A NOVEL APPROACH TO ENERGY EFFICIENT ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORK

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Abstract: Energy constraint is one of the major research topics in Wireless Sensor Networks (WSNs). The routing consumes the largest amount of energy in WSN, so the routing protocol used for communication should be energy efficient. Besides maximizing the lifetime of the sensor node, it is preferable to distribute the energy dissipated throughout the wireless sensor network in order to minimize maintenance and maximize overall system performance. Any communication protocol that involves synchronization of peer nodes incurs some overhead for setting up the communication. So here we study various energy-efficient routing algorithms and compare among themselves.

Keywords: Wireless Sensor Networks, synchronization

1. Introduction

Wireless Sensor Network consists of nearly about hundred and thousands of small tiny devices, which are distributed autonomously, called as sensor nodes. These nodes used to monitor physical or environmental conditions such as temperature, acoustics, sound, pressure, vibration and motion. Since the nodes are battery operated, the energy plays an important role in WSN. As a result, many more protocols have been proposed for initializing the energy consumption of these sensor nodes.

Typically, each and every node in a sensor network consists of one or more sensors, a radio transceiver or other wireless communication devices, a very small microcontroller and the energy source. As in most of the cases of WSN applications, energy plays an important role, since energy source is a battery. The important goal is preserving the consumed energy of each node, which should be considered, while making a routing protocol for wireless sensor network.

In WSN the main objective behind the routing protocol is to make the network more useful and much efficient. Routing protocol is categorized into 3 parts based on the structure of network, which are flat routing; hierarchical routing and location based routing. In flat routing, for collecting or generating the data and routing to the destination, all the sensor nodes of the network performs the same functionality and works together. The directed diffusion protocol and (SPIN) Sensor Protocol for Information via Negotiations protocol are some of the examples which belong to this flat routing. In the hierarchical routing, the whole network is partitioned into many clusters for the improvement of scalability and utilizations of the energy of the nodes efficiently. LEACH protocol is an example for this. Whereas in location based routing, each and every nodes locations are monitored continuously, for finding the routing path for the communication purpose. Global Positioning System (GPS) devices are used along with network nodes. Examples are GRS (Geographic Adaptive Routing). Many routing protocols are of use such as LEACH.

LEACH is Low Energy Adaptive Clustering Hierarchy. It is considered as the very most popular routing protocol which uses the cluster based routing for minimizing the energy consumption. Here in this paper we propose a variant of LEACH protocol to improve the consumption and make it energy efficient.

2. Leach Protocol

LEACH protocol is the first hierarchical cluster based routing protocol, proposed by Wendi. B. Heinemann, et al. for wireless sensor network. It divides the nodes into clusters, and a dedicated node in cluster with extra privileged called CH (Cluster Head). Leach selects the CH randomly and assigns these nodes by following the policy of round robin management for ensuring fair dissipation of energy between nodes. The CH is then responsible for creating and manipulating the TDMA (Time Division Multiple Access) schedule and in order to

reduce the amount of information transmitted to the BS(Base Station), the CH aggregates the data from the nodes where these data is needed using the CDMA (Code Division Multiple Access). All the other nodes are the members of cluster.

LEACH is divided into rounds:

A . Set-up phase

B. Steady state phase

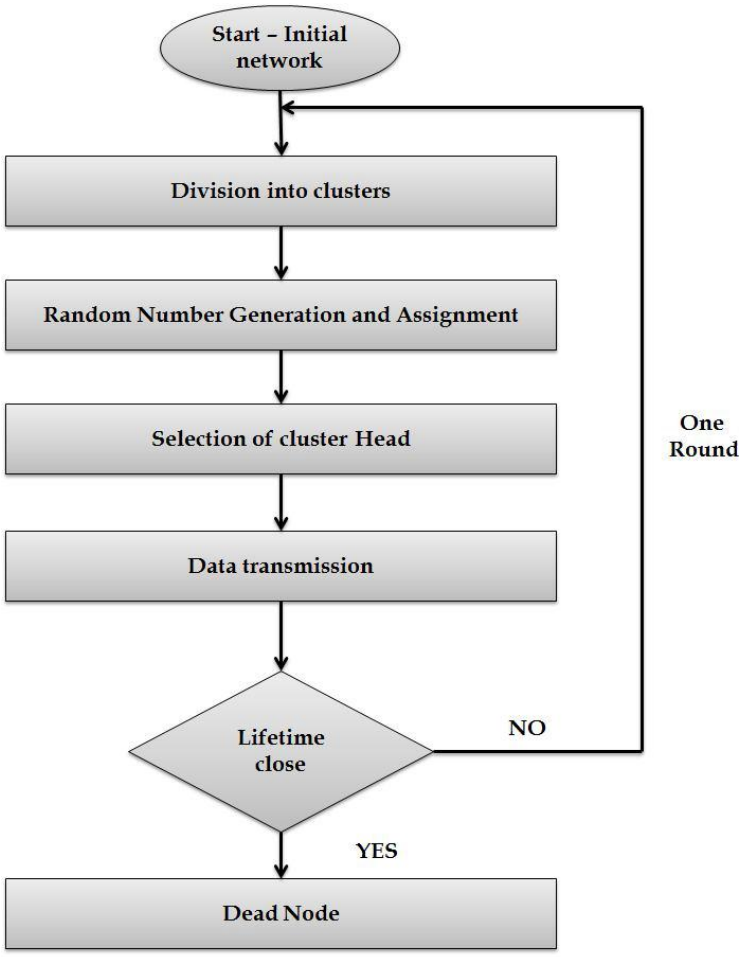


Fig1: Leach Protocol Function

Set –Up Phase

Each node decides independently if it will become a CH or not. The decision takes into account the node that hasn't been a CH for longer time is more likely to choose it-self rather than the nodes which have been a CH recently. By sending the advertisement packets or broadcasting the ADV messages to all non CHs, the CH informs that they become the cluster heads. With the strongest received signal strength, the non-CH nodes pick the advertisement packet.

The members nodes informs the CH, that they have become their IDs using the CSMA. So, the CHs know or get the information about their member nodes and their IDs. On this basis of all received messages within the cluster, CH creates a TDMA schedule. Randomly pick a CSMA code, and broadcast the TDMA table to cluster members. After that steady state phase begins.

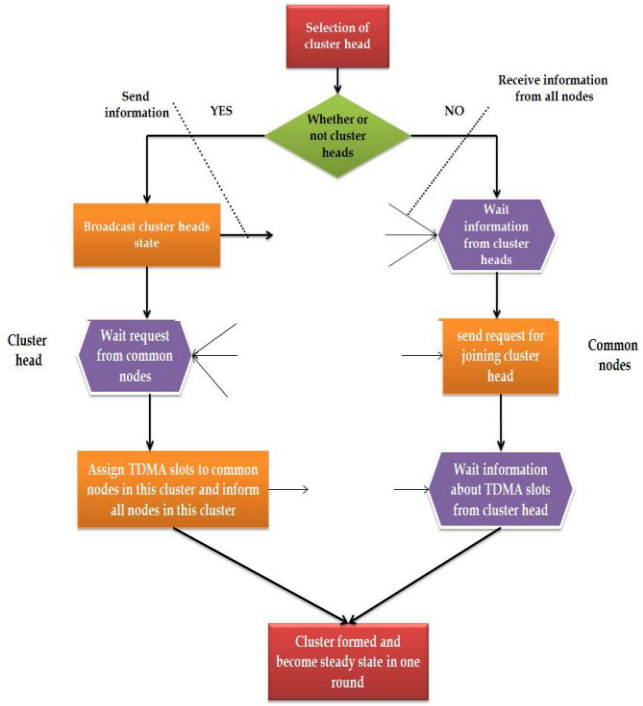


Fig 2: Cluster set up phase in Leach

Steady State Phase

All the non-CH nodes start transmitting the data, after allotment of the TDMA slots, to the CH. The nodes will keep its antenna in ON state only when the data transmission begins. In the other time, it remains OFF in order to save power. The CH will always be in the ON state. Once all the information is received from the nodes (non-CH) by the CH, it does an intelligent data aggregation on the received data and sends it to the BS.

Disadvantages of Leach Protocol

LEACH suffers from many drawbacks which are:

1. Random selection of the cluster head; that does not consider the energy consumption.
2. Some cluster contains more number of nodes and some less.
3. Unable to cover the large area.
4. Non-uniformly distributed CHs; where some CH s is located at the edge of the cluster.
5. Different size of the cluster, which leads to difference in the frequency of sending data from node to CH and CH to base-station, differs.

