A Data Aggregation Protocol to Improve Energy Efficiency in Wireless Sensor Networks

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***Abstract*: Wireless sensor network consist of spatially distributed autonomous sensor nodes to monitor physical or environmental conditions (i.e. temperature, sound, atmospheric pressure etc.) for various applications. The major designing issue with WSN is resources utilization. Subsequently, work will be carried out on clustering, routing and securing node's information for data transmission. The proposed work will be focus on minimizing power utilization during the data transmission in wireless sensor network. A data aggregation with different methods will be investigated for reducing power consumption.**

Keywords: Multi Level Network Data Aggregation, clustering methods, energy efficiency, wireless sensor network.

I. INTRODUCTION

Wireless sensor network (WSN) is a collection of devoted autonomous sensor nodes that observed physical or environmental conditions differently, such as pollution levels, humidity, temperature, sound, wind direction, pressure, etc. To cooperatively deliver data through the network to a main destination. WSNs were initially designed to facilitate military applications such as battlefield surveillance; but its usages have since been drastically extended to monitoring machineries, industrial processes, health, and controls. The WSN consist of "nodes" which may be differ in numbers from a few to several hundreds or even thousands, where every node is in connection with at least one sensor (or sometimes several). The sensor node is equipped with a tiny processor, a small battery, a radio transceiver antenna, and situate of transducers that used to gather information. They describe the variations in the environment of the sensor node [3]. Topology for WSNs can vary from a simple star or mesh network to an advanced multi-hop wireless mesh network.

The propagation of data takes place between the hops of the network with the help of routing or flooding techniques. To attain high energy saving and long network lifetime, nodes can grouped into clusters and can be arranged in a hierarchical manner. In the working process Clustering algorithm includes partitioning of sensor nodes into several clusters, and each cluster selects one sensor node as cluster- head (CH) [2]. In clustered sensor networks, the nodes do not transmit their collected data to the sink or base station (BS), but to designated cluster heads (CH) which aggregate the data packets and send directly or via multi-hop communication to the BS [3], [8]. In-network data aggregation reduces the amount of data transmission and communication; hence the energy consumed, especially in large WSNs. The main idea is to combine partial results at intermediate nodes during data transmission [1].

II. LITERATURE SURVEY

In [4], Tiny Aggregation (TAG), a generic aggregation service for ad hoc networks of Tiny OS motes. They classify aggregates according to four properties that are particularly important to sensor networks. The first is duplicate sensitivity. Duplicate sensitive aggregates will change when a duplicate reading is reported while duplicate insensitive aggregates are unaffected by duplicate readings from a single device. Second, excellent aggregates return one or more representative values from the set of all values; summarized aggregates compute some property over all values. Third, monotonic aggregates have the property that when two partial state records, s1 and s2, are combined via f, the resulting state record s' will be greater or smaller than the complete sample space. The fourth is related to the amount of state required for each partial state record. For example, a partial AVERAGE record , and a partial COUNT record constitutes only a single value.

In [5], they have proposed the DOC protocol, which can be select a set of disjoint potential clusters that maximize the global compression gain of Slepian–Wolf coding. In a cluster hierarchy constructed by the DOC protocol, they have proven that there exists an optimization algorithm that can find an optimal rate allocation within each cluster to minimize the intracluster communication cost and have presented an intracluster coding protocol to locally perform Slepian–Wolf coding within a single cluster.

In [7], they have introduced data density correlation degree and the data density correlation degree (DDCD) clustering method. With the DDCD clustering method, the sensor nodes having high correlation are distributed in the same cluster, allowing more accurate aggregated

data to be obtained in cluster-based data aggregation networks produced by the DDCD clustering method. Also, the amount of data conveyed to the sink node can be minimized. The WSN is modeled by undirected graph G = (V, E). Where V is the sensor node set consisting of all sensor nodes in the WSN, E is the edge set consisting of all links in the WSN. The antenna of sensor node I (I ∈ V) aim an omnidirectional antenna, with a communication radius of α (i). In cluster-based data aggregation networks, the data transmission process is that every cluster head sends aggregated data obtained from its member nodes to the sink node by one hop or multi-hops.

