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A Review on Clustering Based Routing Protocols for WSNs

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Abstract: Wireless sensor network are an emerging technology that has potential application in healthcare. In wireless sensor network, the energy efficiency is a major issue in large space and surveillance, environment and structural monitoring. To extend the lifetime of the WSN it totally depends on nodes that having limited energy,memory, rangeand to increase the energy efficiency by saving the battery power. So many different protocols are used for energy consumption in WSN. LEACH is a base for all the algorithmsas it is well known fact that different field of work in WSN we need different types of schemes for data transmission like clusterhead(CH),chain formation. This paperintroduces a survey on energy efficient hierarchical clustering algorithm for load balancing in WSN.

Keywords: Wireless sensor network, clustering, cluster head, energy efficiency, network lifetime.

I.INTRODUCTION

Wireless sensor network(WSNs) consist hundreds or thousands of nodes that gather the information and forwarded via a multiple hops to the base station node that can used it locally or is connected to other network. In WSNs, the wireless nodes which are irreplaceable due to drain out their battery power, energy resource of sensor networks should be managed wisely to extend the lifetime of the sensors. Energy is major term in WSNs because it determines the aliveness of wireless sensor node. To minimize energy consumption and maximize the network life time is important objective of WSNs.So routing protocols are one of the core technologies in a WSNs.Clustering is widely used for analysis data and it is useful for particular applications that require scalability to hundreds or thousands of nodes. Wireless data transmission is a most critical issue among the sources of energy consumption in a sensor node. The efficiency of WSNs depend upon the amount of data to be transferred and the distance between node to base station and the performance of clustering is depends on the selection of cluster-heads which are in charge of creating clusters and controlling member nodes. Many clustering protocol are used in wireless sensor network.

II. CLUSTERING PROTOCOLS FOR WSNs

Much of the recent research work in the area of cluster-based WSNs has extensively focused on lifetime, stability, energy efficiency and scalability. In the past few years, numerous energy efficient clustering algorithms have been proposed for a wide range of applications.

LEACH is base of all the algorithms [1]. It is hierarchical routing algorithm based on clustering. Every node as the probability to get selected as a cluster head in each round. It contains two phases in every round: cluster setup phase and steady data transmission phase. In sensor network algorithm is used to divide into clusters. So the energy consumption of every part of the network is balanced due to sharing communication load. This protocol assumes that when nodes are selected as cluster heads and non- cluster head then the energy consumption of all the nodes are equal. All non- cluster head sends their data to the closest cluster head. Then cluster heads send aggregated data to the data sink directly. $T_1(n)$ is determined according to the equation:

$$T_1(n) = \frac{P}{1 - P * (r \bmod \frac{1}{P})},$$

For nodes that have not been cluster head in the last $1/P$ rounds, otherwise $T_1(n)$ is zero. Here P is the desired percentage of cluster heads and r is the

current round. Using this algorithm, each node will be a cluster head exactly once within 1/*P* rounds. After 1/*P* – 1 rounds, $T_1(n) = 1$ for all nodes that have not been a cluster head.

Prasad *et. al* [2] presented a framework for fault revoking and homogenous distribution of randomly deployed sensor nodes, so that the cluster head within various clusters consume equal amount of energy. Deployment area was first divided into clusters of equal size. Mobile sensor nodes were deployed in the deployment area with the help of parachutes and each of the mobile sensor nodes was embedded with a static sensor node that can be used to replace the dead sensor nodes in the network. The total number of mobile sensor nodes were equal to the total number of clusters and the number of mobile sensor nodes which were required for fault revoking depends on the number of clusters and the size of deployment area. In a cluster if a sensor node gets damaged then its location id was sent to the mobile sensor node by the base station. The affected sensor node was replaced by mobile sensor node, thus increasing the lifetime of the network.

Rashed *et. al* [3] proposed an energy efficient routing protocol called Weighted Election Protocol (WEP). It is a scheme of combining clustering strategy with chain routing algorithm for satisfying both energy and stable period constraints under heterogeneous environment. Weight was assigned to the optimal probability for each node and this weight was kept equal to the initial energy of each node divided by initial energy of the normal node. After assigning weight, cluster head election was done in the same way as in LEACH.

Nazir *et. al* [4] presented an energy efficient multi-hierarchy clustering protocol. In this protocol, in addition to normal nodes, sensor nodes with more energy called super nodes were deployed to cater hotspot problem and prolong network lifetime. Multi-level hierarchy was achieved by placing super nodes acting as local sink at top level, normal nodes as cluster heads at middle level and normal nodes as cluster member at lowest level. Both coverage and residual energy were used as selection parameter for CH. After CH selection, sleep/wakeup schedules for nodes were defined by CHs. Nodes covering same area were made to sleep and wake alternately. TDMA scheduling was done by CHs to avoid interference in transmission. After that data was sent from cluster members to CH using single hop and from CH to BS using multi-hop communication.

