like EEPSC [14]). The entire operation of network is hypothetical to be consisted of a numerous rounds where each n every round is further separated into three different phases-start-up phase, stable-state phase, and at last the selection of responsible node phase; each of these three phases are described in the following subsections.

Start-up Phase

In the start-up phase, formed the clusters once at the initiate of operation of network. After the node-deployment, then the start of operation performs , base station (BS) communicated by each node as consider for the task of TCH and is acknowledged by the BS in turn with its respective relative location in the network. BS then select k number of nodes as TCHs, where k is the desired number of clusters, known a priori (here k=4 as the scheme forms 4 clusters with equal distributions of nodes) while ensuring that the distance between any two TCHs is A/2 and diagonally opposite pair of such selected nodes be at least but approximately at A/√2 distance where the sensing field is of the dimension A*A. Such distance is maintained so that the network can be partitioned into four equal portions. Once the TCHs are selected, They, TCHs, start broadcasting their status so that other nodes may join them, hence forming the clusters. Then the TCHs locate the midpoint of their respective clusters and appoint the node, nearest to this location as Cluster-Head for the very first round. Remaining nodes attempt to these TCHs based on the received signal strengths by sending the JOIN-REQ message to the respective TCHs. CSMA used by sensor nodes to collision prevention while the JOIN-REQ messages is transmitting to their TCH. TCHs confirm the nodes of their membership by sending them the ACK message, containing the TDMA schedule of the nodes too. Along with these ACK packets, TCHs also request their members sending their respective coordinates. After having such information, TCHs compute the mid-points of their clusters and appoint a node in their cluster as the Cluster Head (CH). With the finalization of CHs and TCHs, set-up phase is complete.

Stable State Phase

This phase is same as steady-state phase of (EEITSSEP) [14]. In the phase of steady-states, the measured data sended by nodes to their equivalent CHs throughout their pre-owed slots of phase and time is supplementary broken into the frames. While each time-slot duration is constant and fixed, time necessary to send a frame depends upon the clusters have no. of nodes. Direct transmission approach is used for communication among CHs and the bases

station. In a cluster, radio of the member nodes are kept off until their allocated timeslot but radio of cluster-head is kept on always to receive data from all the nodes.

Selection of Responsible Node Phase

In this phase, cluster-heads (CHs) and the temporary-cluster-heads (TCHs) for the next round are selected in each cluster. At the every round beginning , each cluster nodes send their energy remaining information to the TCH equivalent. TCH then declare the highest value node of Eresidual as head of the cluster for the round (current) and the node with the least value of residual energy as TCH for the next round. Then CH broadcasts a roundstart packet including responsible nodes id into whole of its cluster which indicates the beginning of next round to other sensor nodes. This point sounds like the same as that is EEPSC, but this gives a significant improvement with respect to the older one as the first choice of CHs has been made around the central positions in the respective clusters.

IV. SIMULATION RESULTS

To evaluate the performance of the proposed scheme, EEITSSEP, MATLAB 7.1 as a tool for simulation. We consider that the nodes of sensor are randomly deployed across a area plained. Every node prepared with amount of equal energy at the simulation beginning. Table represents the simulation used various parameters and their values

Parameters	Value
Network Area	100m X 100m
Base Station's Position	(50m, 175m)
Number of deployed sensors	100
Initial energy for nodes	2 Joule
Size of data message	4000 bits
EDA	5 nj
$Eelec$	50 nj
Efs	10 pj/bit/$m2$
$Eamp$	0.0013 pj/bit/m_4

Table1:Parameters for Simultaion

Simulation Results

A set of experiments is conducted to test the performance of both schemes, EEITSSEP and EEPSC. From the results of various simulations performed as depicted in Fig. 4(a)-Fig. 4(d), it can be firmly stated that the proposed scheme, An Energy Efficient And Increase Threshold Sensitive Stable Protocol (EEITSSEP) outperforms EEPSC in term of lifetime of network.

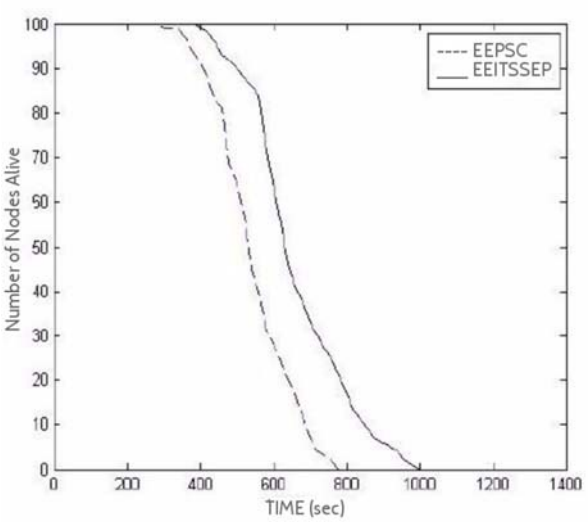

Figure 4(a): Number of Data Packets Received at BS

Figure 4(a) shows that the overall messages received at BS in case of Energy Efficient And Increase Threshold Sensitive Stable Protocol (EEITSSEP) are higher than with respect to EEPSC which is a clear indication of increased network-lifetime.

