Clustering Algorithms for WSNs

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Abstract **- In cluster-based methods, nodes are clustered into clusters, where a resourceful sensor node is designated as a CH while in grid-based method the network is scattered into limited virtual grids usually performed by the base station. In Wireless Sensor Networks, clustering technique is required to make sensor networks communicate efficiently. This paper gives summary on few clustering algorithms and discovers advantages and disadvantages associated with each. Hierarchical schemes are generally characterized as cluster-based and grid-based methods. Clustering plays necessary role in power optimization. In recent periods, enormous researches had been done in zone of networking. It is one of the most vital notions in WSN.**

Index Terms **- Wireless sensor networks, Cluster head, Clustering.**

I.INTRODUCTION

Over the last few years there is a meteoric development in the field of wireless sensor network. Sensor network is incorporate abundant sensor nodes (power constrained nodes) which are interlinked to interchange sensed data in a network. Sensor node is nothing but a device with abilities of sensed data processing and networking containing of sensors and optional actuators. A sensor node consists of a sensing unit, a processor, a transceiver station and a power source.

A WSN is a heterogeneous or homogeneous system consisting of hundreds or thousands of low power and low-cost tiny sensors to monitor and gather real-time information from deployment environment. [6][7].

Wireless sensor network is the collection of wireless nodes that are frequently randomly deployed in a targeted area over strenuously changing environments. These nodes can sense, process, and forward data to neighbouring nodes and base station (BS). In WSNs there are two other components, called "aggregation points" (i.e. cluster-heads deployment locations) and "base station" (i.e. the Sink deployment location), which have more powerful resources and capabilities than usual sensor nodes. As the sensed data has to be redirected to BS for further required action, therefore routing becomes vital for transferring of data from node to node or BS efficiently [1–4].

WSN actually needs energy-efficient rules to reduce the energy consumption to the hilt. So energy plays an important role in WSNs and preserving each node's energy is an important objective that must be considered [5]. In hierarchical routing, Grouping of sensor nodes is called a cluster [8] and each cluster has their own cluster head (CH). All sensor nodes forward their data to CH, which in turns routes this data to base station known as clustering. Every cluster-heads (CHs) amass information from their nearby sensor nodes, aggregate and forward them to the base station (Sink) to process gathered data [12, 13, 6]. Clustering is used in WSNs [9, 10, 11], as it provides overall network scalability, efficient use of constrained resources that gives network topology stability and energy saving characteristics.

Lately, several clustering techniques to reduce energy consumption of sensor nodes have been suggested. Mainly this paper focuses on cluster based hierarchical routing protocols.

II HIERARCHICAL CLUSTERING

Clustering means dividing sensor nodes in virtual group according to some rules (called cluster) and then, sensor nodes belonging in a group can execute different functions from other nodes [14, 15, 16].

Due to rare resources in WSN, direct communication of sensor node with BS or multihop communication of sensor nodes towards BS is not applied as energy use is high which results in early expiry of sensor nodes. Direct communication or single- level communication is not viable for large scale network as WSN cannot support long-haul communication. Direct communication has its drawbacks such as high energy use, repetition of data (sensor nodes that were close to

each other, sending data with very small dissimilarity), and uttermost nodes dying quickly. To overcome these difficulties, two-tier communication through hierarchical approach is used where nodes are clustered into clusters. Lead node also called cluster head (CH) is accountable for accumulating the data and then forwarding it to the BS.

Hierarchical network structure often creates a two-level hierarchy, in which the cluster heads are sited at the upper level, and the lower level is for member nodes. The lower level nodes from time to time send data to their respective CH. The cluster head then groups that data and forwards it to BS. The CH node devotes more energy than member nodes, like all the time CH node is sending data over long distances [1]. Moreover, after certain rounds, the selected CH may be unable to perish due to high energy consumption. In order to guarantee load balancing among sensor nodes, the role of CH is altered periodically to balance the energy consumption [3]. Communication within a cluster is single-hop (intracluster) and between clusters is multihop (intercluster). Cluster-based and grid-based techniques are the most commonly used hierarchical techniques [17].

III. PROCEDURE FOR PAPER SUBMISSION

In this section various of algorithms for clustering are brief overviewed.

A. CURE

It is an agglomerative hierarchical clustering algorithm that causes a balance between centroid and all point methods. Ultimately CURE is a hierarchical clustering algorithm that uses subdividing of dataset. A mixture of random sampling and partitioning is used here so that huge database can be handled. In this procedure, a random sample strained from the dataset. It is first partitioned and then each partition is moderately clustered. The partial clusters are then once more clustered in a subsequent pass to return the desired clusters. It is confirmed by the tests that the excellence of clusters produced by CURE is much better than those found by other present algorithms [25]. Figure 1 shows how the CURE process is accomplished.

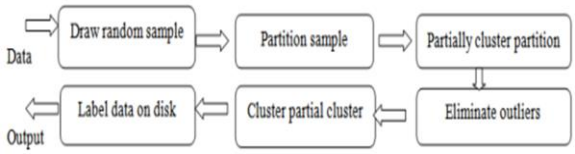

Figure 1: CURE Process

Moreover, it is proved that random sampling and partitioning enable CURE to not only outstrip other existing algorithms but also to scale well for large databases without losing clustering quality. CURE is more vigorous to outliers, and recognizes clusters having non-spherical shapes and wide variances in size. CURE completes this by representing each cluster by a certain fixed amount of points that are produced by choosing well scattered points from the cluster and then shrinking them near the middle of the cluster by a specified section [26].

