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MOBILE SINK BASED EDDEEC FOR HETEROGENOUS WIRELESS SENSOR NETWORK

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Abstract

Clustering is a Key Technique that reduces energy consumption. Sink Mobility is another concept that is used to increase the longevity of sensor networks. This paper discusses about the Combination of Sink Mobility and Clustering technique to prolong the life time of the sensor networks. Among the various Clustering techniques, Enhanced Developed Distributed Energy –Efficient Clustering (EDDEEC) algorithm for Heterogeneous Wireless Sensor Networks is chosen to be combined with the Sink Mobility Concept. In EDDEEC, Base station is stationed at one Place. In the Sink Mobility concept, this base station (sink) is moved randomly around a set of heavily loaded sensor nodes there by evenly distributing the energy among the sensor nodes. Because of this even distribution of energy, the burden on the Sensor nodes is gradually reduced and hence the life time of those nodes are significantly increased. The conducted simulation exercise results prove that the proposed scheme achieves longer life time with Sink Mobility.

Keywords: Clustering, Sink, Energy Efficiency, Event, Heterogeneity.

I. Introduction

Wireless sensor network is composed of many sensor nodes, which sense and monitor the vital information like temperature, humidity, etc., In wireless communication, two types of nodes play the key roles one is the Sensor node that performs the sensing operation and the other is the Sink node that stores the data sent by the Sensor nodes., so whenever we need the information it could be retrieved from it. In the prevailing methods, the load on Sensor nodes that are located near the Base station is huge as they have to forward the data received from the other Sensors that are located in the Sensor field. The main limitation of this existing method is that the Base station (Sink) is stationed at one place. In our proposed method, we are going to deploy the power of Sink Mobility into the existing EEDEEC

Clustering algorithm [1] which follows the three levels heterogeneity schemes. This scheme is based on the random Sink selection approach. We will discuss the following topics in the rest of the paper.

II. Sink Mobility

The concept of using mobile sink is to balance the energy consumption, there are two approaches used in sink mobility. In this method, when a sink node gets burden by having to process more information from its adjacent sensor nodes then automatically one of the other existing sensor node will become the Sink node to take care of the sensor information[2]. Following are the different approaches that have been used in this sink mobility scheme.

- LBM (load based sink movement)
- REAR (residual energy aware routing)
- Hybrid method

Among these, this paper will discuss about REAR approach in detail [2].

III. Flow Diagram

The diagram 1 depicts the flow of the data from the Sensor to the base station through hoping of various Sink nodes until it reaches the destination.

