MinD-LEACH: A Novel Clustering Approach Based on LEACH for Wireless Sensor Network

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Abstract
Wireless sensor network composed of large number of homogenous sensor nodes, connected through a wireless network that collect data and relayed to the sink node. In this transmission such issues are very critical like efficient energy, network lifetime, power consumption. In order to reduce these issues new method has been purposed i.e. LEACH protocol. LEACH (low energy adaptive clustering hierarchy) protocol is a good solution for such issues. Existing O-LEACH protocol performs well in terms of energy efficiency and network lifetime for particularly with the existing probability, but they do not consider the position of nodes and cluster head from the base station for the transmission of data packets. In this research work, few classical clustering routing protocols are systematically analyzed and have been assumed as a base for further work. The proposed work is based on O-LEACH. On the basis of comparison with existing O-LEACH, it shows improvement in the energy efficiency and in network lifetime.

Keywords
Wireless Sensor Network, O-LEACH.

I. Introduction

Wireless Sensor Network (WSN) is considered as most important technologies for the twenty-first century [1]. In the past research, it has been received more attention from both academic and industry all over the world. A WSN consists of a large number of low-cost, low-power, and multifunctional wireless sensor nodes, with sensing, wireless communications and computation capabilities. These sensor nodes communicate with short distance through a wireless medium and combined to accomplish a common task, for example, environment monitoring, military surveillance, and industrial process control [2-3]. Once sensor nodes deployed, the sensor nodes must be able to automatically organize themselves into a wireless communication networks. Sensor nodes are battery-powered and are expected to operate without attendance for a relatively long period of time. In most cases it is very difficult and even impossible to change or recharge batteries for the sensor nodes [4]. WSNs are characterized with closely set levels of sensor node deployment, higher unreliability of sensor nodes, and power saver, computation, and memory constraints. It is a self-organized network composed by a large number of micro sensors that are randomly deployed in monitoring regional through wireless communication [5]. Designing effective data application of WSNs. dissemination mechanisms for Wireless Sensor Networks (WSNs) is of paramount importance, as WSNs rely on data dissemination to carry critical commands or code updates from a sink to a set of nodes in the networks [6-7].

Due to the severe energy constraints of large number of closely set deployed sensor nodes, it requires a suite of network protocols to implement various network control and management functions like synchronization, node localization, and network security. The traditional routing protocols have several shortcomings when applied to WSNs, which are mainly due to the energy-constrained nature of such networks [8]. A large number of research activities have been carried out to explore and overcome the constraints of WSNs and solve design and application issues. In this research various routing protocols for wireless sensor network are discussed and compared [9].

