ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

Enhanced Self-Organizing Tree-Based Energy-Balance routing protocol

Sonam Kamble[1], Dilip Kale[2]

ME Student, Dept. of Computer, Rajiv Gandhi Institute of Technology, Mumbai University, India

Assistant Professor, Dept. of Computer, Rajiv Gandhi Institute of Technology, Mumbai University, India

ABSTRACT: A wireless sensor network (WSN) consists of hundreds to thousands of sensor nodes, working in any physical environment, and having sensing, computation and communication capabilities. Each sensor node in WSN is capable of communicating with each other and the base station (BS) for the purpose of data integration and dissemination. As the battery replacement is not easy for WSN with thousands of physically embedded nodes, energy conservation becomes one of the most important challenges in WSNs. And hence there is a need for energy efficient routing protocol to offer a long-life work time. Along with the minimization of total energy consumption we also need to balance the WSN load. Till now many protocols have been proposed such as LEACH, HEED, PEGASIS, TBC and PEDAP. In this paper, we propose an Enhanced Self-Organizing Tree-Based Energy-Balance routing protocol (ESTBEB). In this protocol for each round BS assigns a root node and broadcasts this selection to all sensor nodes. And then each node selects its parent by considering only itself and its neighbour's information, thus making it a dynamic protocol.

KEYWORDS: Network lifetime;Energy-balance;routing protocol; dynamic protocol; wireless sensor network

I. INTRODUCTION

A. *Network Architecture*

In WSN, a large number of nodes are deployed in a region of interest. The region of interest is often a harsh environment, and the nodes are randomly deployed. The sensed data are transmitted through the nodes to special entities called sinks. The nodes with two or more network interfaces that act as gateway between the WSN and the user network (e.g. a LAN, or the Internet) are known as sinks. The sink usually collects and processes the data from the network sending only relevant information to the user. Sink also receives commands from the user. A sensor node can directly communicate with the sink (single-hop) or use a multi-hop communication passing the information to its neighbor. Single-hop communication leads to long distance transmission, while multi-hop communication results in high energy consumption. Multi-hop network architectures are divided in flat or hierarchical as represented in Fig.1.

In case of flat architecture each node plays the same role in sensing and transmitting the information. While in hierarchical architectures the nodes are organized into clusters. And in each cluster, one or more nodes (head node) are responsible to communicate with other clusters or directly to the sink. The head node may be dynamically selected by various criteria, including its available energy, distance between cluster members and other cluster heads, and node homogeneity.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

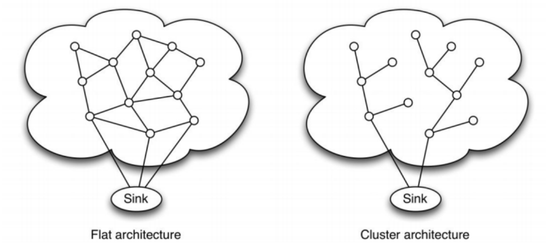

Fig.1. Network architecture

B. *Clustering*

In order to reduce the energy consumption a clustering and node redundancy approach is used. In Clustering approach, sensor nodes are divided into groups to form clusters. Cluster head (CH) is the leader of each cluster. This CH aggregate all the data received by nodes in cluster and sends aggregated data to Base Station (BS). Aggregation of data helps in removing the redundant data and combining the useful data. It also limits the data transmission. The cluster system improves the network lifetime by reducing the network traffic.

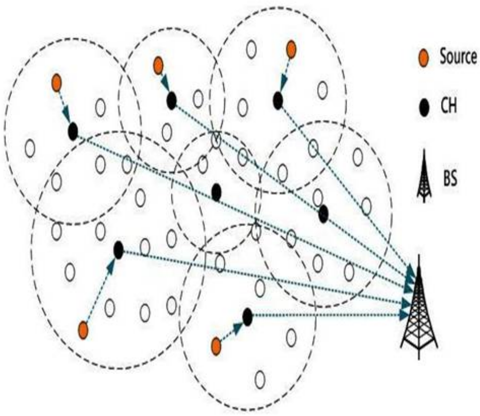

Fig. 2 Cluster System

Energy consumption of a node involves either "useful" or "wasteful" operations. The useful operations consist of transmitting or receiving data messages, and processing requests. While the wasteful consumption involves the operation of constructing routing tree, overhearing, retransmitting because of harsh environment, dealing with redundant broadcast overhead messages, and idle listening to the media.