B. LEACH

Low Energy Adaptive Clustering Hierarchy (LEACH) protocol is the primogenital clustering algorithm in WSNs. LEACH forms on the work described in [18]. It has following design objectives: random settlement of nodes, self-configuring and adaptive cluster development, native control for data transfers and low-energy MAC and application specific data processing. LEACH protocol has different rounds and each round has two stages, a setup stage and steady state stage. In the steady state stage transmission of data takes place and in set up stage it provides cluster construction in an adaptive mode [18].

C. LEACH-C Low Energy Adaptive Clustering Hierarchy Centralized

Low energy adaptive clustering hierarchy centralized (LEACH-C) [19] is the improved version of LEACH. In LEACH-C, the clusters are molded by base station whereas in LEACH each node self-configures them into cluster. The BS acquires all the data regarding the energy and location of all the nodes arranged in the network. By doing so, BS recognizes the number of cluster head (CH) and organizes network into several clusters. Nevertheless, due to lack of coordination among nodes, the number of CHs varies from round to round. In LEACH-C the number of CHs in each round equals the best resolute value. A centralized routing approach is one in which BS calculates the average energy of a network for a set of sensor nodes consuming energy level above average. A CH will be

selected from the set of nodes to confirm that nodes designated should have sufficient energy to be a cluster head. The network is divided into two subclusters and then they are furthermore divided into the preferred number of CHs. By this way, the nodes are evenly dispersed to ensure that load is eventually distributed. The BS picks lowest energy routing paths and forwards the information of clustering and CH to all nodes in the network by means of a minimum spanning tree approach. However, due to centralized approach communication overhead will surge in the reselection of CH, because reselection decision has to be made by BS. Moreover, every cluster will send request; thus energy consumption will be high.

D. LEACH-R

In this Ningbo WANG etal. in [20] had deliberated an improved protocol LEACH-R based on LEACH to improve the selection of CH and advises to choose relaying node compare to LEACH. In this algorithm Low energy nodes being elected as cluster-head is reduced. This algorithm balances network energy consumption and extends the network life cycle more competently. But this surges the difficulty of the algorithm.

E. LEACH-MAC

In [21], low energy adaptive clustering hierarchy-media access control (LEACH-MAC) is proposed to control the arbitrariness of cluster head count in LEACH protocol. The drawback of LEACH is that it selects the CH on the basis of random number; nodes that yield the random number less than the threshold will become CH. The problem of randomness by using media access control layer information is addressed. To attain energy efficiency, LEACH-MAC preferences the CH based on uniform random interval to make the CH count stable.

F. EADC

Energy-Aware Distributed Clustering (EADC) [22] is projected for non-uniform placement of sensor nodes to balance the load across the entire network. EADC builds unequal clusters to resolve the problem of energy holes. Through routing procedure, the CHs select nodes with high energy along with smallest hop count to member nodes to attain load balancing in CHs. The cluster head is then selected on the basis of the ratio of average outstanding energy of nearby nodes and the energy of node itself. Some of the sensor nodes were sacked, consuming extra energy which was disregarded in EADC. This problem was solved in [23]; the terminated nodes were turned OFF based on the schedule. Furthermore, the overall energy consumption was reduced by evading needless sensing and transmission.

G. EADUC

The problem of energy hole was addressed in energy-aware distributed unequal clustering (EADUC) [24] by allowing for unsatisfactory sized clusters. Nodes having different energy resources are deliberated and clusters with unequal sizes are created to solve the energy hole problem. Authors claim that the found results were enhanced in comparison with LEACH regarding energy efficiency and exploiting network lifetime. EADUC attains energy efficiency through unequal cluster construction. However, the redundancy of data in dense area is not considered in EADUC which indications to needless energy consumption affecting network lifetime.

IV. CONCLUSION

In this paper we discussed various hierarchical clustering algorithm like CURE, LEACH, LEACH-C, LEACH-R, LEACH-MAC, EADC and EADUC for wireless sensor network. The paper concludes these algorithms with advantages and disadvantages of each. Advantages of LEACH are nodes correspondingly share load up to some extent, TDMA evades unnecessary collisions and allotted time slots avoid undue energy consumption & disadvantages are single-hop intercluster communication, energy holes and coverage problems, moreover CH selection is probabilistic without considering energy and additional overheads due to dynamic clustering. Advantages of LEACH-C are global view of the whole network, even scattering of load and energy effectual routes & disadvantages are network overhead, CH choice is probabilistic and reselection procedure is resource costly. Advantages of EADC are attains load balancing among CHs and Addresses imbalance energy consumption & disadvantages are dismissed messages cause additional energy consumption, rough clustering in random deployment. Advantages of LEACH-MAC are addresses randomness in CH count,

nodes equally distributing load up to some extent and attains energy efficiency & disadvantages of LEACH-MAC are the CH choice being based on random value, single-hop intercluster communication and CH selection being probabilistic without considering energy. Advantages of EADUC are solves energy hole problem, maximizes network lifetime and has unequal clustering strategy & disadvantages are redundant sensed and transmission messages and additional energy consumption affecting network performance.

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