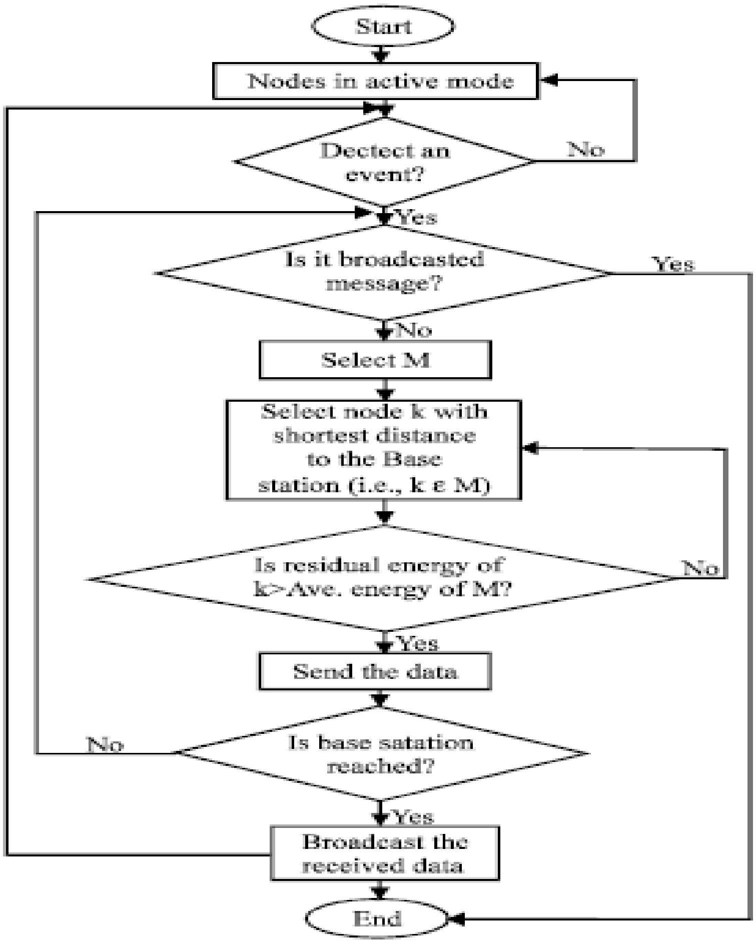

Fig. 1: Data flow in Sink Mobility

At the start, some of the nodes will be in active mode and ready to send the data. All the other nodes will be in relaying mode and ready to receive data for forwarding them to the Sink [6]. When an event is raised, the first node that receives it will check whether it is the broadcasted message, if so then it will send that to the sink directly else it will check for the shortest available route to the sink and accordingly forward the date to the closest node available in that route. This process continues until the data reaches the sink.

IV. System For Energy Efficient Strategy

This System for Energy Efficient Strategy (SEES) [8] is an even driven Sensor network system equipped with Sink Mobility. Sensing activity is purely based on the random events that are not known in advance. Once the event occurs, the nearby sensor will pick up that event and forward that to the sink node. If the sink is far away, then the sensor will forward the event information to the other sensory nodes that are in the shortest route to the sink. Basically it utilizes the Self-approaching algorithm to select the tentative position for the Sink node [8]. This SEES decides:

A. When to move the sink mode

B. Where to move that sink node.

To summarize, the main purpose of SEES is to make the highly energetic active sensor node as the Sink node thereby reducing the overall transmission distance for the data in the sensor network. The optimal position of sink node $p$optimal = (Xs, Ys)

$$X_S = \frac{\sum_{v \in E} x_v}{|E|} \quad (1)$$

$$Y_S = \frac{\sum_{v \in E} y_v}{|E|} \quad (2)$$

Here E is the set of all *active* sensor nodes in the network and (xv, yv) are the coordinates of sensor node $v \in E$

V. Rear Algorithm

The goal of the algorithm is to avoid the low energy nodes; it will calculate the routing paths from each sensor to sink [2]. This algorithm will chose the node based on their energy levels; only during exceptional situation it will use the low energy node.

The important role of rear algorithm is that edge cost are calculated differently for energy level.

$$C_{ij} = d_{ij}^2 \, d\_ij + \alpha \, . \, (IE - RE_j) \quad (3)$$

Where,

- IE is the Initial energy level for each sensor node when the network is first deployed, this is assumed to be the same for all sensors.
- REj is the Residual energy level of sensor node. d_{ij} is the transmission distance between the sensor.
- The sink node d_ij is the distance between the adjacent sensors and α is the pre specified weight of the sensor nodes.

According to Equation (3) it is clear that lower the residual energy of a node (i.e., lower value of *REj*), higher the complexity to send the data by that node. Once the routing paths are calculated, based on the assigned position of sink, the load on each sensor node and the final position of the sink can be determined, The purpose of REAR is to avoid using sensors that are running low on residual energy. Instead it attempts to utilize sensors with higher residual energy as the first option to set up alternative routing paths, so that the energy dissipation can be balanced. As a result each individual sensor node can achieve a longer lifetime and extend the lifetime of the network.

Following steps are used to calculate the position of sink

Step 1: Calculate tentative sink position $p_{tentative} = (X's, Y's)$, based on SESS from equation (1) and (2)

Step 2: Calculate paths, using the shortest path algorithm [] to compute the path from each sensor $si \in S$ to sink node at $(X's, Y's)$.

Step 3: Determine load on each sensor node, Load on node sj is

$$bj = \Sigma\, s_i \in S \;\; r_{ij} \cdot b_i + w_j, \forall\, s_j \in S \qquad (4)$$

Where,

- b_j is number of bit transmitted by the sensor node $s_j \in S$
- w_j is the total number of bits generated by the sensor node $s_j \in S$
- $r_{ij} = 1$ if and only if node s_i transmits its data directly to node s_j
- S represents the set of Sensor nodes

Step 4: Calculate final sink position $p_{final} = (Xs, Ys)$

VI. Network Model

Each sensor node in this proposed method can either sense event or forward data or remain idle [12]. The actual status of node changes many times over the lifetime of the network. The changes in the status may occur as a response to start /or end of the random events due to energy level with in the node [8] [6]. At any point in time, each sensor node can be in anyone of the following state.