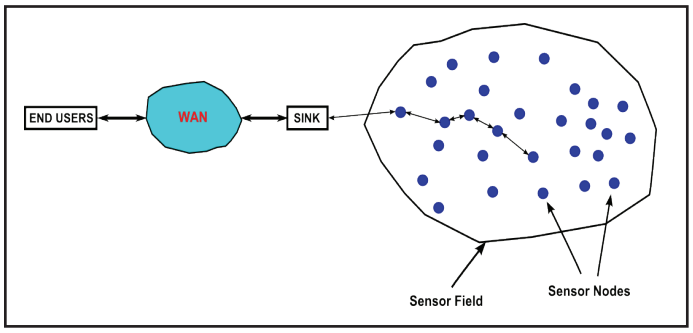

Fig. 1: Wireless Sensor Network

II. Related Work

Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol for sensor networks is proposed in [10] which minimize energy wastage in sensor networks. It is very famous hierarchical routing algorithms for sensor networks which make clusters of the sensor nodes based on the received signal strength. Energy consumption is less as transmission will only be done by cluster head. In [11] author discussed "Synchronization issues in Wireless Sensor Network", in which they utilized random based rotations of local cluster. It is used to distribute the energy for balancing the load. In [12] authors propose V-LEACH which aims to reduce energy consumption within the wireless network. In this, LEACH and V-LEACH was evaluated through extensive simulations using OMNET++ simulator. It shows that V-LEACH performs better than LEACH protocol. In [13] Multi-hope LEACH protocol select best path between the CH and the BS through other CHs and use CHs as a relay station to transmit data. First, multi-hop communication was adopted among CHs. CH forward data to next CH which was closer to BS according to best path. CH send data from single hop to multi hop within CH and BS instead LEACH, in which each CH directly communicates with BS and does not matter the distance between CH and BS. It shows that channel heads send data to multi-hop and as well as improve the energy efficiency rather than previous approaches. In [14] O-LEACH (optimization Low Energy Adaptive Clustering Hierarchy) which is basically selects cluster according to the residual energy of nodes dynamically. The simulation results prove longer stability rather than original LEACH and LEACH-C. In [15] author proposes PEGASIS protocol that is a near optimal chain-based power efficient protocol based on LEACH. According to this protocol, all the nodes have information about all other nodes and each has the capability of transmitting data to the base station directly. PEGASIS outperforms LEACH by eliminating the overhead of dynamic cluster information, minimizes the sum of distances and limits the number of transmission.

III. System Model

In this section, we describe the network model. Assume that are N sensors nodes, which are uniformly dispersed within a MxM square region. The nodes always have data to transmit to a base station, which is often far from the sensing area. This kind of sensors network can be used to track the medical object or seism detection. Without loss of generality, we assume in first simulation that the base station is located at the center of square region, and in the second simulation we assume that the base station is in the top or square region (99m X 99m). The network is organized into a clustering hierarchy, and the cluster-heads execute fusion function to reduce correlated data produced by the sensor node within the clusters. The cluster heads transmit the aggregated data to the base station directly. To avoid the frequent change of topology, we assume that the nodes are in static mode [15]. Network model followed by MinD-LEACH is depicted in fig. 2.

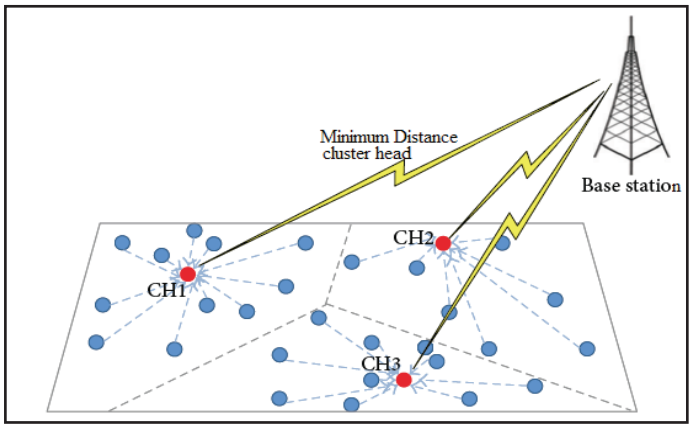

Fig. 2: Network Model for MinD-LEACH

The consumed power by sensor is the sum of the power consumed by captures units, treatment units and communication units. So the energy model for MinD-LEACH is shown in fig. 3 and energy consumption formula is defined below:

Ec = Ec/Capture + Ec/Treatment + Ec/Communication

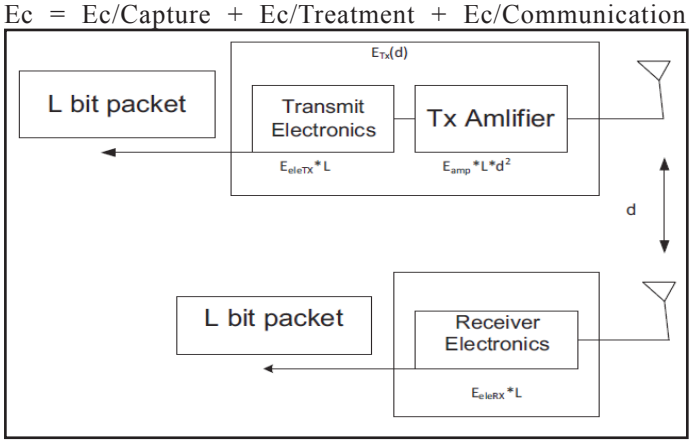

Fig. 3: Energy Model for MinD-LEACH

A. Proposed Algorithm

Basic working of MinD-LEACH is described by the following algorithm.

