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Clustering Based Approach for Load Balancing to Prolong the Network Lifetime in Wireless Sensor Network

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***Abstract*— Wireless technology growing rapidly now a day. Information congregation is a rapid increasing and challenging field in today's world of computing. This interacts with the various kinds of Things, Objects, Technological devices, Sensors in various fields. Wireless sensor networks consist of small battery powered devices with restricted energy resources. The main merit of the sensor network is that it includes power utilization constraint for sensor nodes with the help of battery life. The sensor nodes are typically out of the way for the user; therefore substitution of the energy source or battery is not practicable. For this reason, energy efficiency is a main design concern that wants to be improved in order to extend the life time of the sensor network. To extend the lifetime of sensor nodes, energy utilization and routing design issues are considered. The lifetime of network, depends on number of nodes, strength, coverage area and connectivity of nodes in the network. Clustering is one of the effective and scalable ways to extend the lifetime of wireless sensor network. In this paper, we introduced a strategy of balancing the energy consumption of sensor nodes. Prolonging the lifetime of sensor network by minimizing the consumption in energy a clustering technique is used for balancing the load among the sensors. This mechanism is useful to improve the scalability and the reliability of network. This approach will increase the network lifetime.**

Keywords-clustering; lifetime; load balancing; energy consumption wireless sensor network.

I. INTRODUCTION

Wireless sensors networks are a collection of hundred of miniature sensor nodes to organize environmental conditions such as high temperature, motion, etc. These sensor nodes are responsible for data sensing, information collection and transmission to destination. The sensor nodes are operated on battery. The battery of sensor node having limited source of energy, once the battery drained the sensor node will dead and unable to sense information in particular location. So the Energy efficiency is one of the important parameter for network lifetime enhancement. Sensor networks are adhoc in nature so according to it number of sensors in network may be vary, mechanism of sensor deployment, power level may be different. The nodes having high energy are considered for data transmission. Sensors in such environment are irreplaceable and utilize the battery power till dead. Therefore the energy is an important resource for such sensors and managing such resources intelligently for the improvement in lifetime of network.

The sensor nodes are typically out of the way for the user; therefore substitution of the energy source or battery is not practicable. For this reason, energy efficiency is a main design concern that wants to be improved in order to extend the life time of the sensor network. Sensors are having the capabilities of data transmission and processing. The sensors sense information from the environment and transform it by converting into electrical from. Network lifetime is the mainly very important metric for the assessment of sensor networks and sensor nodes. In a resource constrained environment, the use of every inadequate resource must be carefully taken in consideration. The network can only achieve its principle as long as it is considered alive in the network. It is as a result a metric for the maximum effectiveness a sensor network can supply. If the metric is used in a study prior a real-life deployment, the calculated estimation of network lifetime can also add on to justify the cost of the consumption. Lifetime is also considered a fundamental limit in the situation of availability and security in networks. Network lifetime strongly depends on the lifetimes of the single sensor nodes that form the network. If the lifetimes of single nodes are not predict precisely, it is possible that the derived network lifetime metric deviates in an irrepressible manner. It should therefore be clear that an accurate and consistent modeling of the single nodes is very important in whole network life time. Load balancing is a method for equal allocation of load across a network so that congestion does not take place. Equal allocation of load means workload is equally divided across two or more wireless sensor networks links. We needed load balancing for achieve maximum throughput, for achieve minimize response time, for obstruction free network and for optimal resource utilization.

II. RELATED WORK

Before Yunxia Chen and Qing Zhao originated a general formula for the lifetime advancement of wireless sensor networks which holds separately of the underlying network model, network architecture protocol and data collection origination. It provides a measure of performance valuation of the network model and increase the network lifetime. With reference to the formula, they proposed a MAC protocol this algorithm has utilized both the channel and remaining energy information of each sensor node. This protocol approach maximizes the smallest amount residual energy across the network in each data compilation. [3]