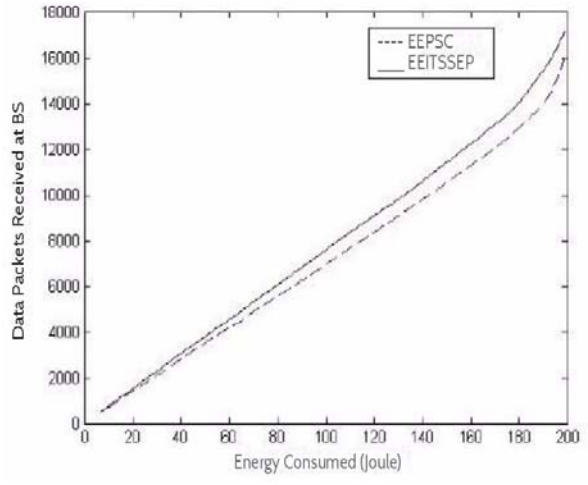

Figure 4(b): Packets Received at BS per amount of Energy

Figure 4(b) describes that the number of messages received at base station for any amount of energy consumed in the network is greater in

Energy Efficient And Increase Threshold Sensitive Stable Protocol (EEITSSEP) than that in EEPSC. Energy Efficient And Increase Threshold Sensitive Stable Protocol (EEITSSEP) results in greater data packets at less cost of network-energy in a consistent manner

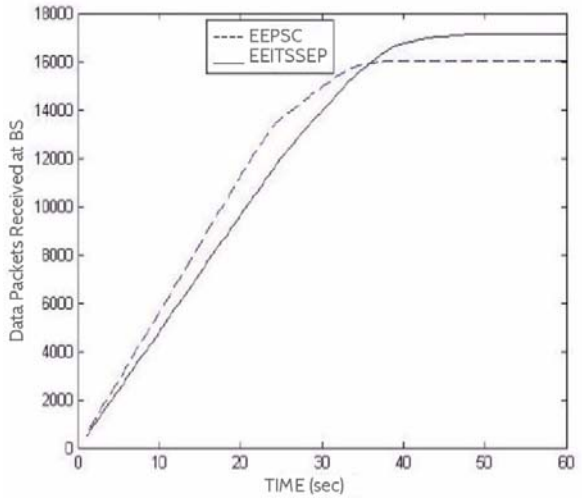

Figure 4(c): Nodes Alive Numbers Over Time

Fig 4(c) show the plot comparative number of alive nodes over time in both schemes. It indicates that the last node dies after 780 sec. in EEPSC whereas the same event occurs after 1000 sec. in Energy Efficient And Increase Threshold Sensitive Stable Protocol (EEITSSEP), hence a gain of more than 20% in terms of network lifetime has been achieved. Some of the authors have also defined network lifetime as the time when the first node dies in the network; even in that regard too, the proposed scheme outperforms the EEPSC as clearly shown . Not only the network lifetime, but also the nodes death rate is also lower than that in EEPSC; which confirm its supremacy over EEPSC.

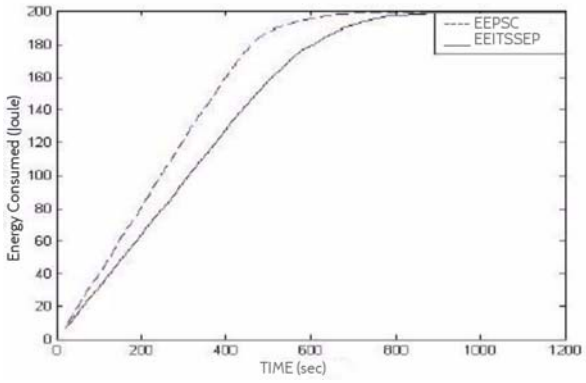

Figure 4(d): Energy Consumed in the Network over Time

Figure 4(d) clearly shows that the rate with which energy is consumed in the EEITSSEP is significantly lower than that in EEPSC resulting in a decay lower rate of the nodes too and hence achieving a longer network lifetime.

V. CONCLUSION AND FUTURE WORK

In WSN Protocol the stability and network lifetime are major key issues. In this paper,we have been proposed an energy efficient reactive cluster routing protocol. In order to improve the performance of the network system and lifetime, this paper report on the residual energy of the election of the cluster head. This improve the energy and stability of node.

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