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An Energy Efficient Load Balanced Clustered Data Collection Approach in WSN Using Relay Nodes

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ABSTRACT: In wireless sensor networks, with minimized energy dissipation extending the lifetime of wireless sensor network is a challenging issue. Node Density based Clustering and Mobile collection (NDCM) was an effective method, where the MEs gather data with minimum energy consumption. The paper introduces Enhanced Node Density based Clustering and Mobile Collection (ENDCM) method. The method has a clustering based scheduling algorithm which contributes great to the enhancement of saving energy, power and packet latency. The clustering is done on the geographical areas. A random relay node selection is also done to minimize the energy consumption of the clusters.

KEYWORDS: Energy Dissipation, Scheduling, Lifetime, ME, NDCM, ENDCM, Relay node.

I. INTRODUCTION

Wireless Sensor Networks: A wireless sensor network (WSN) comprises a large number of nodes either deterministically or deployed in a random manner, for instance, from an aircraft, to observe the environment. Sensor nodes communicate with each other by multihopping, that is, by using other sensor nodes in the network as relay nodes. One of the most important issues regarding the design of sensor networks is power consumption since these networks consist of sensor nodes densely deployed in hazardous and remote areas where the replacement of batteries is impossible. The major portion of energy is consumed during data transmission and reception.

Need for Scheduling in WSNs: The WSNs comprise a collection of sensor nodes. The main purpose of energy efficient Scheduling algorithm is to maximize the network lifetime. These algorithms are not just related to maximize the total energy consumption of the nodes but also to maximize the life time of each node in the network to increase the network lifetime. Energy efficient algorithms can be based on the two methods: i) Clustering based scheduling algorithm ii) Relay Node Selection.

II. RELATED WORK

In [1] author proposes an Energy Efficient Cluster Based Scheduling Scheme for wireless sensor networks that balances the sensor network lifetime and energy efficiency. (i) Cluster topology is discovered and cluster head is chosen based on remaining energy level. The cluster head monitors the network energy threshold value to identify the energy drain rate of all its cluster members. (ii) Scheduling algorithm is presented to allocate time slots to cluster member data packets. Here congestion occurrence is totally avoided. (iii) Energy consumption model is proposed to maintain maximum residual energy level across the network. Also propose a new packet format which is given to all cluster member nodes. The simulation results prove that the proposed scheme greatly contributes to maximum network lifetime, high energy, reduced overhead and maximum delivery ratio. In [2] author proposes an Efficient Approach for Data Gathering and Sharing with Inter Node Communication in Mobile-Sink. The algorithm is divided into seven parts: Registration Phase, Authentication Phase, Request and Reply Phase, Setup Phase, Setup Phase (NN), Data Gathering, and Forwarding to Sink. The approach provides an efficient way to handle data in between the intercommunication nodes. By the above approach the data from the node which is not in the list can be accessed by sharing the data from the

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node which is approachable to the desired node. For accessing and sharing need some security so that the data can be shared between authenticated nodes. For this used two way security approach one for the accessing node and other for the sharing. In [3] author produces a new algorithm which focused on reducing the transmission bath between sensor nodes and cluster heads. A proper utilization and reserving of the available power resources is achieved with this technique compared to the well-known LEACH algorithm. In [4] author presents a modified clustering and data forwarding protocol combined with a MS solution for efficient data gathering in wireless sensor networks (WSNs) with delay constraints. The adopted cluster formation method is based in the 'residual energy' of the SNs and it is appropriately modified in order to fit properly to the requirement of length-constrained MS tour, which involves, among else, the need for inter-cluster communication and increased data forwarding. In addition, a suitable data gathering protocol is designed, based on an approximated TSP route that satisfies the given length constraint, whereas the proper application of reclustering phases guarantees the effective handling of the 'energy holes' caused around the CHs involved in the MS route. Extended simulation experiments show the stable and energy-efficient behavior of the proposed scheme (thus leading to increased network lifetime) as well as its higher performance in comparison to other competent approaches from the literature.