In [9] This paper many energy efficient protocols were proposed. LEACH protocol (Low-Energy Adaptive Clustering Hierarchy) is a self-organizing and based on clustering hierarchy which is able to outperform the MTE (Minimum Transmission Energy) protocol by 8 times in fig 1.

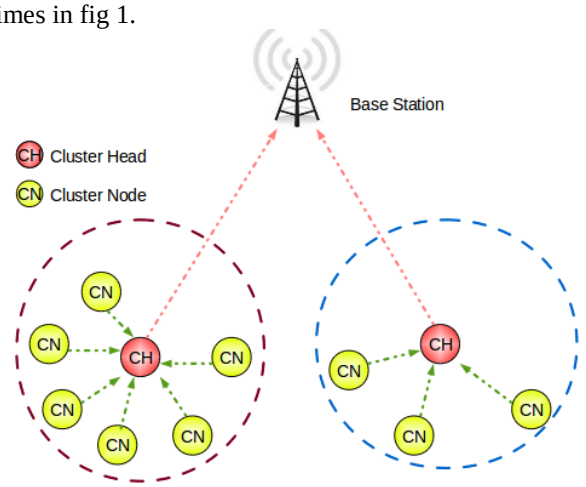

fig 1. LEACH Clustering Hierarchy.

In [10] this paper considers a WSN deployed for real life applications. The following assumptions are made about the sensor nodes and the network model:

1. The base station (i.e. sink node) is located inside the sensing field.
2. Nodes are location aware that is equipped with GPS capable antennae.
3. The communication channel is symmetric.
4. Data gathered can be aggregated into single packet by cluster heads.
5. Nodes are left unattended after deployment so battery re-charge is not possible. The Cluster head selection and Cluster formation with TDMA schedule creation and actual data transfer in steady state phase.

In [6], they proposed an energy efficient algorithm using node ranking in electing cluster heads. The difference between this algorithm and other algorithms is that this algorithm uses a more competent mechanism to select cluster heads. This is accomplished by calculating the distance, the current energy level of nodes and scheming the number of rounds that they can be clustered heads for, to maximize the network lifetime and decrease unnecessary communication overheads used for electing new cluster heads. In this algorithm, nodes are ranked based on their current energy level (En) and their positions (dn) in reference to the BS. This ranking is used for choosing cluster heads which are also ranked into levels based on their position, Euclidean distance, from the BS. Therefore,each node is assigned a rank Rn (En, Dn) reflecting its candidacy for being elected as a cluster head.

