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Analysis of GFEAR Protocol

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Abstract—

Recently wireless sensor network have witnessed research interest in a wide range of applications. The open challenges in Wireless Sensor Network are harmonizing energy utilization and extending network lifetime. The network routing protocols are major responsible for maintaining routes. The existing routing protocol has a drawback that it operates on the basis of the Geographical data for routing by which data aggregation at any point is absent and also has a problem of limited scalability. Existing protocols have moderately high overhead which affects the energy efficiency. The proposed GFEAR (Gateway based fidelity Energy Aware Routing protocol) for WSN is discussed in this paper. This conserves energy when unnecessary nodes in the network sleep without affecting the routing fidelity. The performance of the proposed protocol is evaluated using MATLAB and the results obtained were compared with LEACH (Low Energy Adaptive Clustering Hierarchy). It is shown by simulation that the GFEAR performs better than the LEACH in terms of the Throughput, percentage of alive nodes, dead Nodes and energy of data transmission.

Keywords— GFEAR, LEACH, Routing, Energy, WSN

I. INTRODUCTION

Wireless sensor network (WSN) is broadly considered as one of the most imperative technologies for this technology era. In the earlier period, the WSN has received fabulous attention from both academicians and industrialist in the overall globe. The intend of diverse type of networks for abundant purposes was led due to the rapid growth in the technologies. A Wireless Sensor Network consists of wireless sensor nodes spatially distributed which are of low power consumption, low cost and multifunctional nodes in which each node connected to a sensor which contains the transceiver and also the battery. It also has wireless sensing, communications and wireless computation capabilities. Many useful applications like surveillance in military, industrial processes, monitoring of environment is done using those sensor nodes which communicate and transmit the relevant information to the short distance through the wireless medium. The core thought behind the Wireless sensor network is that, for the particular operations the collective power of the entire network is sufficient while the potential of each individual sensor node is limited. This property makes the rapid growth and use of WSN. Now a days in many wireless sensor network applications the sensor node is developed using an ad hoc technology without any correct plans and technology. Once it was developed the sensor node will autonomously organize them in to a wireless communication network. Even if it is intended using Ad hoc technology the sensor nodes need a battery power and these nodes are expected to operate without any maintenance for a long period of time. In this paper the new routing protocol which is based on the GEAR method is proposed and it is called as GFEAR (Gateway Based Fidelity Energy Aware Routing). The section 2 deals with the related works and the section 3 deals with the proposed methodology and the result in the section 5.

II. RELATED WORKS

Nazia Majad [1] proposed the technique called U-Leach. In the practice of clustering the random distribution of cluster heads make the network life time effective. Whereas for the whole network Leach cannot distribute the cluster head in random. Thus this matter has been solved using the U-Leach method in which within the transmission range of CH each sensor node remains and thus, the life span of the network is extended.

Threshold Sensitive Stable Election Protocol (TSEP) [2] has been proposed which is reactive protocol heterogeneity and used in three levels. The performance has been calculated and the simulation result has been compared with the other protocol algorithms like LEACH, DEEC, SEP, ESEP and TEEN [2-8].

Based on the sensing field location the sensor nodes divided into four logical regions. Out of the sensing area the base station has been installed and at the center of the sensing area the gateway node was installed. And the other nodes were divided in to two regions equally which distance is beyond the threshold distance. Based on probability in each region a cluster head has been selected which are independent to other region. And the performance has been compared with leach protocol.

Juan L et al [9] focus on data relay in one-dimensional (1-D) queue network with minimizing energy consumption and maximizing lifetime of the network. Through opportunistic routing algorithm is designed to protect the nodes with low residual energy and to minimize the power cost during relay for saving the energy.

Anuja et al [10] proposed the novel routing strategy. The position based routing protocol was used. The two location based routing protocols used are Geographic and Energy Aware Routing - GEAR and GAF - Geographic Adaptive Fidelity. The not lively which are in resting mode nodes are used in this algorithm[11-16].

Hussaini et.al [18] proposed an enhanced radio model. This model has been proposed to adapt the frequent changes in the sensor nodes location. And also investigates the impact of stepwise energy level and the enhanced data transmission scheme[19-21].