1. Initiation of routing process by base station.
2. Cluster head will be selected on the basis of two criteria:
   - If Energy>10% of individual residual energy.
   - Minimum distance between cluster head and node.
3. Connect nodes with the cluster head.
4. Create table TDMA and send it to members.
5. Launch of transmission phase.
6. If energy < value in step 2, Launch LEACH.

Fig. 4 depicts flowchart of proposed method by which we can easily understand the working of MinD-LEACH.

IV. Simulation and Results

Experiments are carried out to prove that MinD-LEACH efficiently utilizes energy of the nodes. The parameters used during simulation of proposed clustering algorithm (MinD-LEACH) is shown in fig. 4. In fig. 5, we observed the network life time of MinD-LEACH is better than existing one. As we can see first node get dead at 1200 and last node 2985which indicates long network lifetime of MinD-LEACH.In Fig.6. We observe that the stability of route has been chosen by MinD-LEACH protocol and achieved higher Packet delivery ratio as compared to LEACH-C and old LEACH.

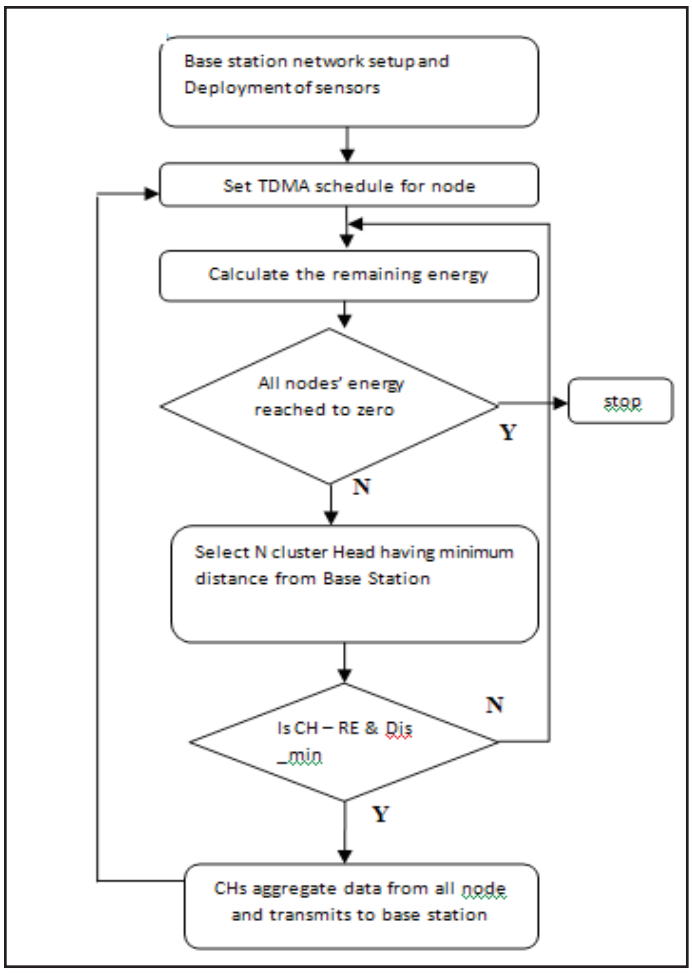

Fig. 4: Basic Design of Proposed Work

Table 4: Simulation Parameters

Parameter Name	Value
Topology Size	300*300
No. of Nodes	300
CH Probability	0.05
Initial Node Power	0.5 Joule
Node Distribution	Randomly Distributed
BS	Centralized
Transmit Amplifier Type (εfs)	100 pJ/bit/m^2
Power (εmp)	1.3Fj/bit/m^4