Ioan Raicu, Loren Schwiebert, Scott Fowler and Sandeep K.S. Gupta contributed by a new algorithm, e3D (energy-efficient Distributed Dynamic Diffusion routing algorithm), with a comparison done with two algorithms, i.e. directed, and random clustering communication algorithm. The new algorithm has also been compared with the performance of optimum counterpart and an optimum clustering algorithm. This algorithm benefited with the cost of astronomical prohibitive synchronization costs. The comparison of the algorithm is done in terms of lifetime of the network system, distribution of power dissipation, synchronization cost, and simplicity of the algorithm. [4]

Fatma Othman, Nizar Bouabdallah and Raouf Boutaba study the conservation of potential energy which is achieved by balancing the traffic throughout. They studied and concluded distributing the traffic by multiple paths save more energy than the single path hence energy efficiency is increased in multi path system. For this a new analytical model for load balancing system has been introduced [5]

Isabel Dietrich and Falko Dressler introduced the algorithm to be used in analytic evaluations as well as in simulation models for focusing on a formal and concise definition of network that has been accumulated and its total network life time. This algorithm introduces some additional life time measures to the network life time. There new concept is to make network tolerance and disruption free. With another new additional feature is to fulfill the requirement in certain period of time other than every point of time. With this coverage and connectivity is also combined to form a single requirement called connected coverage. They proved that the connected coverage is different from non combined coverage and connectivity. It also supports the concept of graceful degradation by providing means of estimating the degree of compliance with the application requirements [6]

Vinay Kumar, Sanjeev Kumar and Sudharshan Tiwari introduced a survey which increases the network lifetime in Wireless Sensor Networks (WSNs) .Here the route for data transfer are selected in such a way that the total energy consumed along the path is minimized. For this clustering concept was used as cluster helps energy utilization in limited resources which extends and maximizes network lifetime. [7]

Jin Wang, Tinghuai Ma and Jinsung Cho worked on the problem of hotspot, since this problem cannot be addressed under many routing because of energy depletion of sensor nodes. They proposed a Ring-based Energy Aware Routing (REAR) algorithm for wsn network that can achieve both energy balancing and energy efficiency for all sensor network nodes. This algorithm considers the hop number as well as the distance with the residual energy of the next hop node during routing. [8]

J S Rauthan and S Mishra described WSN as next generation of sensing machines and structures with limited energy as most important drawback of wireless sensor nodes. In order to distribute the energy throughout the wireless sensor network, data load of the sensor nodes must be properly balanced. Clustering is one of the important mechanisms for load balancing. Clustering algorithms may result in some clusters that have more members than other clusters in the network and uneven cluster sizes negatively affect the load balancing in the network. The work they proposed improved a cluster algorithm for load balancing in clusters generation. [9]

K R Yadav, Vipin Pal, Girdhari Singh and R P Yadav defined Clustering as an efficient approach to capitalize the energy of sensor nodes which has energy as constraint in wireless sensor networks. Clustering schemes do not guarantee cluster formation with equal number of nodes. So data frames transmitted by the nodes vary. TDMA schedule of nodes of with smaller cluster formation than others results more number of data frames and hence more consumption of energy. The non consistent energy utilization of nodes affects the load balancing of network and these nodes are more prone to collapse earlier than other nodes. Here they found an improved scheme for cluster head selection. Clusters having variable frame slots for nodes are applied to E-LEACH and improved E-LEACH to make the cluster more balance in term of load. They Simulate using NS-2 simulator to analyze the performance of E-LEACH and improved E-LEACH with variable outline length. [10].

Low-Energy Adaptive Clustering Hierarchy (LEACH) is proposed in [11, 13] .The functioning of LEACH is structured in rounds which contains setup and transmission phase. In the setup phase, nodes systematize themselves into clusters among these nodes one node selected as cluster head. During the transmission phase, Cluster head receives data from all other sensor nodes from the cluster and send data to the base station.

Hybrid Energy Efficient Distributed (HEED) [14] is a clustering based protocol which is support scalable data aggregation. Cluster heads are probabilistically selected on the basis of their residual energy and the power level of the sensor nodes. The HEED protocol is operational in a distributed environment.