In this paper, we are considering a situation in which the network collects information periodically from a terrain where each node continuously senses its surrounding environment and sends the data back to BS [6]. We are going to consider the definition for network lifetime, that is The time from the start of the network operation to the death of the first node in the network [2].

II. Related work

During the past decade, considerable research efforts have been investigated in developing clustering mechanisms for deployed sensor nodes in WSNs. The first well known clustering protocol developed by Heinzelman et al [8] is Low Energy Adaptive Clustering hierarchy with Deterministic CH Selection (LEACH). LEACH has been developed

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

based on a clustering mechanism to select CHs using optimal probability. The protocol works on periodic randomized rotations of the CH within the cluster range between zero and one. If the random number is less than the pre-determined threshold value, the node becomes a CH for the current round. The authors have succeeded to achieve a reduction in energy dissipation compared to direct communication and transmission protocols. However, since in the protocol the number of clusters is predefined, LEACH cannot guarantee an acceptable CH distribution. Additionally, due to lack of support in deploying network with a large number of sensor nodes, the protocol cannot be used in a large region. Moreover, LEACH suffers from significant energy consumption when there is no CH selected in some rounds.

In [5], the authors have proposed a hybrid, energy-efficient, distributed clustering algorithm (HEED). HEED is an improvement of LEACH on the manner of CH choosing. In HEED CHs are selected based on the residual energy of each node and secondary parameter considered is nodes proximity to their neighbours. By iterations and competition, only one CH is ensured by HEED within a certain range, so that uniform CHs distribution can be achieved across the network. HEED effectively prolongs network lifetime as compared to LEACH and is suitable for situations such as where each node has different initial energy.

LEACH and HEED consume energy heavily in the head nodes, which results in head nodes dying quickly. S. Lindsey *et al.* proposed an algorithm related to LEACH, and it is called PEGASIS [7]. PEGASIS uses GREEDY algorithm to make all the sensor nodes in the network form a chain, its nearly optimal power efficient protocol. In PEGASIS, the (i mod N)th node is chosen to be a leader. The leader is the only node which needs to communicate with BS in round i. N is the total number of nodes. Data collection begins from both endpoints of the chain, and then transmitted along the chain. The data is fused each time it transmits from one node to the next until it reaches the leader. This is how PEGASIS reduces the total amount of data for long-distance transmission and achieves a better performance than LEACH in terms of network lifetime.

Tree-Based Clustering (TBC) [4] is also an improved protocol of LEACH. It forms several clusters in the same way as LEACH, and each cluster has a cluster-head (CH). The nodes within a cluster construct a routing tree where the cluster-head is the root of it. For tree configuration, the cluster-head uses the distance information between the member nodes and itself. Each node is location-aware, it can estimate the distance between the root and itself. Every cluster is divided into some levels. The distance of a node to the root is the basis for determining its level in the cluster. The cluster-head is at level-0(root) and a node in level L(i) will choose the node in L(i)-1 and nearest to itself as its parent node. Data transfer simultaneously happens between the nodes in two neighbouring levels, and each node fuses the received data and transmits it to its parent. TBC is an excellent protocol in which each node records the information of its neighbour's and builds topography through computing, which is similar to GSTEB. But some cluster-heads in the network consume more energy than other nodes when BS is located far away.

PEDAP [8] is a tree-based routing protocol. In PEDAP all the nodes form a minimum spanning tree, costing minimum energy for data transmission. In PEDAP-PA energy is slightly increased for data transmission but balances energy consumption per node. PEDAP has the same network assumptions as PEGASIS and uses data fusion. However, both PEDAP and PEDAP-PA are protocols that need BS to build the topography which will cause a large amount of energy waste. This is because if the network needs BS to build the topography, BS has to send a lot of information to the sensor nodes, including what time is the Time Division Multiple Access(TDMA) slot, who are their child nodes and who are their parent nodes. . This kind of information exchanging will cause a lot of energy to be wasted or will cause a long delay.

III. PROPOSED ALGORITHM

The main aim of ESTBEB is to achieve a longer network lifetime for different applications. In each round, BS assigns a root node and broadcasts its ID and its coordinates to all sensor nodes. The path is computed by the network either by transmitting the path information from BS to sensor nodes or by having the same tree structure being dynamically and individually built by each node. For both cases, ESTBEB can change the root and reconstruct the routing tree with short delay and low energy consumption. Therefore a better balanced load is achieved compared with the protocols mentioned in Section II.