3. Proposed Work

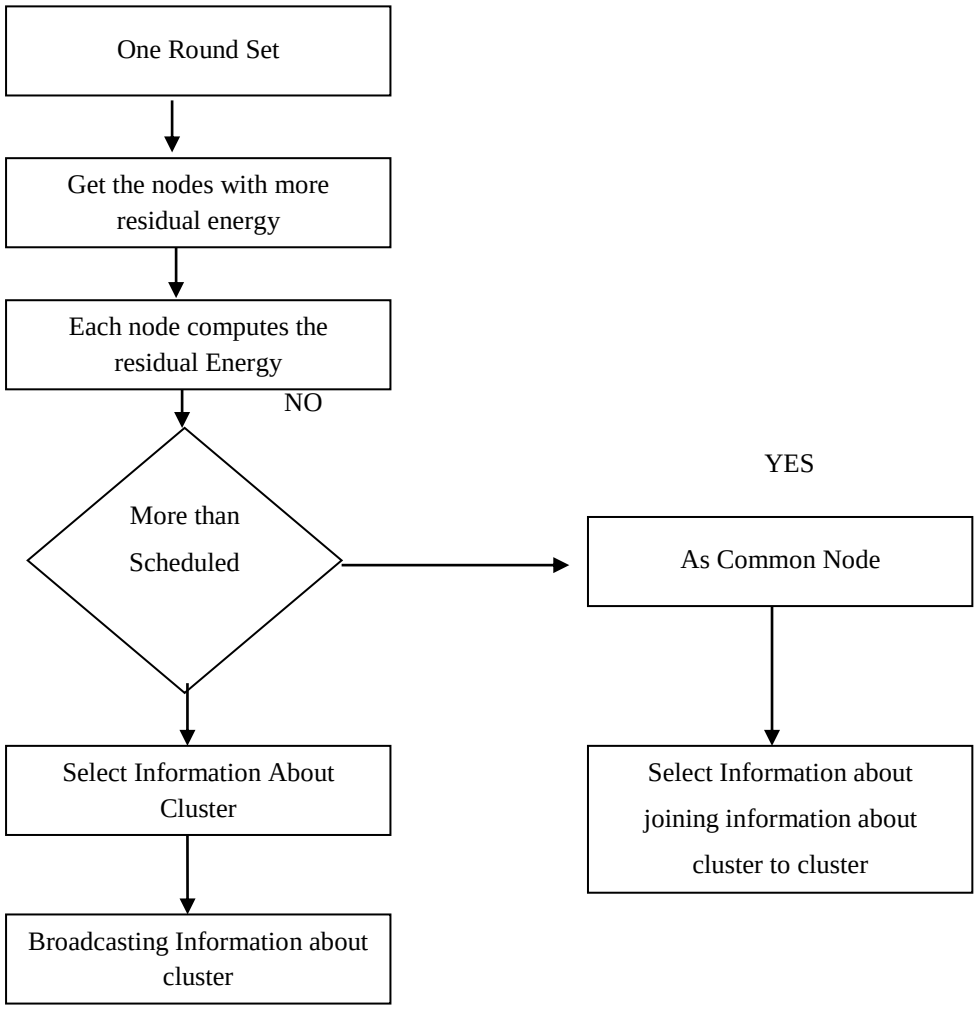
Energy –LEACH Protocol

Energy-LEACH protocol improves the cluster head selection procedure. It makes residual energy of node as the main matrix which decides whether these nodes turn into cluster head or not in the next round. In first round communication, every node has the same probability to turn into cluster head, n (n=p×N) nodes are randomly selected as cluster heads, and then, the residual energy of each node is different after one round communication. We select n nodes with more residual energy as cluster heads in next round communication, and so on until all nodes are dead. Same as the LEACH protocol, energy-LEACH protocol also divides into many rounds, and each round contains cluster formation phase and cluster steady phase.