Said *et. al* [5] proposed an improved and balanced clustering algorithm called IB-LEACH. In this scheme, some high energy nodes called NCG nodes (normal node/cluster head/gateway) were made cluster heads to aggregate the data of their cluster members and transmit the data to the chosen gateways that requires the minimum communication energy in order to reduce energy consumption of cluster head and to decrease probability failure of nodes. It was more effective in prolonging lifetime and stability period than LEACH and Stable Election Protocol (SEP).

Qing *et. al* [6] had described another protocol for heterogeneous wireless sensor networks. It is a distributed energy efficient clustering protocol based on clustering. Cluster heads were elected on the basis of probability based on ratio between residual energy of each node and average energy of the network. The epochs of being CH for each node was different depending upon its initial and residual energy. The nodes with high initial energy had more chances to become CHs than the nodes with less initial energy. DEEC had prolonged network lifetime as well as the stability period.

Elbhiri *et. al* [7] discussed another clustering protocol for heterogeneous wireless sensor networks called stochastic Distributed Energy Efficient Clustering DEEC (SDEEC) protocol. The cluster head election was based on residual energy of the nodes. This protocol was based on DEEC with new strategies [6]. The stochastic energy was the main idea where the intra cluster transmission was reduced. This protocol also considers two-level heterogeneity, but unlike DEEC energy consumption was reduced by making non-CH nodes sleep. The drawback in this protocol was that if non-CH nodes turn off their radios when CH is performing data aggregation, how would they know about the next round of CH selection.

Yassein *et. al* [8] presented another clustering protocol called V-LEACH in which besides having a cluster head, a vice-cluster head was also elected that performed the role of cluster head when it was dead. Advantage of this protocol was reliable data transmission to the base station and there was no need of electing new cluster head each time when a cluster head was dead

Kumar *et. al* [9] presented an extension of Stable Election Protocol. EEHC is an energy efficient clustering protocol for heterogeneous WSNs. This scheme extended the network lifetime by introducing three degrees of heterogeneity: normal, advanced and super nodes. For each type of nodes optimal percentage to become CH was defined. Principle of EEHC was kept same as that of SEP with addition of

one more node type. Network lifetime achieved was more than that achieved using SEP.

Li *et. al* [10] developed another clustering protocol in heterogeneous environment called REECR. Cluster head election was done on the basis of residual energy and energy consumption rater (REECR) of the node rather than the rotation in turn. Since type-1 nodes transmitted bigger data packet than type-0 nodes, therefore energy consumption rate of two types of nodes was imbalanced. Hence energy consumption rate becomes one of the factors of electing cluster heads. At the same time, residual energy of a node was also considered as a factor of electing cluster heads so that nodes having more residual energy were elected as cluster heads.

Li *et. al* [11] also proposed an improved version of REECR called ZREECR (Zonal-based REECR). This protocol divided the network into fixed zones depending upon the distance and orientation from base station. It was expected that clusters formed near the base station would have smaller cluster size because CHs had to relay the data from the farther CHs to the base station. In the first round cluster heads were selected at the geometric centers of the zones to avoid the situation of very far and near node becoming CH. But in the second round CH selection in each zone was based on the residual energy and energy consumption rate. This protocol was more stable than REECR.

Loscri *et. al* [12] had proposed another LEACH based protocol which used two level hierarchies. In this, instead of one cluster head, two cluster heads were elected, primary and secondary. Cluster head collects data from other cluster member as in LEACH, but instead of transferring data directly to the base station, it used one of the cluster heads lying between the cluster head and the base station as a relay station. Data was sent from each sensor node to its secondary cluster head. Then aggregated data from secondary cluster head was sent to its primary cluster head. Transmit distance for nodes had been reduced, so less energy was consumed and hence it was possible to do data aggregation could be done both on primary and secondary levels to further improve the energy efficiency.

Smaragdakis *et. al* [13] proposed an energy-aware protocol for heterogeneous wireless sensor networks. SEP or Stable Election Protocol is used for electing cluster heads in two-level hierarchical wireless sensor networks. It is based on weighted election probabilities of each node to become cluster head according to the remaining energy in each node. SEP improved the stable region of the clustering hierarchy process using the fraction of advanced nodes (m) and the additional energy factor between advanced and normal nodes (α). Since advanced nodes had more energy than normal nodes, so advanced nodes were made cluster heads more frequently than the normal nodes. This was done by increasing the epoch of the sensor network in proportion to the energy increment. However, SEP cannot be used for multi-level heterogenous wireless sensor networks.