The operation of ESTBEB is divided into Initialization Phase, Root Node Selection Phase, Parent Node Selection Phase, Data Transmitting Phase, and Information Exchanging Phase.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

A. *Initialization Phase*

In the Initialization Phase we consider 100 nodes randomly place in a network field of 600m x 600m. The nodes are allocated energy randomly and the Base Station is allocated 100J energy. The Base Station is fixed and the remaining nodes are heterogeneous in nature with a mobility functionality. The co-ordinates of the nodes must be stored for further distance calculation.

B. *Root Selection Phase*

The ROOT node is selected by the Base Station which has the highest energy among the sensor nodes. Once the Base station selects the ROOT it will broadcast the root id to the remaining nodes in the network field.

C. *Parent Selection Phase*

In this phase each node searches for neighbors in the region of 250m range. Each neighbor count of the node is stored and processed. The node will select the parent from its neighbors having highest residual energy. The parent which is selected will in turn forward to the Base Station.

D. *Data Transmission Phase*

Each node will calculate distance from the parent and the root by using Euclidean distance formula. The distance which is shorter is selected for transmission. If the root is near the node, the node will send to the root directly. If not then it will send via parent.

E. *Information Exchange Phase*

If a node is getting exhausted with energy then the Base Station will in turn inform all the sensor nodes that the node is getting exhausted.

Algorithm

Energy Value Calculation
set alpha 10
select each node and fetch its energy
calculate EL(node) =exprenergyL(i) / alpha
display and store the Energy Level Value of All Nodes
Neighbour Count

1) For each node set count = 0
For each node calculate neighbour within range of 250m
- for each node calculate {
- if node within 250m range {
[Increment count]
Set count
}

2) Save the node with its neighbour count
}
Weight Calculation of Nodes
- Node weight= w1 * EL + w2 * NC
- Calculate for all nodes
- Save in file
- Display

Weight Calculation of Neighbours
- For each node
- Access the weights of the neighbours

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering
(An ISO 3297: 2007 Certified Organization)
Website: www.ijircce.com
Vol. 5, Issue 4, April 2017

```
- Save neighbour weight values.
Sorting of Highest Weight

3) for {set i 1} {node(i)} { incr i } {
- for {set m 1} {m <= neighbour count } { incr m } {
- for {set x 1} {x <= count(i) } { incr x } {
if { $NODE_NB(1) > $NODE_NB(2) } {
set swap node with highest energy
}
}}

4) Save the sorted neighbours in the file for each node
}}

Parent Selection
5) for {set i 1} {i < total nodes} { incr i } {
- for {set g 1} {g <= neighbour count} { incr g } {
- if { highest neighbour weight == node weight } {
set node ==Parent
} }
}
```

IV. EXPERIMENTAL RESULTS

In this project we have compared the results of GSTEB (General Self-Organized Tree-Based Energy Balanced) Protocol with EGSTBEB (Enhanced Self-Organizing Tree-Based Energy Balanced) with the Quality of Service parameters of the Wireless Sensor Network such as packet delivery ratio, packet drop, throughput, routing load. The simulation is done by the help of NS-2 (Network Simulator Version 2).

TABLE I
SIMULATION PARAMETERS

Parameter	Value
Simulation Area	600 x 600
Simulation Time	50 Seconds
Number of nodes	Random
Initial Energy	100 Joules
Routing protocol	AODV

Figure 3,4,5 and 6 shows different phases of the ESTBEB. Fig.3 shows the root selection phase in which a node with the highest energy level is selected as the root node. Once the root node is selected base station will broadcast id of the root node to all other nodes, fig 4 shows that. After this clusters are created based on the nearest neighbouring nodes. And for each cluster there will be one cluster head. Fig 5 shows the cluster head selection i.e. parent node selection

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

phase. Once the clusters are created data transmission begins. In fig 6 we can see how the data is transmitted among the clusters.