(1) In cluster formation phase, each node decides whether to turn into cluster head or not by comparing with residual energy ;

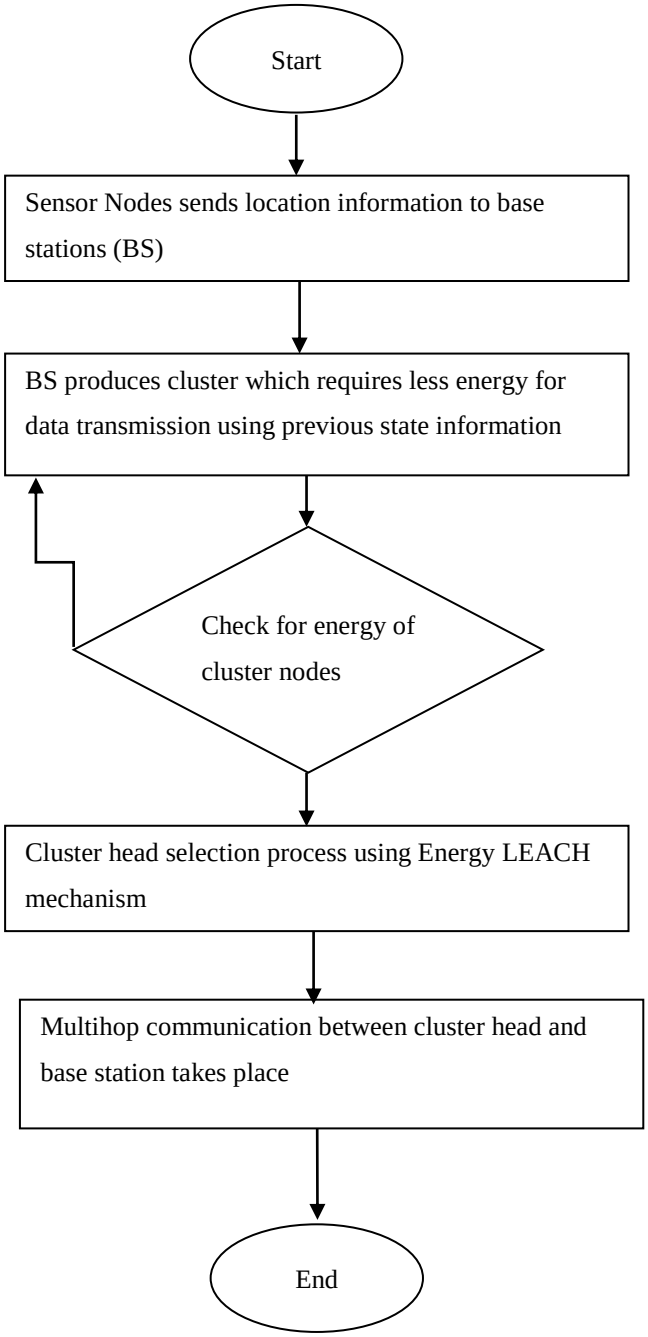
(2) Some nodes with more residual energy turn into cluster heads and send cluster head information to inform other nodes. The other nodes with less residual energy turn into common nodes, and send information about joining cluster

to a cluster head ;
(3) In cluster steady phase, nodes in a cluster send data according to TDMA table, and cluster heads receive, fuse and send data to sink. After a period of time, the network reforms the cluster head selection procedure in a new round.
In cluster formation phase, the flow chart of whether a node turns into cluster head or a common node is shown in Figure.



(Flowchart of Energy Leach)

The proposed work is designed to provide the energy efficient performance in such a way that it offers the advantages of the Energy –LEACH and Multihop-LEACH. It works like a Energy-LEACH in the first phase of Conventional LEACH (i.e. Cluster set-up phase) and it also provide the functionality of Multihop-LEACH in the Second phase of Conventional LEACH (i.e. Steady state phase) The procedure of the proposed algorithm is shown in the flowchart and also elaborated First, all the nodes are linked in the network with the provision of the predetermined energy standard. Each node sends the location and energy information to the base station; it produces the cluster based on nodes current and previous state energy measures.
After this the selection process carried out (i.e. set-up and steady state phase). This set-up phase follows the mechanisms of Energy-LEACH protocol and steady-state phase follows the mechanisms of Multihop-LEACH protocol. After completion of each round, again the whole procedure starting from cluster head election and all other things carried out.



Flow chart of proposed work

Conclusion

WSN routing protocol is a new area of research , here we try to show some new protocols developed over the years based on legacy based algorithms like LEACH,PEGASIS,TEEN, HEED, these new algorithm depict some new concepts and techniques.

Here we have discussed the conventional LEACH protocol for a wireless sensor network. The purpose of proposed approaches is to improve the Cluster Head Election process by modifying it.

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Biographical Notes

Mr. Raghunath Rout is working as an Associate Professor in the department of Computer Science and Engineering,DRIEMS, since 2004. His area of interest includes Soft computing, Real time system, embedded system. He is continuing PhD under BPUT.

