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An Energy Saving Approach in Wireless Sensor Network

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ABSTRACT-
Wireless sensor networks consist of small battery powered devices with limited energy resources. Generally nodes are deployed in an area where human being cannot reach, therefore the small sensor nodes are usually not accessible to the user, and thus replacement of the energy source is not feasible. Hence, energy efficiency is a key design issue that needs to be enhanced in order to improve the life span of the network. In most of the existing protocol cluster head sends data directly to base station which dissipates a lot of energy, so in this paper an energy efficient approach is proposed which use the heterogeneous network of sensor nodes and multi hope approach for data transmission

Keywords-Cluster Head, Energy Consumption, MATLAB, Network Lifetime, Wireless Sensor Network.

I. INTRODUCTION

A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomena like temperature, humidity, vibrations, seismic events, and so on [1]. Typically, a sensor node is a tiny device that includes three basic components: a sensing subsystem for data acquisition from the physical surrounding environment, a processing subsystem for local data processing andstorage, and also a wireless communication subsystem for data transmission. In addition, a power source supplies the energy needed by the device to perform the programmed tasks. This power source often consists of a battery with a limited energy budget.

The development of wireless sensor network was originally motivated by military applications like battlefield surveillance. However, WSNs are now used in many civilian application areas including the environment and habitat monitoring due to various limitations arising from their inexpensive nature, limited size, weight and ad hoc method of deployment; each sensor has limited energy. Moreover, it could be inconvenient to recharge the battery, because nodes may be deployed in a hostile or impractical environment. At the network layer, the intention is to find ways for energy efficient route setup and reliable relaying of data from the sensor nodes to the sink, in order to maximize the lifetime of the network [2]. The major differences between the wireless sensor network and the traditional wireless network sensors are very sensitive to energy consumption. Moreover, the performance of the sensor network applications highly depends on the lifetime of the network.In some cases it is possible to scavenge energy from the external environment [3] (e.g. by using solar cell as a power source). However, external power supply sources often exhibit a non-continuous behavior so that an energy buffer (a battery) is needed as well. In any case, energy is a very critical resource and must be used very sparingly. Therefore, energy conservation is a key issue in the design of systems based on wireless sensor networks.

The remainder of the paper is organized as follows. In Section 2.review of literature is discussed. Section 3.describes Proposed Approach. Secti 4.Compares Proposed Approach with Existing protocols. Finally, Section 5.gives concluding remarks and future scope.

II. RELATED WORK

Low Energy Adaptive Clustering Hierarchy (LEACH) protocol [5] has proposed by W. R. Heinzelman, A. P. Chandrakasan and H. Balakrishnan. It is one of the most popular hierarchical routing algorithms for sensor networks. The idea is to form clusters of the sensor nodes based on the received signal strength and use local cluster heads as routers to the sink. This will save energy since the transmissions will only be done by such cluster heads rather than all sensor nodes. Optimal number of cluster heads is estimated to be 5% of the total number of nodes. All the data processing such as data fusion and aggregation are local to the cluster. Cluster heads change randomly over time in order to balance the energy dissipation of nodes. This decision is made by the node choosing a random number between 0 and 1. The node becomes a cluster head for the current round if the number is less than the threshold.

S. Lindsey and C. Raghavendra [6] introduced Power Efficient Gathering in Sensor

Information Systems (PEGASIS) protocol. It is an improved version of LEACH. Instead of forming clusters, it is based on forming chains of sensor nodes. One node is responsible for routing the aggregated data to the sink. Each node aggregates the collected data with its own data, and then passes the aggregated data to the next ring. The difference from LEACH is to employ multi hop transmission and selecting only one node to transmit to the sink or base station. Since the overhead caused by dynamic cluster formation is eliminated, multi hop transmission and data aggregation is employed, PEGASIS outperforms the LEACH. However excessive delay is introduced for distant nodes, especially for large networks and single leader can be a bottleneck.