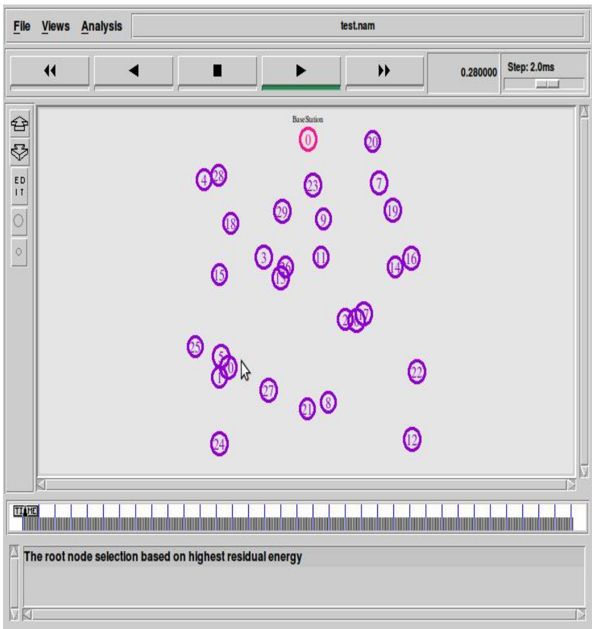

Fig.3 Root selection phase

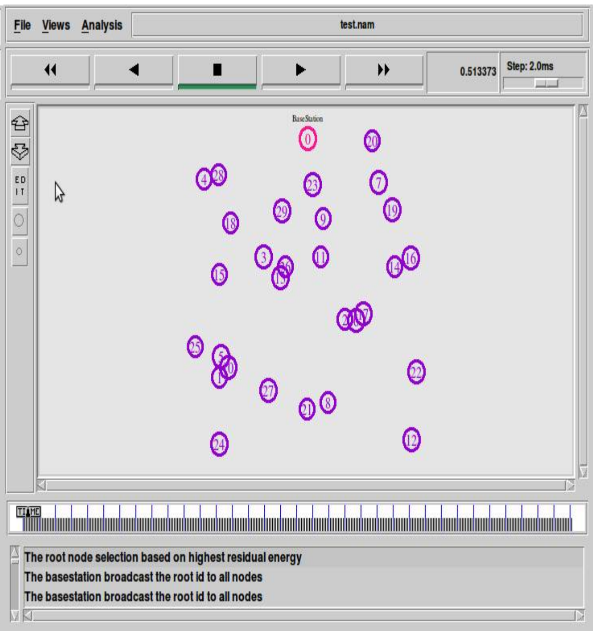

Fig.4 Broadcasting phase

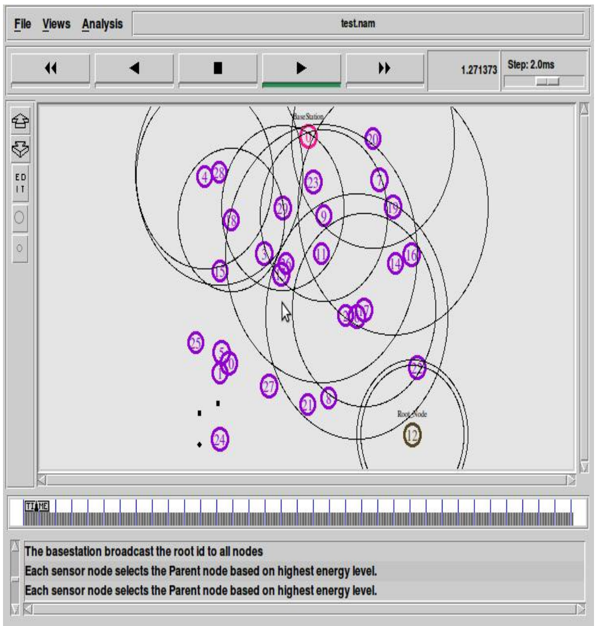

Fig.5 Parent selection phase

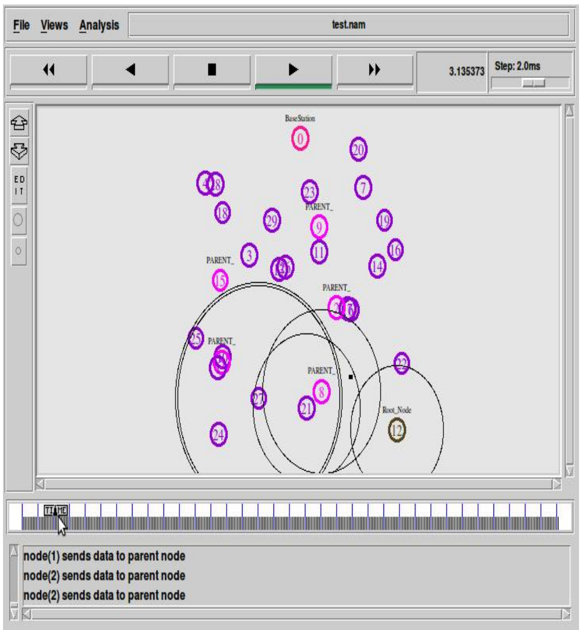

Fig.6 Data Transmission Phase

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

The comparison shows that GSTEB and ESTBEB in terms of PDR, RL, Packet Drop and Relay with varying number of nodes.Results of quality ofService parameters such as packet delivery ratio, routing load, packet drop and throughput are shown below:

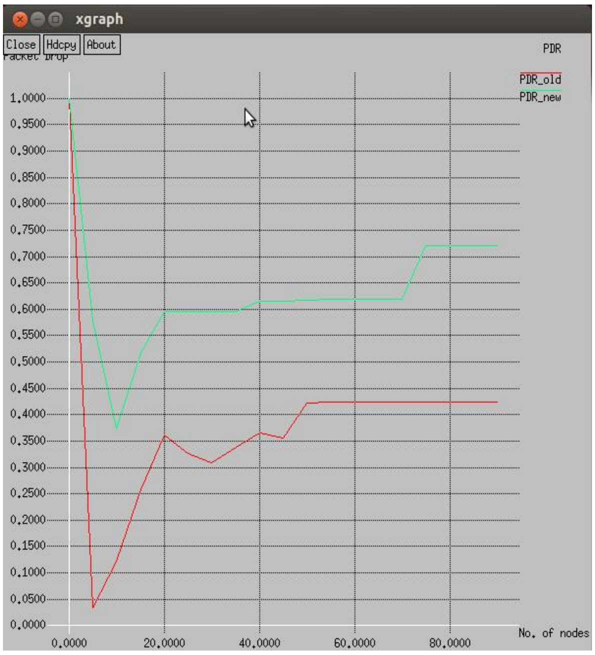

Fig.7 Packet Delivery Ratio

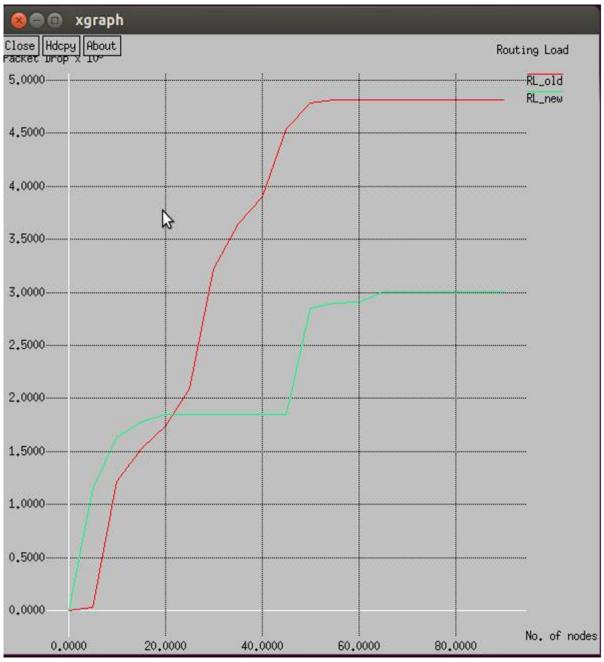

Fig.8 Routing Load

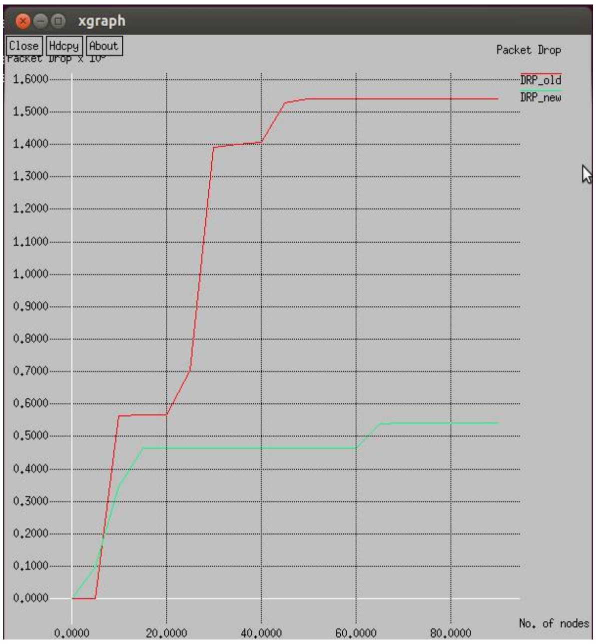

Fig.9 Packet Drop

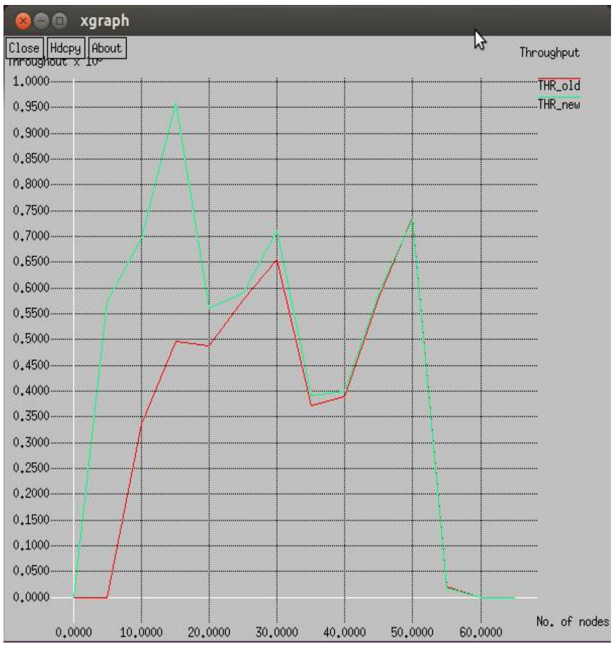

Fig.10 Throughput

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 4, April 2017

V. CONCLUSION AND FUTURE WORK

We simulate the Enhanced Self-Organizing Tree-Based Energy-Balance routing protocol (ESTBEB) using Network Simulator-2 (NS-2). In WSN, along with the minimization of total energy consumption we also need to balance the WSN load. The algorithm provides energy efficient path for data transmission and maximizes the lifetime of entire network. The performance of the proposed algorithm can be compared with other energy efficient algorithm.

REFERENCES

1. H. O. Tan and I. Korpeoglu, "Power efficient data gathering and aggregation in wireless sensor networks," *SIGMOD Rec.*, vol. 32, no. 4, pp. 66–71, 2003.
2. J. H. Chang and L. Tassiulas, "Energy conserving routing in wireless ad hoc networks," in *Proc. IEEE INFOCOM*, 2000, vol. 1, pp. 2–31.
3. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks," *Elsevier Ad Hoc Network J.*, vol. 3/3, pp. 325–349, 2005.
