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A Review on Different Type of Leach Algorithm in WSN

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ABSTRACT: Low Energy Adaptive Clustering Hierarchy ("LEACH") is a TDMA- Time (division multiple access) based MAC protocol which is integrated with clustering and a simple routing protocol in wireless sensor networks (WSNs). The goal of LEACH is to lower the energy consumption required to create and maintain clusters in order to improve the life time of a wireless sensor network. LEACH is a hierarchical protocol in which most nodes transmit to cluster heads,and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

KEYWORDS: TDMA, CDMA, Cluster Heads, Base station and GPS

I. INTRODUCTION

Nodes that have been cluster heads cannot become cluster heads again for *P* rounds, where *P* is the desired percentage of cluster heads. Thereafter, each node has a 1/*P* probability of becoming a cluster head in each round. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data.

All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot.
LEACH also uses CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters.

II. LITERATURE REVIEW

Dakshayini et al .[1] proposed an energy aware routing algorithm by assuming that nodes in a network are equipped with global positioning system (GPS).Initially the nodes are deployed randomly, and after deployment all the sensor nodes inform the location information to the base station before the set -up phase and steady state phase. After the location information is collected in the base station, the network coverage area A is divided into groups A1, A2,A3, etc. The groups are created based on the location of the node and cluster head election probability p .The group's creation is done by the BS and does not guzzle too much energy. In each group a CH is selected randomly for each round, therefore the elected cluster heads are distributed uniformly in the network. Then each CH sends identity message to the group member nodes before starting the steady state phase. In steady state phase , all the CHs receive and aggregate the data from group member nodes as in LEACH but instead of directlysending the data to the base station. Therefore CH reduces the radio communication distance. In the proposed LEACH the residual energy remains up to 460 rounds when compared to LEACH which remains only for 193 rounds because the modified LEACH distributes the energy equally among all nodes compared to LEACH. In the modified LEACH he first node dies in 240th round and in LEACH the first node dead at 102 rounds.

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Dong et al.[2] proposed Coverage Preserving routing for WSN. To maximize the life ime of the energy limited WSN, energy efficient routing algorithms are needed. Energy efficient algorithms arrange the nodes into hierarchy and make sure the collaboration among nodes. The clustering-based LEACH is one of the widely used classic routing protocols among them. The author proposed a modified version of EACH called as PBEACP, which concentrates on the selection of cluster-head nodes in the network. The remaining residual energy and the nodes' geographic distribution of nodes are considered for the selection of cluster-head nodes, which lead to even distribution of the energy consumption among nodes. PBEACP also guarantee s the sensing coverage of cluster -head nodes, even the topology of the network is dynamic when there are nodes running out of energy. Simulation results proved that the mean of nodes' life time is increased, the deviation is decreased and also the number of cluster-head nodes in the network is more stable.
W. Heinzelman, [3], use an improved algorithm, LEACH-C protocol was described. LEACH-C is a centralized version of LEACH where only the advertisement phase differs. In LEACH-C, a centralized algorithm at the base station makes cluster formation. At this phase, each node sends information about its current location and residual energy level to the sink.

III. ENERGY WASTAGE IN WSN

In WSN, sensors dissipate energy mainly for transmitting and receiving data as compared to data sensing and processing, while a significant amount of energy is wasted with regard to data communications as described below.

- **Data Collision:** Data packets collide when a node receives more than one at the same time resulting in all the packets that caused this collision being discarded which will in turn necessitate retransmission of the discarded packets causing significant energy waste.
- **Data Overhearing**: Although a node is not transmitting, it will eventually listen to transmissions destined for other nodes causing continuous energy waste.
- **Idle Listening:** This phenomenon occurs when a node keeps listening to an idle channel in search of a data packet destined for it, thus wasting a good amount of energy.
- **Interference:** Energy is wasted as each node within the transmission and interference range receives a packet but cannot decode it.
- **Control Packet Overhead:** Control packets usually synchronize the whole data transmission phase but don't carry any user data. Therefore, it is always a design goal that minimal number of control packets be generated to reduce the energy consumption by these non-data packets.

In order to reduce the energy wastage in WSN and improve the overall lifetime of the network, there is a need of efficient routing but there are certain challanges in routing the WSN network.

IV. TYPES OF ENERGY EFFICIENT ALGORITHMS

- **LEACH:** Several cluster-based routing algorithms are proposed that among them, LEACH algorithm is the most famous algorithm. This algorithm uses a random model to selects CH nodes then, non-CH nodes join to the clusters using one-hop transmissions with Time-Division Multiple Access (TDMA). LEACH algorithm does not consider the remaining energy and geographical position of sensor nodes in the CH selection process. This leads to the early death of sensor nodes and the decrease of WSN lifetime.
- **PEGASIS Algorithm:** PEGASIS algorithm forms chains of sensor nodes rather than clusters to transfer information packets to the BS, so that each sensor node sends receives data from its close neighbor.. Under the PEGASIS algorithm, all nodes need to have a general knowledge of the network to form chains and greedy algorithms are used. This increases PEGASIS algorithm spent cost and makes it difficult to implement it in real applications.
- **HEED:** HEED algorithm extends the basic idea of LEACH algorithm by incorporating residual energy and sensor node proximity to its neighbors in the CH node selection; but it does not pay any attention to the distribution or density of sensor nodes. In HEED algorithm, unlike LEACH, CH nodes are well distributed in the network. But, this algorithm does not consider any assumptions about the sensor node capabilities, such as geographical position.
- **LEACH-C:** LEACH-C algorithm, forms better clusters via the dispersing of CH nodes within the network. Besides, during the initialization phase of LEACH-C algorithm, each sensor node sends information about its