Threshold sensitive Energy Efficient sensor Network Protocol (TEEN) [7] has proposed by A. Manjeshwar and D. P. Agarwal. Closer nodes form clusters, with a cluster heads to transmit the collected data to one upper layer. Forming the clusters, cluster heads broadcast two threshold values. First one is hard threshold; it is minimum possible value of an attribute to trigger a sensor node. Hard threshold allows nodes transmit the event, if the event occurs in the range of interest. Therefore a significant reduction of the transmission delay occurs. Unless a change of minimum soft threshold occurs, the nodes don't send a new data packet. Employing soft threshold prevents from the redundant data transmission. Since the protocol is to be responsive to the sudden changes in the sensed attribute, it is suitable for time-critical applications. They have also proposed AdaPtive Threshold sensitive Energy Efficient sensor Network Protocol (APTEEN) protocol [8]. The protocol is an extension of TEEN aiming to capture both time-critical events and periodic data collections. The network architecture is same as TEEN. After forming clusters the cluster heads broadcast attributes, the threshold values, and the transmission schedule to all nodes. Cluster heads are also responsible for data aggregation in order to decrease the size data transmitted so energy consumed. According to energy dissipation and network lifetime, TEEN gives better performance than LEACH and APTEEN because of the decreased number of transmissions. The main drawbacks of TEEN and APTEEN are overhead and complexity of forming clusters in multiple levels, implementing threshold-based functions and dealing with attribute based naming of queries.

Stable Election Protocol (SEP) protocol [9] has proposed by G. Smaragdakis, I. Matta and A. Bestavros. This protocol is an extension to the LEACH protocol. It is a heterogeneous aware protocol, based on weighted election probabilities of each node to become cluster head according to their respective energy. This approach ensures that the cluster head election is randomly selected and distributed based on the fraction of energy of each node assuring a uniform use of the nodes energy. In this protocol, two types of nodes (two tier in-clustering) and two level hierarchies were considered. Distributed Energy Efficient Clustering Protocol (DEEC) [10] has proposed by Q. Li, Z. Qingxin and W. Mingwen. This protocol is a cluster based scheme for multi level and two level energy heterogeneous wireless sensor networks. In this scheme, the cluster heads are selected using the probability based on the ratio between residual energy of each node and the average energy of the network. The epochs of being cluster-heads for nodes are different according to their initial and residual energy. The nodes with high initial and residual energy have more chances of the becoming cluster heads compared to nodes with low energy.

Hybrid Energy Efficient Distributed clustering Protocol (HEED) [4] has proposed by O. Younis and S. Fahmy. It extends the basic scheme of LEACH by using residual energy as primary parameter and network topology features (e.g. node degree, distances to neighbors) are only used as secondary parameters to break tie between candidate cluster heads, as a metric for cluster selection to achieve power balancing. The clustering process is divided into a number of iterations, and in each iterations, nodes which are not covered by any cluster head double their probability of becoming a cluster head. Since these energy-efficient clustering protocols enable every node to independently and probabilistically decide on its role in the clustered network, they cannot guarantee optimal elected set of cluster heads.

III. PROPOSED APPROACH

The proposed approach assumes heterogeneous network with the sensor nodes having different energy levels and processing power. Some high Energy nodes (Powerful nodes) are deployed. All the nodes with high initial energy level and processing power are selected. A Subset of higher node from the set is selected as a CH based on the fact that they should not be in a communication range of each other. Another subset of nodes is asked to go to sleep.The subset of node which is chosen as a CH broadcast its presence to normal sensor nodes and starts receiving data from the sensors that have decided to become a part of the cluster. Normal sensor decides to which cluster they wish to belong based on the signal from the broadcast. It is assumed that the stronger the signal, the closer the head is and therefore the head with strongest signal is chosen. All the cluster members will send the sensed data to the CH. The CH will send the aggregated data to the

Base Station directly or by using some intermediate CH.

When the energy level of the CH will reach to the threshold value TL, the CH will activate one of the nodes of another set and will make it CH. This information about the new CH will be sent to all the cluster member and other CH also.

1.1. Algorithm

The algorithm is divided into two phases

3.1.1. Selection Phase

Step1: Select a subset of higher node as cluster head

Step2: CH broadcast its presence to normal sensor nodes and starts receiving data from the sensors that have decided to become a part of the cluster

Step3: If the CH energy reaches to the threshold value, then higher node of other subset will act as CH.