4. K. T. Kim and H. Y. Youn, "Tree-Based Clustering (TBC) for energy efficient wireless sensor networks," in *Proc. AINA 2010*, 2010, pp. 680–685.
5. O. Younis and S. Fahmy, "HEED: A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks," *IEEE Trans. Mobile Computing*, vol. 3, no. 4, pp. 660–669, 2004.
6. R. Szewczyk, J. Polastre, A.Mainwaring, and D. Culler, "Lessons from sensor network expedition," in *Proc. 1st European Workshop on Wireless Sensor Networks EWSN '04*, Germany, Jan. 19-21, 2004.
7. S. Lindsey and C. Raghavendra, "Pegasis: Power-efficient gathering in sensor information systems," in *Proc. IEEE Aerospace Conf.*, 2002, vol. 3, pp. 1125–1130.
8. W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energyefficient communication protocol for wireless micro sensor networks," in Proc. 33rd Annu. Hawaii Int. Conf. Syst. Sci., vol. 2, Jan. 2010, pp. 10–15.
9. W. B. Heinzelman, A. Chandrakasan, and H. Balakrishanan, "An application-specific protocol architecture for wireless micro sensor networks," *IEEE Trans.WirelessCommun*, vol. 1, no. 4, pp. 660–670,Oct.2002.

BIOGRAPHY

Ms.Sonam Ashok Kamble[1]is a ME student in the Computer Department of Rajiv Gandhi Institute of Technology, Mumbai University.

Mr. Dilip Kale[2]is an Assistant Professor in the Computer Department of Rajiv Gandhi Institute of Technology, Mumbai University.