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current position with the help of gps and residual energy level to the BS. Therefore the BS manages the clustering process having a more efficient knowledge of the network.

- **DBS algorithm:** In DBS algorithm, adaptive clustering of sensor nodes is based on their distance from the BS. In this algorithm, sensor nodes death rate is high, and all sensor nodes die in a short time after the death of the first sensor node.
- **I-LEACH:** a cluster-based routing algorithm is proposed that selects CH nodes based on sensor nodes factors geographical position, energy remaining, and number of neighbors. It also manages the sensor nodes and clusters to reduce the energy consumption within the WSN. Similarly, in the proposed algorithm, the operation of selecting the route with minimal energy cost is effective in increasing the WSN lifetime.
  LEACH-C and I-LEACH are modifications to the existing LEACH Algorithm.

I-LEACH ROUTING ALGORITHM

In my research work in worked on I-LEACH routing algorithm and in found that I-LEACH an efficient algorithm which considers these issues to offer a significant reduction in energy consumption and is applicable for a WSN which has following specifications:

All nodes have the same initial energy and their batteries are not rechargeable. Sensor nodes die with the end of their battery. Sensor nodes are fixed i.e., when they are first randomly distributed, they remain in the same place. Each sensor node has a unique ID and knows its current position and its remaining energy. Each sensor node has enough power to communicate directly with the BS. In a cluster, nodes can obtain various sensory data. Every sensor node has a computational unit and a memory unit. Nodes can run some processes, including the definition of sensed data and aggregated data, etc.

V. CH NODE SELECTION PHASE

In order to select the appropriate CH (Cluster Heard) nodes in the CH nodes selection phase, the Improved LEACH (I-LEACH) algorithm takes important factors such as the amount of residual energy of each sensor node, position of the sensor node relative to the BS and the number of neighbours of each sensor node into account. The CH nodes selection directly affects the performance factors of WSN such as load distribution, energy efficiency, and network lifetime [1][14]. The first factor to be examined in the CH nodes selection phase is the number of neighbors of each sensor node. The sensor nodes in the radius (R) of neighborhood of each sensor node are considered as neighbors of that sensor node. The radius of neighborhood is calculated according to (1)

$$R_{CH} = \sqrt{((M \times M) / (\pi \times k))} \qquad (1)$$

where, *RCH* is the radius of neighborhood, $M \times M$ is the area where sensor nodes are distributed, and *k* is the number of clusters [1]. In the CH nodes selection process of I-LEACH algorithm, a sensor node with more neighbors has higher chance to be selected as a CH node. In the I-LEACH algorithm the optimal number of clusters or *kopt* is considered for the *k* value. The *kopt* can be calculated by (2) [1].

$$k_{opt} = (\sqrt{N}/\sqrt{2\pi})\left(\sqrt{\epsilon_{fs}/\epsilon_{mp}}\right)(M/d_{toBS}^2) \qquad (2)$$

$$d_{toCH} = M/(\sqrt{2k\,\pi}) \quad \text{and} \quad d_{toBS} = 0.765\,(M/2)$$

In (2), *dtoCH* is the average distance between sensor nodes and their CH nodes, *dtoBS* is the average distance between CH nodes and the BS (Base station, and N is the number of sensor nodes in the WSN.

VI. USED ENERGY MODEL

In this model, *k* represents the transmitted data packet size; *d* is the transfer distance; *ETX* is the required energy Consumption for data transmition which is dependent on the two parameters of *k* and *d*, and *ERX* is the required energy consumption for data receiving that is dependent on the value of *k*. The following equations are energy consumption relations.

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$$E_{TX}(k,d) = \begin{cases} kE_{elec} + k\varepsilon_{fs}d^2 & , d < d_0 \\ kE_{elec} + k\varepsilon_{amp}d^4 & , d \geq d_0 \end{cases}$$

$$d_0 = \sqrt{(\varepsilon_{fs}/\varepsilon_{mp})} \quad (5)$$

$$E_{RX}(k) = kE_{elec}$$

Eelec is the energy consumption of electronic circuits.

VII. CONCLUSION

Using MATLAB simulator, I-LEACH algorithm is simulated and the performance is compared with algorithms such as LEACH, DBS, and LEACH-C algorithms. Results proved that I-LEACH improved the performance at least 65%, decreases the consumption of energy up to 62.5%, and improves the successfully PDR by at least 57% as compared to the these algorithms for WSN.

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