Younis *et. al* [14] presented another energy efficient clustering protocol for multi-hop networks called HEED . CHs were selected periodically according to a combination of two clustering parameters. The primary parameter was residual energy of each sensor node which was used to probabilistically select an initial set of CHs, and secondary parameter was the intra-cluster communication cost as the function of cluster density and it was used for breaking ties. CHs selected in HEED were well distributed across the network and the communication cost was minimized.

Mhatre *et. al* [15] made comparative study on homogenous and heterogeneous network for single hop communication. For homogenous networks LEACH was used as the representative and for heterogeneous networks, a network with two types of nodes was used. A method to estimate the optimal distribution among different type of sensor nodes was proposed. The case of multi-hop routing was also studied within each cluster. For multi-hop homogeneous network, a multi-hop variant of LEACH called M-LEACH was proposed and analyzed. Results show that M-LEACH had better energy efficiency than LEACH in many cases. A comparison based on cost was also done between multi-hop homogenous network M-LEACH and multi-hop sensor network with two types of nodes.

Heinzelman *et. al* [16] discussed a centralized clustering algorithm called LEACH-C. During the setup phase each node's location and energy level was sent to the base station. Decision of node to be selected as cluster head was made by the base station on the basis of average node energy. Once the cluster heads were elected and the associated clusters were formed, data transmission was done as in LEACH. This protocol produced a better cluster distribution than LEACH as it had global knowledge about the location of all the nodes but it required nodes to be equipped with GPS or other location finding algorithms and also if base station was far away from the network then the cost to reconfigure the network would be high.

Manjeshwar *et. al* [17] had presented an improved version of TEEN to overcome its drawbacks. It is a hybrid clustering protocol that allows the sensor to sense the data periodically (as in LEACH) and react to any sudden change in the value of the sensed attributes (as in TEEN). The architecture of APTEEN is same as that of TEEN. APTEEN supports 3 different query types namely a) historical query, b) one-time query, to take a snapshot view of the network and c) persistent queries, to monitor an event for a period of time.

Manjeshwar *et. al* [18] proposed another hierarchical protocol for reactive networks called TEEN. Reactive networks are the networks in which node respond immediately to the changes in the relevant parameters. In this protocol, in addition to the attributes, CH sends a hard and a soft threshold. The nodes sense their environment continuously. The first time a parameter from the attribute set reached its hard threshold value, the transmitter of the node was switched on and data was sent. The sensed value was stored in an internal variable called sensed value (SV). The data was sent by the nodes in the current cluster period if the following conditions were true: the current value of the sensed attribute was greater than the hard threshold, and the current value of the sensed attribute differs from sensed value by an amount equal to or greater than the soft threshold. Both strategies tend to reduce the number of transmissions. The main drawback of this scheme was that, if the thresholds were not reached, the nodes would never communicate; the user would not get any data from the network at all and would not come to know even if all the nodes were dead.

III. META-HEURISTICS CLUSTERING ALGORITHM

In wireless sensor network novel applications and technological platform is a rapidly evolving. Depending on the network architecture and the application, proper attention has been given to the routing protocols. LEACH is mainly used its simplicity and efficiency energy an attractive wireless sensor network routing protocol. Evolutionary Algorithms (EAs) is a meta-heuristics algorithm which has been utilized by several researchers. HCR is an example of routing mechanisms which increased the lifetime of network of wireless sensor network, but unfortunately decreasing the stability period of wireless sensor network [19]. The fitness function clustering of EAs is most probably abstract modeling. In wireless sensor network 20 random heterogeneous shows the simulation results in Evolutionary routing protocol (ERP) and compare these results with LEACH, SEP, and HCR protocols. The EA always have increased the lifetime of network, or greater energy is preserved or compare to the LEACH, SEP, and HCR protocols.

The wireless sensor networks supported the optimization methods that proposed the framework of cent razed that is developed practically. To design and implementation the real time application of sensor network which is based on the framework in protocol using HSA [20]. HSA is an optimization method of music-based. To optimize the energy distribution in wireless sensor networks in which cluster members minimizes intra-cluster distance with respective cluster-heads. Wireless sensor networks compared with the cluster based protocols by using FCM clustering algorithm or to develop with a LEACH-C. The proposed protocol shows experimental results using harmony search algorithm can be realized in the surveillance applications of building environments and for safety centralized cluster in networks. Using proposed HSA based protocol in the lifetime of network extended in wireless sensor and obtained the experimental test of results, that is comparison the LEACH-C and FCM protocols.

IV. CONCLUSION

InWSNs energy is an important issue. So designing energy efficient protocol is very important. In this paper, our primary focus is on increase the network lifetime of wireless sensor network. It is hoped that this detailed discussion will be beneficial insight into various concepts involved and boost further advances in the area. So meta-heuristics based energy efficient clustering hierarchal protocol can be used to improve the energy at great extend.

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