A. Active- sensor is operational and generating data
B. Relaying –sensor node is operational and forwarding data from other sensor
C. Idle-sensor node is operational but is not generating or forwarding data
D. Dead- sensor node has exhausted its energy

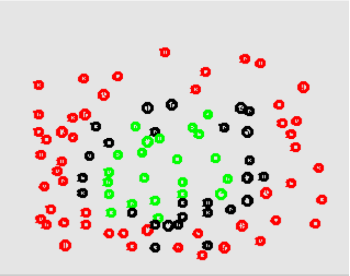

Fig. 2. Sensor nodes distribution in the field.

Sensor nodes are randomly deployed in the network field. To calculate the tentative sink position; sensor node will send the data to the sink via other sensor nodes that can forward the data. All the nodes that sense and forwarded the data to nearby sink sensor nodes have multi-level heterogeneity in terms of energy i.e. all nodes have different initial energy some nodes have more energy than the other nodes

VII. Experimental Setup

It has been proven already that in SEES, sink mobility can significantly extend the network life time [2][10]. Mobile sink placement achieves a considerable improvement compared to the existing method. In this work, we will evaluate our proposed scheme to justify how we achieved further improvement compared to our existing method in prolonged network lifetime. In this experiment we measure the following factors to prove that how these factors are improved in the proposed system are:

A. Network life time
B. Energy consumption
C. Longevity of the node
D. Energy distribution

6. Simulation and Result

In this section we present the simulation result of the mobile sink based EDEEC using network simulator tool. A sensor network consist of ‘n‘ no of sensors that are randomly deployed in sensor field, each sensor finds the tentative sink position. Sensors send the data packets to sink by using the shortest path algorithm. In mobile sink based EDDEEC heterogeneity wireless sensor networks we used the following parameters

Parameters	Values
No. of nodes	100
Initial energy	100j
Message size	4000 bits
Max transmission Range	40-60m
Size of data packets	10 bits
Energy dissipation for processor	100nJ/unit
Amplifier energy dissipation	100nJ/bits
Protocol	AODV

Table-I: Simulation Parameters.

In our simulation, we deploy 100 sensor nodes that belong to three types. Normal nodes (22 nos.), Advanced nodes (25 nos.), having twice the amount of energy of normal nodes and Super nodes (53 nos.), having the thrice the amount of energy of normal nodes. Figure 3 and figure 4 point out the alive rate and death rate of sink, where super node is indicated by blue in colour, advanced node indicated by the green in colour and normal node I indicated by red in colour. Figure 5 indicates the packet delivery of the sensor network. Figure 6 indicates the packet throughput of the sensor network. At the end of the simulation nine super node and five advanced node and four normal node deaths. Figure 7 and figure 8 proposes the comparison of existing and proposed method.

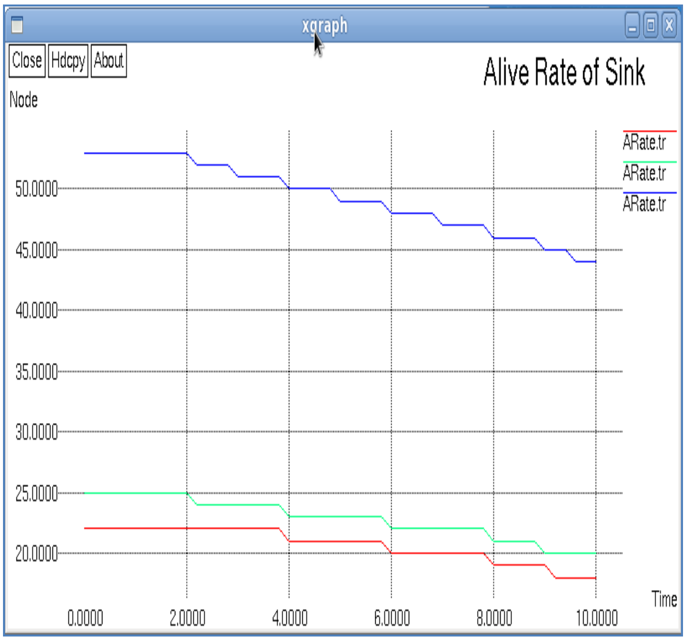

Fig. 3. Alive rate of Sink.