III. PROPOSED ALGORITHM

Aim of the proposed algorithm is to maximize the network life by minimizing the total transmission energy using energy efficient algorithms to transmit the packet. The proposed algorithm is consists of three main steps.

(i) Multihop Routing Algorithm
(ii) CH Selection Algorithm
(iii) Relay Node Selection Algorithm

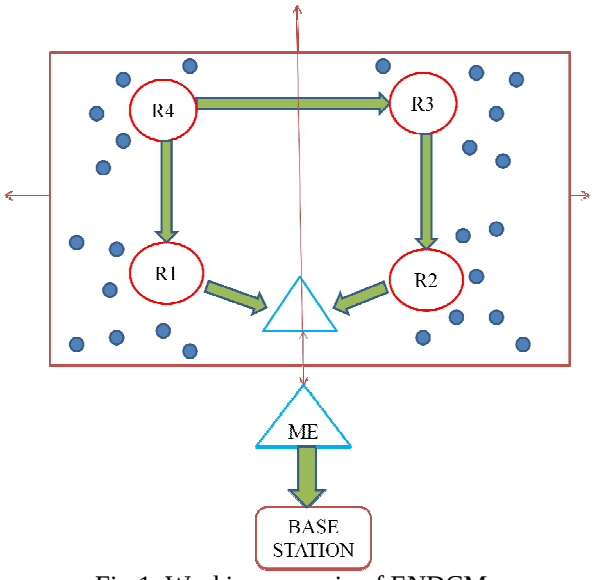

Fig.1: Working scenario of ENDCM.

After CH selection the network is set. For the purpose of data collection using relay node it is necessary to choose the Relay Node. The major advantage is it is not necessary for the ME to travel along the network. The steps are: In the working scenario when

1) These are selected as RN (Relay Node).
2) All the RNs send the collected data from other nodes.
3) Send to the RN near to ME.
4) ME collect the data to Base Station.

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IV. SIMULATION RESULTS

Fig.2.compares the energy consumption of the sensor nodes using hybrid routing with fixed track (determined arbitrarily) the NDCM and ENDCM algorithm. The network settings are the same as above. Two different fixed data collection tracks are taken. It is shown that the expected remaining energy of a node using NDCM is larger than all fixed-track routing. Although the result for the NDCM is close to that of the ENDCM, it can be seen that the length of the track is actually quite long due to its zigzag shape. Furthermore, ENDCM approach has less variance in the distribution of the remaining energy among the nodes, which is preferable because the work load is more balanced among the nodes and the network lifetime is prolonged. The number of nodes which have run out of energy (the remaining energy is less than the threshold, i.e., El < E0) is shown in Fig.2. Fig.3. compares the network lifetime using the proposed ENDCM with the benchmark of NDCM and RCM scheme.