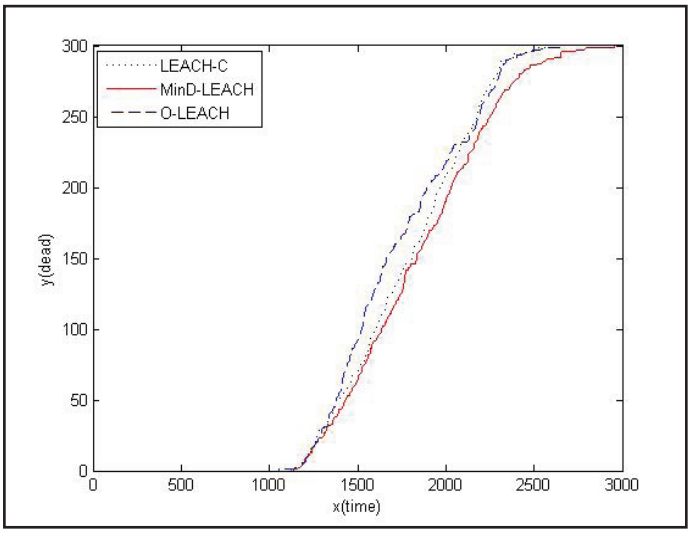

Fig. 5: Network Lifetime

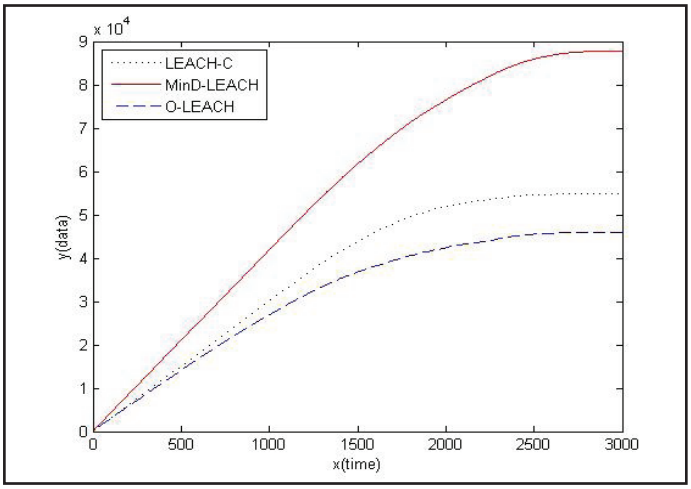

Fig. 6: Transmission Rate

In fig. 7 represents alive nodes statics and again shows that Mind- LEACH is better than existing energy efficient protocols i.e. LEACH-C and old LEACH.

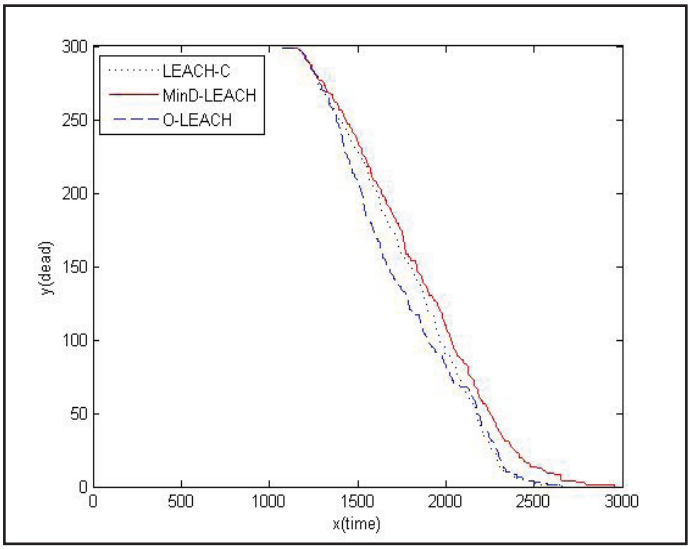

Fig. 7: Number of Alive Nodes

V. Conclusion

Energy consumption is the core issue in Wireless Sensor Networks. In WSN, when trying to reduce the energy consumption, this can lead to poor performance or network life time reduction. Numbers of protocols were used that tried to make more efficient and less energy consumption model. In this research work, we are also proposing method which is named as MinD-LEACH and perform much better in terms of energy and network life by skillfully choosing cluster head.

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