III. GFEAR

LEACH stands for Low-Energy Adaptive Clustering Hierarchy is most popular hierarchal routing protocol for sensor networks. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads compress and aggregate the data and forward it to the base station. It assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

GFEAR is a Gateway Based Fidelity Energy Aware Routing for WSN which is proposed in this paper. This protocol conserves energy since the unnecessary nodes in the network sleeps without affecting the routing fidelity. The sensor nodes in the network arrange themselves in the form of grids. The nodes which are placed in a same grid manage among themselves to decide who will go into sleep state and for how long. In order to improve lifetime of the network and throughput, a gateway node at the centre of the network field is deployed. Purpose of gateway node is to collect data from CHs and from nodes near gateway, which is aggregated and send the data to BS.

There are three states in this protocol

- Sleep
- Discovery
- Active

These states are *discovery*, for determining the neighbors in the grid, *active* reflecting participation in routing and *sleep* when the radio is turned off. Our results ensure that network lifetime and energy consumption.

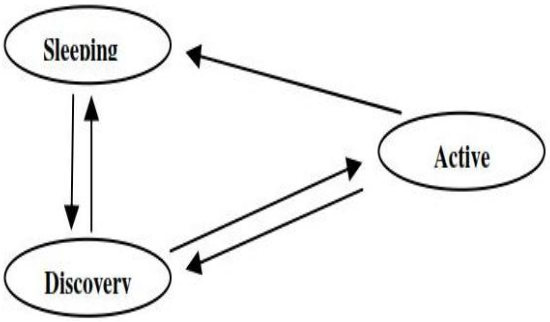

Fig. 1 State Diagram

IV. DATA TRANSMISSION

i) Cluster Formation

After selecting CHs, It advertise to the nodes in the network. Depending on the strength of the signal, the nodes decide to join with which cluster.

ii) CH selection

Every round begins with a CH selection. Each node in the network decides whether to become the CH for the current round or not. Depending on the required percentage of cluster heads for the network and the number of times the node has been a cluster head. For any node *n*, the threshold equation for CH selection is given by,

$$\mathbf{T(n)= p/1-p*(r^2 \bmod 1/p)}$$

if n € G

T(n) – 0, otherwise

where, P is the desired percentage of CH, r denotes the current round and G is the set of nodes that have not been CH in the last 1/P rounds. Every node in G selects a number between 0 and 1 in random manner. The CH for the current round is selected if the number is less than the threshold value.

iii) Transmission Schedule Creation

The data transmission takes place based on Time Division Multiple Access (TDMA) technique. Depending on the number of nodes in the cluster, the CH allots different time slots for each node to transmit the data.

V. RESULTS AND DISCUSSION

This section presents the simulation results of our proposed protocol using MATLAB. The performance of our proposed protocol is compared with LEACH routing protocol in wireless sensor networks in terms of the Throughput, percentage of alive nodes, dead Nodes and energy of data transmission. We consider a wireless sensor network with 100 nodes distributed randomly in 100m X 100m field. A gateway node is deployed at the centre of the sensing field. The BS is located faraway from the sensing field.

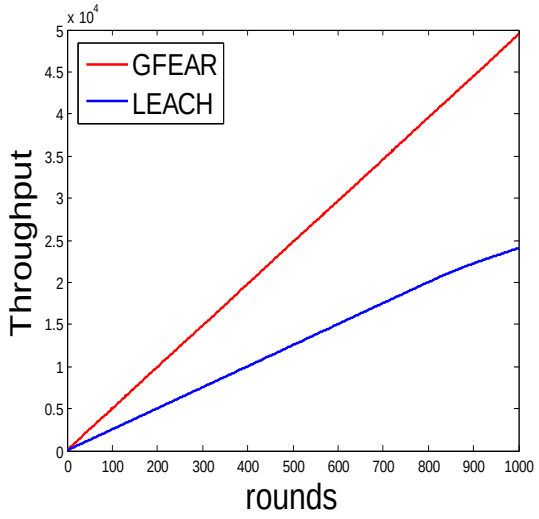

Fig.2: Analysis of Throughput

Analysis of throughput

During simulation the packets has been sent to the base station in order to analyze the throughput. Fig.2 describes the performance comparison of the GFEAR and LEACH protocols. When the round is 600, GFEAR achieves throughput of 3.5 and LEACH has 1.5. It clearly defines that the throughput of GFEAR increases than LEACH protocol.