III. PROPOSED WORK

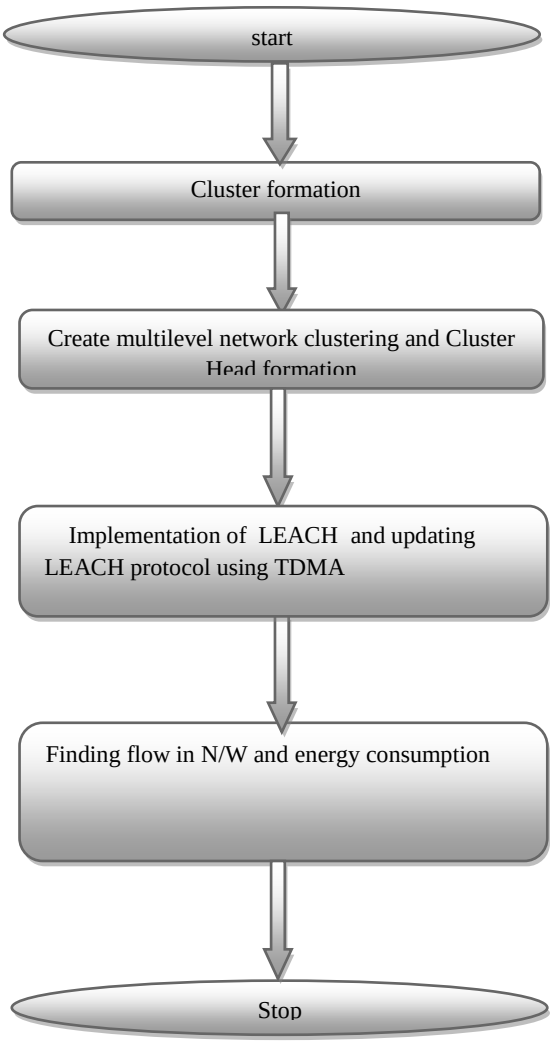

fig 2. Work flow design

1. Dynamic node network formation
2. Clustering at multilevel network for data aggregation
3. Implementation of LEACH protocol
4. Updation in LEACH at TDMA.
5. Comparison of energy efficiency between normal LEACH to proposed LEACH protocol as per fig 2.

IV. SIMULATION RESULTS AND ANALYSIS

Papers are reviewed and analyzed related to clustering and aggregation mechanisms in WSN. Those techniques are reviewed, are different from each other, some are based on density of deployed sensor nodes, while some are based on node connectivity, energy, position, etc. . In TAG approach, the most of the significant computation time is utilized for data aggregation purpose. Also the number of messages to be exchange is high. Data aggregation is performed on the information present in the database in the form of queries. This extends time complexity. In GDSDA, the CHs are chosen based on the node connectivity, then the genetic algorithm is used. When the cluster member wants to transmit data to the aggregator, a data encryption technique is utilized. Here nodes connectivity does not guarantee the largest possible energy node will be elected as cluster head and hence may lead to node exhaustion. In DDCD clustering method, clusters are formed based on their level of correlation, the sensor nodes having high correlation are distributed in the same cluster. This allows aggregated data to be obtained more accurately. LEACH protocol (Low-Energy Adaptive Clustering Hierarchy) is a self-organizing and based on clustering hierarchy which is able to outperform the MTE (Minimum Transmission Energy) protocol by 8 times.

Results:

As per projects initial results are follows :

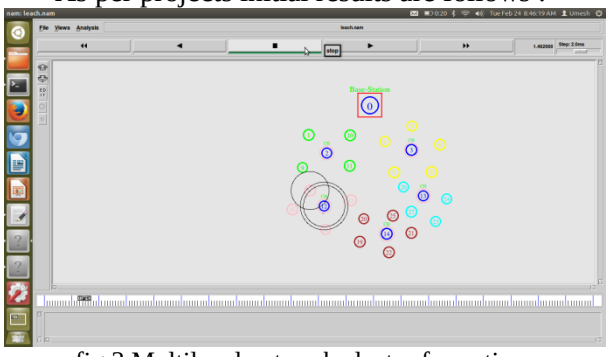

fig 3.Multilevel network cluster formation

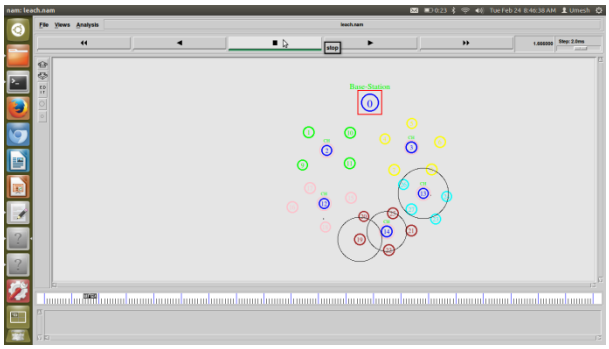

fig 4 .Multilevel network cluster head(CH) formation

V. CONCLUSION

The comparison of various clustering and aggregation techniques have been done and presented in this paper. The direct further work on the DDCD clustering method is developing a method which could confirm the parame- ters adapted to the real sampled data, especially the data threshold has major effect on clustering performance. In the data transmitting process, the energy of sensor nodes should be considered to construct an energy balanced networks. Hence, this will be researched in our future work as well. Based on the analyzed parameters, data density correlation degree and node ranking algorithms are energy efficient for immobile nodes in Wireless Sensor Network.

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