Fig. 4.Death rate of Sink.

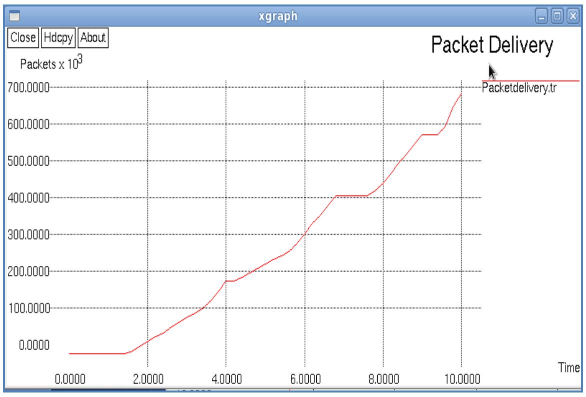

Fig. 5. Packet Delivery.

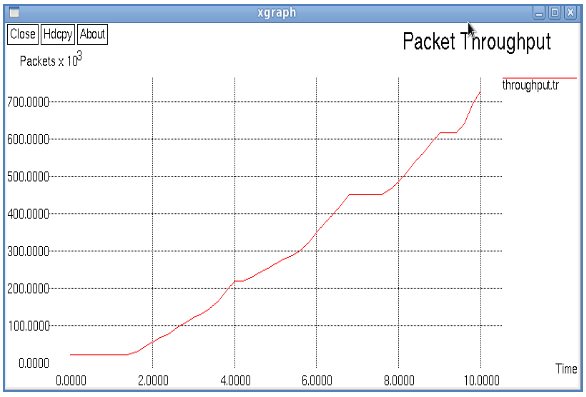

Fig. 6: Packet throughput.

VIII. Comparison of Approaches

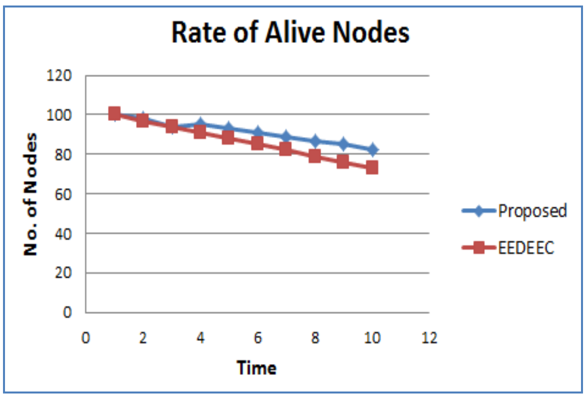

Fig. 7. Alive rate of nodes.

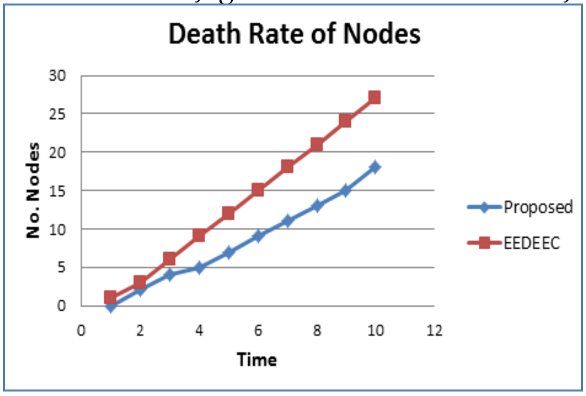

Fig. 8. Death rate of nodes.

IX. Conclusion

In this mobile sink based is proposed for wireless sensor network is AODV protocol which use random sink approach and the distribute the energy uniformly throughout the network we performance the and evaluation simulation new proposed method In this thesis, REAR scheme is applied to prolong the network lifetime in the time based, random event driven scenario. In this scenario, random events arise frequently and last for a specified period of time. REAR scheme is designed to utilize the energy dissipation in a more balanced way to extend the overall network performance and Sensor nodes' lifetime. REAR scheme establishes alternative routing paths to reduce the usage of those sensors running low in residual energy there by preserving the energy on each sensor node as much as possible [8] [2]. A network simulator tool is used to evaluate the performance of the proposed approach, and compared with existing EDDEEC approach. The simulation results clearly indicate that the proposed approach consistently outperformed well than existing method.

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