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Energy Efficient Clustering Algorithm for Decreasing Energy Consumption and Delay in Wireless Sensor Networks (WSN)

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ABSTRACT: In recent years, there has been increasing research interest in Wireless Sensor Networks (WSNs). WSN consist of small nodes with sensing, processing and wireless communications capabilities. Wireless Sensor network's key issue is developing energy-efficient clustering Protocol. Hierarchical clustering algorithms increased network life time. The primary point in these algorithms is the cluster head selection. Overall simulation performance shows energy consumption is better than the existing algorithm. And with that delay consumption is decreased.

KEYWORDS: Wireless sensor network; energy efficiency; cluster head

I. INTRODUCTION

Wireless Sensor Networks (WSNs) is a great enabling technology that can revolutionize information and communication technology. In fact, it has the potential to significantly change the way we live – just like the Internet and World Wide Web – perhaps more so. WSN has opened up the challenge for distributed and cooperative computing and communication. A Wireless Sensor Network is a self-configuring network of small sensor nodes communicating among themselves using radio signals, and deployed in quantity to sense, monitor and understand the physical world. It is highly distributed networks of small, lightweight wireless nodes, deployed in large numbers and monitors the environment or system by measuring physical parameters such as temperature, pressure, humidity.

In flat networks, each node typically plays the same role and sensor nodes collaborate together to perform the sensing task. In this type of network, it is not possible to assign a global identifier to each node due to large number of nodes. Therefore, base station send queries to different part of the field and waits for the data from sensors in selected parts of the field. This consideration has led to data-centric routing. In data-centric routing, the sink sends queries to certain regions and waits for data from the sensors located in the selected regions. Some of routing protocols in this category are: SPIN [1] [2], Directed Diffusion [3] [4], Rumor Routing [5] and MCFA [6].

Hierarchical routing works in two layers, first layer is used to choose cluster heads and the other layer is used for routing. To make the WSN more energy efficient, clusters are created and special tasks (data aggregation, fusion) are assigned to them. It increases the overall system scalability, lifetime, and energy efficiency. In a hierarchical architecture, higher energy nodes can be used to process and send the information while low energy nodes can be used to perform the sensing in the proximity of the target. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, lifetime, and energy efficiency. Some of routing protocols in this group are: LEACH [7], SOP [8], and VGDRA [9].

In most cases location information is needed in order to calculate the distance between two particular nodes so that energy consumption can be estimated. Generally two techniques are used to find location, one is to find the coordinate of the neighboring node and other is to use GPS (Global Positioning System). Some of routing protocols in this group are: GAF [10] and SPAN [11].

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The rest of paper is structured as follows: Section II discusses some related works and previous studies. Section III provides complete understanding of our proposed hierarchical clustering algorithm with the ability of cluster head selection. Section IVand Vprovides the simulation set up and result analysis respectively.Section VI gives concluding remarks and directions for future works.

II. RELATED WORK

AshishUpadhyay, et. al. [7] introduced a hierarchical clustering algorithm for sensor networks, called Low-Energy Adaptive Clustering Hierarchy (LEACH) is a classical clustering routing in wireless sensor networks .However the cluster-head selection in LEACH protocol is lack of balancing the whole network energy consumption, with the result that low energy nodes run out of energy prematurely and decline the network life. This paper analyses the effectiveness of LEACH protocol in cluster-head selection, and proposes an improved energy balanced clustering algorithm. In [12], authors proposed Energy Efficient Clustering Algorithm (EEAC)for WSN. This algorithm is based on static clustering concept and dynamic cluster heads selection technique, which divides the entire network area into a number of fixed regions. Cluster head (CH) is selected that it reduces communicating distance between nodes, for this reason energy consumption reduces while transmitting the data from one node to another and increases network efficiency as energy consumed. The proposed (EECA) algorithm gives better result than the LEACH, LEACH-C and DR scheme with respect to throughput and stability. Authors in [13] proposed Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network with Isolated Nodes. A new regional energy aware clustering method using isolated nodes for WSNs, called Regional Energy Aware Clustering with Isolated Nodes (REAC-IN). In this algorithm cluster heads (CHs) are selected based on weight which is determined according to the residual energy of each sensor and the regional average energy of all sensors in each cluster and improves the cluster head selection process and solves the problem of node isolation, lifetime and stability of a network is more favorable.

III. PROPOSED A NEW HIERARCHICAL CLUSTERING ALGORITHM

In this section, our proposed a new hierarchical clustering algorithm with the ability of cluster head selection is described.

In proposed algorithm, some of the nodes have to select cluster heads that, in comparison to them, have a longer distance to the BS. These nodes send their data to a further location and then their data has to go through a long distance to reach the base station (BS). Such transmissions waste the network‘s energy and are called extra transmissions. In the proposed protocol, deploy all the sensor nodes into the distributed cluster environment and select the area into the different number of cluster. Every sensor selects one of the head nodes of that cluster, the entire cluster having their own cluster head (CH) for communication purpose and the entire cluster head communicated with the BS.

When the base station wants to communicated with the sensor nodes or sensor nodes want to communicate with the base they are able to communicate with the cluster head.