III. MOTIVATION

In this Wireless sensor networks consist of small battery powered devices with restricted energy resources. The main merit of the sensor network is that it includes power utilization constraint for sensor nodes with the help of battery life. The sensor nodes are typically out of the way for the user; therefore substitution of the energy source or battery is not practicable. For this reason, energy efficiency is a main design concern that wants to be improved in order to extend the life time of the sensor network. To extend the lifetime of sensor nodes, energy utilization and routing design issues are considered.

In this paper we introduce and implement an Extended Energy Efficient Clustering Algorithm for the wireless sensor networks. A comprehensive survey on various methods proposed in literature for the Clustering based approaches to improve network lifetime mainly focusing on the LEACH and HEED algorithm. The most important benefits of the projected method are that the energy utilization is condensed and enhanced network lifetime.

IV. PROPOSED METHEDOLOGY

In this section, we are proposing a novel methodology to offer resourceful energy utilization in sensor network. The main goal of the proposed algorithm is to minimize the data transmission distance of the sensor nodes with the formation of uniform cluster. The proposed clustering algorithm is based on centralized approach. In this approach Base Station collects information on the position and energy level of the node from the entire sensors node in the network. The residual energy of the sensor node is more than the average energy then sensor node will elect as a Cluster Head in particular cluster. The algorithm is organized as following steps.

A. Phase I: Setup Phase

a) The Main intention of this phase is to form Clusters and selection of cluster head.
b) During this phase Base Station collets information of energy status and the position from all the nodes in network.
c) As all nodes are fixed obtain mean point and find out average distance nodes.
d) Find the nodes whose residual energy is more than average residual energy and select as a cluster head.

B. Phase 2: Execution Phase

a) Headings After formation of cluster head base station sends routing information to all sensor nodes.

b) A sensor node knows the distance from any other node within the cluster so compute its transmission power. TDMA allot time slot for cluster nodes.

C. Phase 3: Communication Phase

a) The sensor nodes in cluster transmit data to cluster head as per the allocation of transmission time.
b) The cluster head collects or aggregate all the information received from all other nodes then compressed the information and transmit it to base station.

V. PERFORMANCE ANALYSIS

In this section we appraise the performance of the projected method. We compare our proposed scheme with LEACH, HEED. We design our simulation environment using ASP.Net. The assumptions are as follows. According to Figures 1.1, 1.2, 1.3 and 1.4 the lifetime of the sensor node with the proposed methodology is efficient as compare with the LEACH and HEED algorithms, and the figure 1.1 shows that first dead node in the sensor network for the 100 sensors after the number of rounds in the proposed method after 945 rounds means proposed methodology is reduces the numbers of nodes for transmission hence lifetime of network extended. Fig 1.2 shows that energy consumptions after the number of rounds in clustering data transmission is more in proposed methodology as compare with other technology. The motive for this performance is that the data communications reserved a big amount of energy in wireless sensor networks.

TABLE I. PARAMETERS

Parameter	Value
Electronics Energy (Ee)	50 nJ/bit
Communication Energy (єFS)	10 PJ/bit/m4
Communication Energy (єMP)	0.0013 PJ/bit/m4
Energy for data aggregation (Eda)	5 nJ/bit
Initial Energy	100J
Packet Size	512 byte
No. of nodes	50,100,150,200
Sensing Area	100x100,200x200

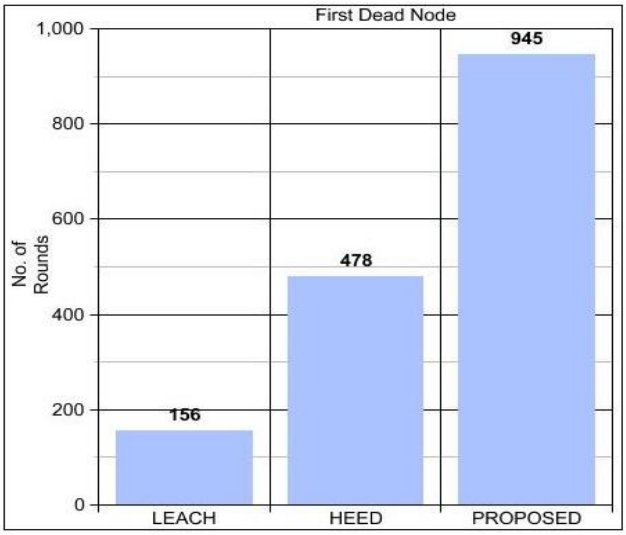

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Fig 1.1 First Dead node (Sensor Nodes=100)