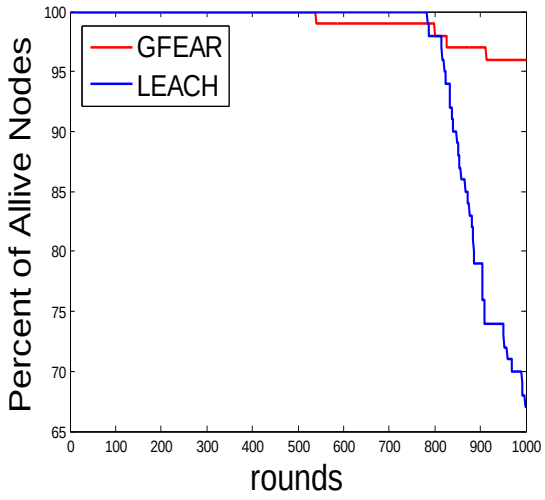

Fig.3: Analysis of Alive nodes

Analysis of alive nodes:

In fig 3, we show the results of the percentage of Alive nodes. When the round is 1000, GFEAR achieves of 95% of alive nodes and LEACH has 65% of alive nodes. This shows that the sensors consumes less energy than LEACH during transmission. By these conditions nodes stay alive for longer time period.

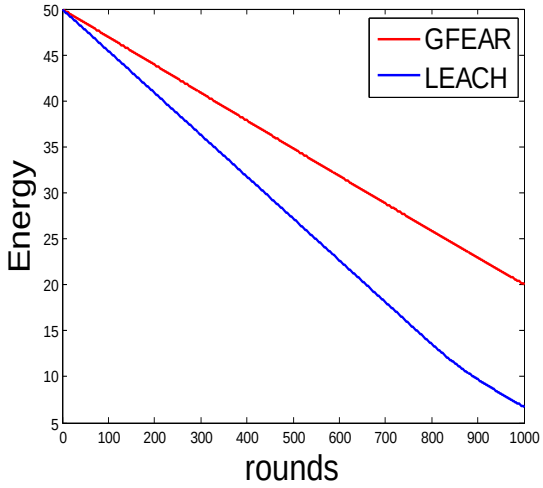

Fig.4: Analysis of Energy

Analysis of energy consumption:

Energy consumption is estimated by how much energy is used during data transmission and during data reception. This performance metric is evaluated as the total amount of energy consumed from the initiation of the network operation till the death of the last alive node in the entire sensor network. It is observed that the GFEAR technique has better energy consumption performance when the number of nodes increases compared to the LEACH protocol .

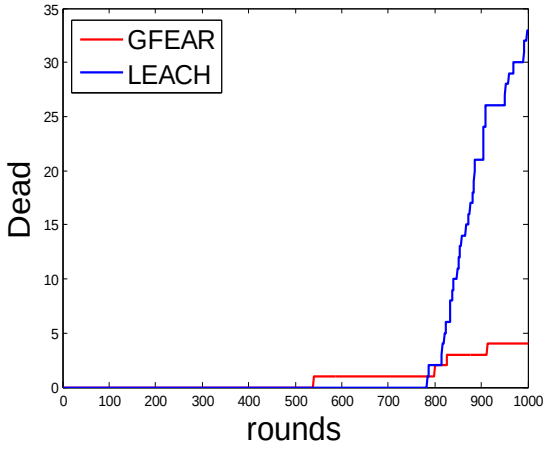

Fig.5: Analysis of Dead nodes

***Analysis of dead nodes*:**

GFEAR protocol obtains the longest network lifetime. This is because the energy consumption is well distributed among nodes. Network is divided into logical regions and two of them are further sub divided into clusters. GFEAR protocol balance energy consumption among sensor nodes. Whereas, in LEACH nodes die quickly as stability period of network ends. It is not evident that predestined CHs in LEACH are distributed uniformly throughout the network field.

VI. CONCLUSIONS

In this work we describes an gateway based and energy aware routing protocol which conserves energy since the unnecessary nodes in the network sleeps without affecting the routing fidelity. In this work network is divided into logical regions. The sensor nodes in the network arrange themselves in the form of grids. The nodes which are placed in a same grid manage among themselves to decide who will go into sleep state and for how long in order to improve lifetime of the network and throughput. In this work, we study the three performance metrics: Throughput, percentage of alive nodes, dead Nodes and energy of data transmission. A simulation result shows that our proposed protocol GFEAR performs better than the LEACH.

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