ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 9, September 2016

An Energy Efficient Clustering Algorithm in Wireless Sensor Network

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***Abstract*—In this fast forward world, we require all the information instantly . In some areas, Wireless Sensor Network is helping us to get this information. In aa thousand of cheap micro-sensor nodes allows a user to monitor a remote environment for civil as well as a military application from the main station. The data collected by micro-sensors is communicated through a network to a single sink node. For this communication first cluster sensors into groups, and via cluster head they will communicate to a sink node. Major energy Is getting consumed while communicating with the sink node resulting the sensors life become very short. This consumption of energy is not advisable, and also at the remote place it is very difficult to replace the battery of thousands micro sensor. To solve all these issues the algorithms has been invented . For effective balances cluster head and prolonged network lifetime, there is a novel uneven clustering scheme invented by Qi Zhang(2). By considering residual energy and distance from the sink node the modified algorithm has given a better performance. The same algorithm is called Distance and Energy Based Uneven Clustering (DEUC). By changing the method of selection of cluster head and also changing the probability factor modified DEUC algorithm gives a better performance than the previous one. The modified algorithm improves the lifetime of the node also the energy of the network.**

***Keywords*—Algorithm ,Network. LEACH,DEUC**

I. INTRODUCTION

Wireless Sensor Network is attentive field in the world wide in recent years due to advances occurs in wireless communication. Recent advances in Micro Electro Mechanical System (MEMS), Wireless Sensor Network (WSN)[1] playing a vital role in our day to day basis. These MEMS are working on simple principle i. e. Sensing, CPU & Radio. These sensors are distributed in the area from which we want to gather an information. The gathered information is then processed and transmit to the users. This type of method of communication is used to monitor variety of environment like civil and military applications. Previously human used to rely on wired sensor network for simple task like temperature monitoring to complex task such as monitoring of life-signs in hospitals. In this wireless sensor network the sensors are distributed in the area from which we want to gather an information. In recent trends the research in low cost , low power and multi-functional sensor is increasing. Major areas of WSN is target surveillance and battle field mapping where sensor can monitor safety and provide information to the sink node. A wireless network don't have infrastructure. It consist thousands of sensor node scattered around the area. Presently available sensors devices are considerably constrain in terms of memory, power, efficiency and capability of communication due to technological as well as economical reasons. Because of this most of the research is concentrated on efficient algorithms and protocol. The"In Situ" sensing technology consisting automated compact devices named sensor nodes sensing the data and report it to base station. These nodes are battery operated and it deployed to perform specific task for a long period , even several years. If these nodes are giving more battery life it is beneficial to use their communication and computational data for the network. The wireless network is of two types. Structured and unstructured. In the unstructured network the nodes are deployed and left unattended to perform the work. But in structured network the nodes are deployed in preplanned manner. From these nodes any one node can be choose randomly as a cluster head which passes the information to the sink node. This cluster head changes timely and it depend on probability. In DEUC algorithm the cluster head is selected by probability factor which is used very old method. Also while selecting cluster head node energy is not being considered Because of this energy distribution is not proper. Resulting network life time is less. In this paper, we propose a new clustering approach based on the distance and residential energy of the sensors. The selection of cluster head is depending on average energy of cluster head.

II. RELATED WORK

Very initially the LEACH [1] [2]has been invented. LEACH is Low Energy Adaptive Clustering Hierarchy algorithm. LEACH uses a random rotation of cluster head

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and providing balancing of energy usage.Heinzelman, et. al. [3] have introduced a LEACH a hierarchical clustering algorithm for sensor networks, This Low Energy Adaptive Clustering Hierarchy (LEACH) is a cluster based algorithm . This algorithm randomly selects a few sensor nodes as a cluster heads and rotates this role evenly.In DEUC [4] algorithm the distance and energy uneven concept is used . To transmit l bit data for a distance d the energy consumption is as follows:

$$Etx(l,d) = \begin{cases} lEelec + lEfsd^2 d < d0 \\ lEelec + lEmpd^4 d \geq d0 \end{cases} \text{-----1}$$

$$E_{elec}\ is\ radio\ Dissipation$$

E_{fs} is the free space coefficient

E_{mp} is the multipath fading parameter.

$E_{RX} l = lE_{elec}$ ----------2

From above equation if the distance is far enough the energy consumed is mainly about the distance and the amount of data.

To aggregate l- bit data the energy is

$E_{DF} l = lE_{DA}$ ---------- 3

$E_{DA}$is the aggregate coefficient.

In TDEEC[5] algorithm the probability factor is choose Pi will be as follows.

$$P(i) = \begin{cases} \frac{P_{opt}E_i(r)}{(1+m(a+M*b))E(r)} & \text{if } si \text{ is the normal node} \\ \frac{P_{opt}(1+a)E_i(r)}{(1+m(a+M*b))E(r)} & \text{if } si \text{ is the advance node} \\ \frac{P_{opt}(1+b)E_i(r)}{(1+m(a+M*b))E(r)} & \text{if } si \text{ is the super node} \end{cases} \text{-----4}$$

By substituting value of P we get value of threshold

$$T(s) = \begin{cases} \frac{p}{1-p\left(r \bmod \frac{1}{p}\right)} * \frac{Residual\ Energy\ of\ a\ node * Kopt}{Average\ energy\ of\ network} & S \in G \\ 0 & otherwise \end{cases} \text{---5}$$

Ecluster=

Ehead-receive+Ehead-transmit+Enode-transmit-----6

Ehead-receive – is the energy that the cluster head gets data from the node on its cluster

Ehead-transmit – the energy that the cluster head transmit to the next hop.