Step4: Repeat step 2

3.1.2. Data Transfer Phase

Step1: The cluster members send the sensed data to the CH in the allotted time using TDMA schedule.

Step2: CH will aggregate the data from all the nodes in its cluster.

Step3: CH will transmit the data to the base station through intermediate cluster heads.

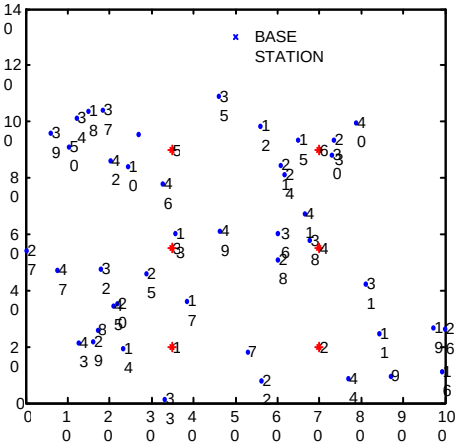

Fig.1. Random deployment of normal nodes

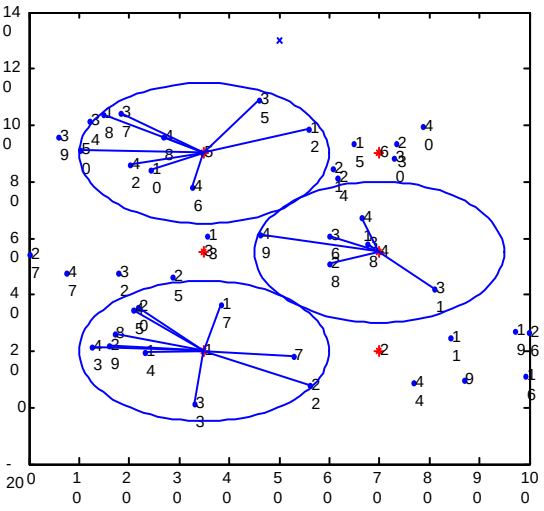

Fig. 2. Cluster formation

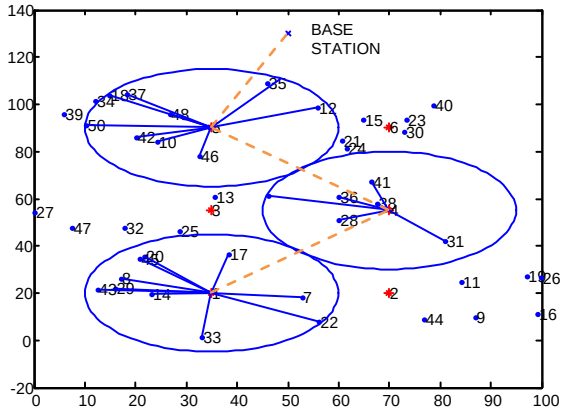

Fig. 3. Data Transfer to Base Station

IV. COMPARISON OF EXISTING PROTOCOLS

In LEACH, HCR all nodes have same energy ie. **Eo**, therefore Energy of network is **n*Eo.** WhereasIn proposed approach it is assumed that a percentage of node population is equipped with times more energy than rest of the nodes therefore Overall Initial energy of network is increased by factor of (1+ **.m**)

In existing protocols each node have capability of cluster head therefore it is necessary for each node to have hardware capable of performing long range transmission to base station, whereas in this approach complex data computation, Hardware complexity is limited to few nodes, thereby reducing the hardware cost of rest of the network.

V. CONCLUSION & FUTURE SCOPE

In this paper, an approach for energy saving in the wireless sensor network has proposed. Algorithms for cluster head selection, cluster formation, data Transmission in wireless sensor network are proposed.In this Heterogeneous network is

considered thereforeoverall Initial energy of network is increased by factor of (1+ □**.m**)and hardware cost of network is reduced as compare to LEACH, HCR etc. protocols.

In future, The proposed approach is planned to implement in MATLAB, and compare the performance of algorithm with original LEACH algorithm.

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