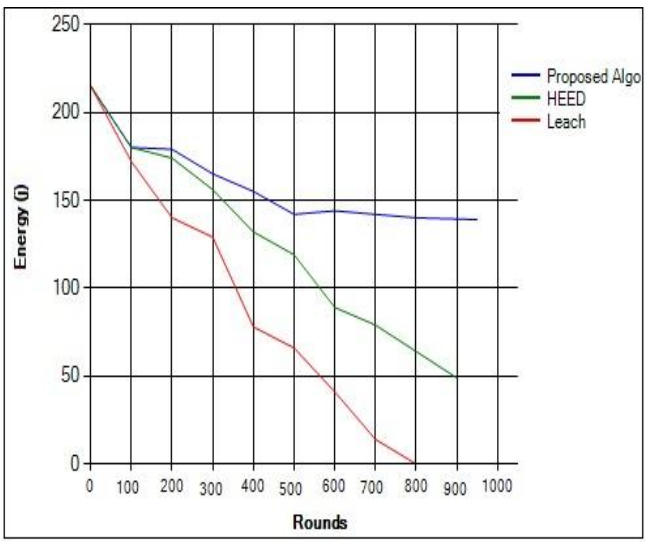

Fig 1.2 Total Energy (Sensor Nodes=100)

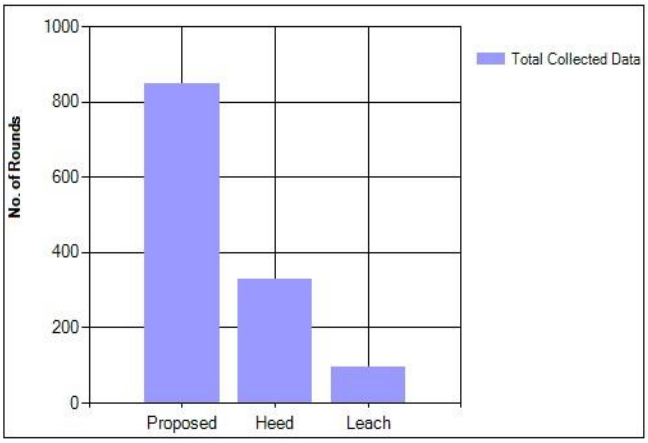

Fig 1.3 Total Data Transmission (Sensor Nodes=100)

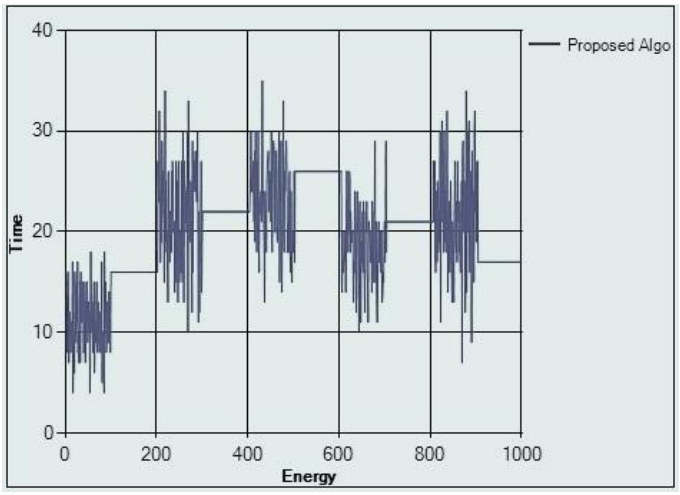

Fig 1.4 Efficiency of Energy in Proposed Algorithm

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