Enode-transmit – the energy that nodes in a cluster transmit data to the cluster head.

Ehead-receive=l*πRc2*mdensity*(ERX+EDA) -------7

Rc – is the radius of the cluster.

mdensity- is the density of the nodes in the cluster.

From equation 1 we can get

$E_{node-transmit} = \pi R^2 * M_{density} E_{elec} + E_{fs} * E[r^2]$ ----8

$E[r^2]$is the expectation value ofR^2 and equals to$\frac{1}{3}{R_c}^2$

$E_{head-transmit} = (E_{elec} + E_{fs} * \mathrm{d}hop2)$*ηT --9

$d_{hop}$is distance between the cluster head and its next hop destination.

n_T – transmit parameter represents the number of data transmission through cluster head.

Here assumption is that sink node is not close to the sensor node, also $n_T$is inversely proportional to the distance between the cluster head and sink node.

$N_{T=}$ ----------10

where*dl* is distance between cluster head and sink node

dmax– max. distance between sink node and sensor node.

Avg. node energy consumption of the cluster is given by following formula

$$E_{avg} = \frac{E_{cluster}}{number\ of\ nodes} = \frac{E_{cluster}}{\pi R^2 * M_{density}} \text{----------11}$$

When energy consumption in the area is balanced then the average energy consumption of each cluster will be same.

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$$R_{C_=} \sqrt{\frac{d_l}{d_{max}}} * R_c{}^0 \quad \text{----------12}$$

R_c^0- radius of the furthermost cluster. By equating d0 = R_c^0we can save energy.

It has been finalized that the energy of the cluster head decrease the radius of the cluster head should also be decreased for energy saving

Finally it has been proven that

$$R_{C_=} \sqrt{\frac{d_l}{d_{max}}} * R_c{}^0 \quad * \frac{E_{res}}{Etotal} \quad \text{----------13}$$

III. SIMULATION

We use 200X200 field size to deploy the sensor node in the simulation software. We implemented the algorithm in command level. MATLAB software use for simulation purpose. For simulation purpose we consider parameters shown in table 1.

First we implemented LEACH algorithm and Then TDEEC, DEUC and after modified DEUC and compare the performance of all.

The modified algorithm is giving better performance than the DEUC algorithm.

Parameter	Value
Area	200X200
Location of the sink node	(100,100)
Number of nodes	150
Initial Energy	0.5J
$E_{elec}=E_{Rx}=E_{TX}$	50 nJ/bit
ε_{fs}	10PJ/bit/*m*2
ε_{mp}	0.0013PJ/bit/*m*2
E_{DA}	5nJ/bit/signal
Packet Size	4000 bits

Table 1: Parameters for Simulation

IV. RESULT

For three level heterogeneous network we use following parameters m=0.6, m0= 0.5, b= 0.3 and a=1.

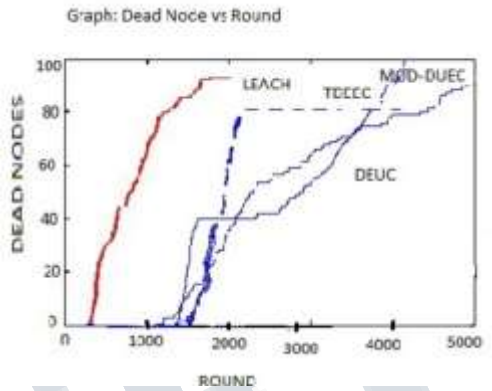

Fig. 1. Dead Node verses Round

Dead Nodes	Round			
	LEACH	TDEEC	DEUC	Mod-DEUC
1	200	1500	1200	1500
20	200	1500	1200	1800
50	1000	2000	3000	3000
70	1000	2000	3500	4000
100	1500	2000	3800	5200

Table 2: Comparison of Dead Nodes to Round

From table and fig 3 it is clear that all 100 nodes of Mod- DEUC algorithm are alive till round 1500. Also all 100 nodes are from other

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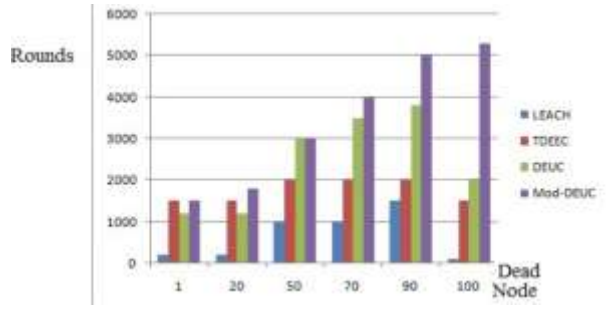

algorithm become dead till 4500 round. But in proposed algorithm all 100 nodes dies after 5200 rounds. Hence it is clear that the he modified DEUC gives longer network lifetime than other algorithms.

CONCLUSION AND FUTURE WORK

The conventional sensor network protocols like LEACH fails to ensure the capability of the network for a longer time. In this work a Distance and Energy Uneven Clustering protocol is ensures maximum lifetime of the edges. By using three level heterogeneousnetworks we select the cluster head as per energy of the node. In this method the highest energy of the node is selected as a cluster head for more number of times. Because of this the node having less energy will withstand for more time and accordingly the network lifetime is getting increased and thus minimizing the losses. Result show that the lifetime of the proposed system is better than the conventional Leach, DEUC, DEEC.There are some issues of throughput, Hence the work can be further improved by incorporating data aggregation method.

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