Algorithm 1 :Proposed Algorithm for WSN

Step-1: Initialize:

Cluster Head node = CH
Total number of clusters = Cn
Nodes = i, j
Threshold energy = Eth

Step-2Cluster-head selection:

1. CH is selected by considering the three parameters namely remaining energy of the node, distance from the base-station and degree (surrounding nodes) of the node.
2. For j=1 to Cn % Cn= total number of clusters
3. For i=1 to length (Region (j))
4. If [Node (i).Renergy] >= Eth % Eth= threshold energy.
5. Weight= (Node (i).degree*Node (i).Renergy)/ (Node (i).distance.)
6. End

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7. A node with maximum weight will be selected as CH for that round.
8. End

Step 3: All the sensor head or cluster head connected with the base station (BS).
Step 4: The base station sends the advertising message to all the cluster head.
Step 5: Each cluster head send the reply message to the base station.
Step 6: After that the transmission of data and message will start and every sensor nodes communicated with other nodes and base station.
Step 7: Process end.

Figure 1. Proposed Algorithm for WSN

IV. SIMULATION PARAMETERS

In this section, we evaluate the performance of our proposed algorithm via NS2 simulator. The simulation parameters are given in "Table. I". Results obtained for Performance of proposed scheme in terms of energy consumption and consumption delay with different parameters performance.

This section explains the complete evaluation methodology along with simulation environment and performance metric in detail. Simulation was performed using NS2 simulator [14] to measure the performance of our proposed scheme and to be able to compare it with that of LEACH protocol under different network size varying the number of nodes from 100, 200 and 300. The simulation setup is summarized in Table 1

Table 1.SimulationParameters

Parameters	Value
Area	100mt *100mt
Number of Nodes	100,200,300
Routing Protocol used	Proposed Scheme, Leach
Time	10s
Eq_Energy	<=1
Initial Energy	10
Sense power	0.3
Channel type	Wireless
Model	Energy Model

V. SIMULATION RESULTS

In this section, simulation results of our proposed algorithm comparedto the LEACH protocols are discussed under different network sizes with respect to performance metrics i.e. energy consumption and consumption delay. The simulation results are shown in Figure 2 and Figure 3.

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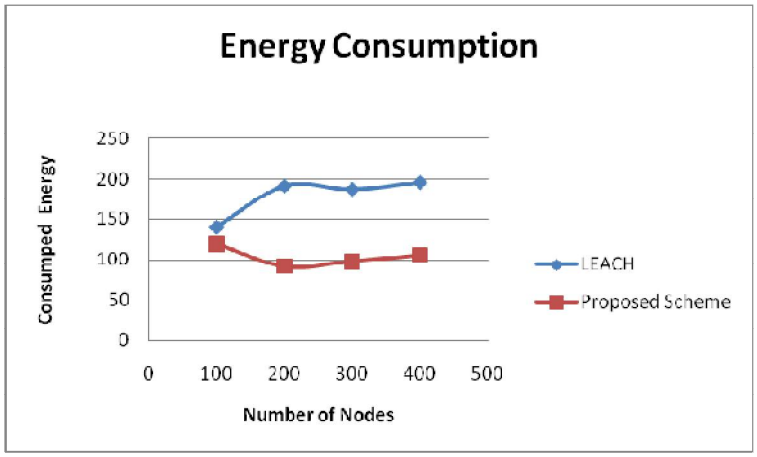

Figure 2. Comparison of Energy Consumption

Figure 2 shows the result comparison of amount of energy consumed by CHs in our proposed scheme and that of LEACH protocol. The energy consumed by CHs per round in proposed algorithm is much lower than the LEACH, because in LEACH, CHs send their data to the BS via single hop communication; the energy consumption is much higher.

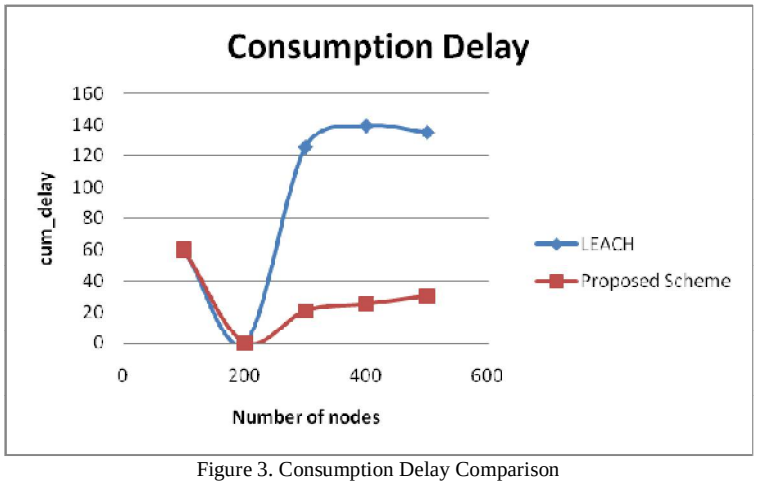

Figure 3. Consumption Delay Comparison

Figure 3 shows the result comparison of consumption delay in our proposed scheme and that of LEACH protocol. It is observed from the figure that at starting upto 100, 200 nodes in network, consumption delay is almost same in both protocols, however, consumption delay of our proposed scheme is always less than that of LEACH and it is still maintained when network size increases.

VI. Conclusion and Future Work

In this paper, by considering the advantages and disadvantages of our previous works, we proposed a new Energy-Efficient Clustering algorithm for Wireless Sensor Networks. It has the ability of selecting a cluster heads of clusters of the network. Evaluated the performance of our proposed scheme and compared with LEACH protocol using NS2 simulator in different network scenarios, simulation experiments show that the proposed scheme provides better results than the other existing protocolwith respect to energy consumption and consumption delay The future study will lie in how to select cluster head from the selected cluster heads of cluster and try to consume more energy with less delay.

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BIOGRAPHY

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