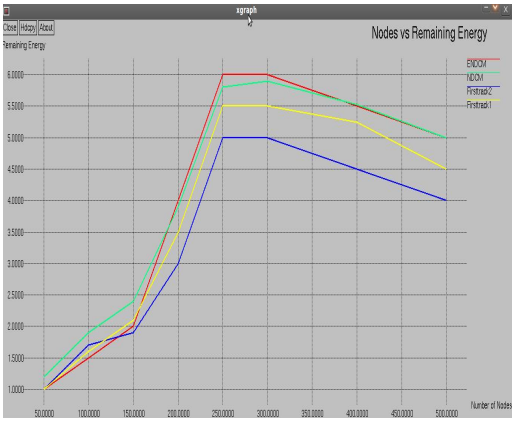

Fig 2: Number of nodes versus remaining energy

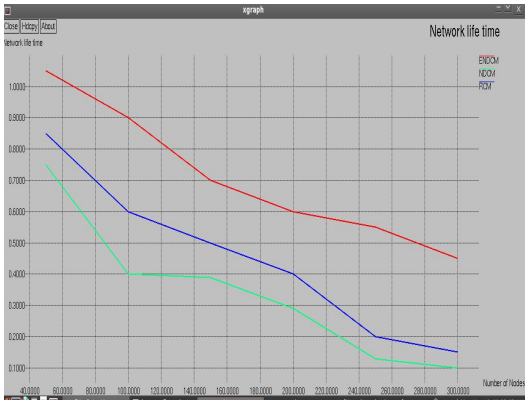

Fig 3: Network lifetime using ENDCM, NDCM and RCM

The network settings are the same as above. The network lifetimes with the proposed ENDCM, NDCM and RCM schemes are plotted in Fig.3. When the number of nodes varies from 10 to 100. It can be observed that the lifetime is increased by about 50% using NDCM. This is because in NDCM the CHs are mostly at the centres of the areas where sensors are crowded. Thus, the number of hops in intra-cluster routing from a sensor to the CH is minimized on average, which can save the power consumption of the sensors considerably. This simulation illustrates the advantages of selecting the CHs based on node density. In fig.4.On comparing ENDCM fixed track and NDCM for nodes Vs out of energy it is seen that ENDCM finishes the data collection in limited time more efficiency.

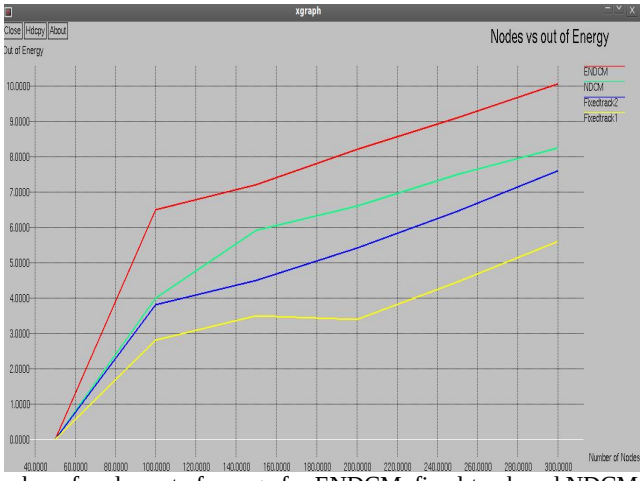

Fig 4: Number of nodes out of energy for ENDCM, fixed-track and NDCM data collection.

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Table 1: Comparison of power consumption in different methods.

Message Size (MB)	Power consumed in Random Selection Method (J/mS)	Power consumed in Proposed Homogeneous Selection Method (J/mS)	Message Size (MB)	Power consumed in Random Selection Method (J/mS)	Power consumed in Proposed Homogeneous Selection Method (J/mS)
0.01	0.0375	0.021	0.11	0.4125	0.231
0.02	0.075	0.042	0.12	0.45	0.252
0.03	0.1125	0.063	0.13	0.4875	0.273
0.04	0.15	0.084	0.14	0.525	0.294
0.05	0.1875	0.105	0.15	0.5625	0.315
0.06	0.225	0.126	0.16	0.6	0.336
0.07	0.2625	0.147	0.17	0.6375	0.357
0.08	0.3	0.168	0.18	0.675	0.378
0.09	0.3375	0.189	0.19	0.7125	0.399
0.1	0.375	0.21	0.2	0.75	0.42

Power Consumption: While analysing the power consumption it is found that for short message transferring the power consumed is less compared to higher message transmission in Random Selection Method. In the proposed Homogeneous Selection Method comparing to random method power consumption is very much less even for long message transmission.

V. CONCLUSION AND FUTURE WORK

This paper proposes a cluster based scheduling algorithm in large-scale WSNs called ENDCM, which adds advantages for the NDCM approach. ENDCM can effectively balance the power consumption of the sensors and the ME and conveniently tradeoff the power saving and data collection latency compared to NDCM. The proposed node density based CH selection, simple local geographic routing with void avoidance and hybrid data collection has been validated by simulation. Also CHs replaced by Relay nodes improves data collection efficiency and improves the network lifetime with less energy consumption.

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