

# Clustering in Wireless Sensor Network: A Review

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**Abstract**— The Network life time is an important aspect in wireless sensor network (WSN). Due to its limited sensor node energy, it is important to optimize the energy of sensor Node for improving the life time of WSN. The Sensor Nodes mainly depend on the batteries for energy, which may get exhausted due to the computation and communication overhead and results in decreasing the network life time. Clustering plays very essential role in WSN as it increases the network life time and scalability. The aim of clustering is to gather the data in a systematic manner, so that network life time is enhanced. The selection of Cluster Head (CH) is done in the existing algorithms. The algorithms try to guarantee that the whole network stay alive for longer time which results in improving the overall performance of WSN in term of increasing the lifetime of sensor Node.

**Key words:** Clustering, Cluster Head, Energy Efficiency, Wireless Sensor Network

## I. INTRODUCTION

Wireless Sensor Network (WSN) consist of a collection of nodes, with small computing device, memory and transmitter module. The nodes may vary from few to several hundreds or even thousand [1]. WSN is an arrangement of sensor nodes which interacts with each other using wireless network. It comprises of many sensor node which can sense the environment and process this data into information and send to the user through monitoring centre. It sense the data into distinct forms such as humidity, light, sound, vibration, pressure etc. Many protocol and algorithm are used to gather such type of information.

The number of applications where sensor network is used are agriculture, security, military, surveillance, healthcare etc. The nodes in the WSN can be deployed in through random fashion or uniformly [2]. It is beneficial to organize sensor nodes in some group. By organizing sensor nodes in a group, the data will be pooled from all the sensor nodes and only desired data will be transmitted to the base station, so that it will consume less energy. The process of grouping nodes is called clustering [3].

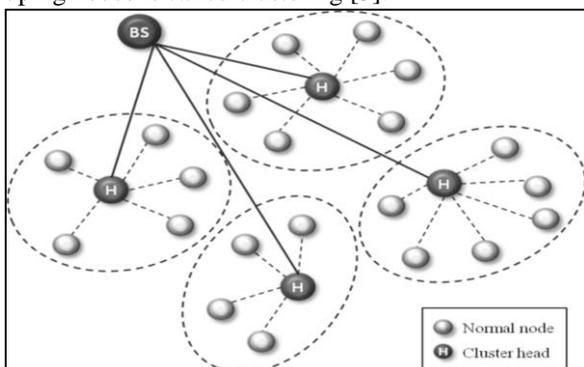


Fig. 1: Clustering in WSN

In WSN the Clustering technique plays significant role. It maintains the network topology that effectively

partitions the group of nodes. The life time of WSN is mostly effected by position node, topology pattern and routing protocol.

The major challenge in WSN are latency, data integrity, energy and communication constrain.

## II. RELATED WORKS

In this paper, a survey of existing clustering algorithm for Wireless Sensor network has been discussed.

Low Energy Adaptive Clustering Hierarchy (LEACH) [4] is the basic distributed clustering algorithm for WSN, where each node transfer the data to CH and cluster head further transfer this data to BS. In each round CH is selected. If a node turns into CH then it cannot become CH for next  $1/p$  round. In this  $p$  is the probability of cluster head. The problem with this technique is that the nodes are allocated in random fashion and hence reduces the Network lifespan as well as the efficiency of network.

To conquer the limitation of LEACH algorithm various algorithm were developed. W.Heinzelman et al [5]developed dynamic clustering algorithm for WSN. In this CH is not same in each round. This protocol helps in dropping the data that wants to be transmitted to BS. There are two stages in each round SETUP and STEADY stage. Clusters are formed in SETUP stage and data are transmitted during steady phase. There are many limitation of this algorithm such that it does not provide best possible number of CH. So that energy factor is not considered while selecting CH.

In order to conquer the LEACH, new clustering algorithm was developed by W.HEINZELMAN. LEACH-C algorithm is that in which CH is determined by BS. BS determines the threshold level and the node that have energy more than threshold value is selected as a CH. The BS sends a message contains CH. When Node receives this message it compares it with CH ID. If it matches it is a CH, otherwise it is a cluster member.

BS controlled Dynamic Clustering Algorithm. This algorithm was developed by S. MURGUGANATHAN et al [6]. In this BS take decision regarding the cluster head like routing path, rotation of CH. The main aim of this algorithm is to create the cluster with the same number of members and uniformly deployment of CH across the network. This algorithm solves the hot spot problems because nodes change every round.

R.Randriatsiferana proposed an algorithm which rectifies the work of LEACH algorithm. It finds the optimal number of CH. The nodes with higher residual energy and lowest energy consumption variance become the CH.

Hybrid Energy Efficient Distributed (HEED) is a well organized Cluster based Routing Protocol. In this high residual energy is compared with the member Nodes and depending on this, clustering HEAD is selected. The main disadvantage of LEACH is that CH is selected randomly which leads to insufficient coverage and network release. So

CH selection is an important aim to achieve higher longer network life time [7].

Genetic Algorithm (GA), is an evolutionary technique which is used now-a-days for CH selection by many researchers. Most of the real time problem on optimization can be solved by evolutionary technique. The outcomes of the GA identify the suitable Cluster for the Network. It is used in the BS. The BS Broadcast the full network detail to all the Nodes in Network. The entire sensor Nodes get the packet broadcast by the BS, and according to this Cluster is created. GA produced balanced and energy efficient data aggregation spanning tree for WSN. In this the fitness function contains residual energy, transmission load, receive load and the distribution load.

In the GA Algorithm Selection of CH is based in the residual energy, bandwidth and memory capacity. The node with maximum residual energy, maximum unused bandwidth and maximum unused memory has more probability to become the CH. If any two of these have maximum value and other one with minimum value then the chance of that Node to become CH. It depends on the weight given for that these three parameters.

In the field of WSN a large number of research work have been carried out using the GA [8]

#### A. Algorithm for CH selection using GA

- 1) Produce an initial population of individuals with random chromosomes
- 2) Evaluate the fitness of all individuals and rank them
- 3) while ( the number of CHs < 10 % of the node density) {
- 4) Do
- 5) Select best individuals with maximum fitness value for Reproduction
- 6) Remove some bad solutions from set having very small fitness values.
- 7) Apply crossover on best individuals
- 8) Mutate best individuals
- 9) Evaluate the fitness of the modified individuals
- 10) Generate a new population }
- 11) End while

The fitness functions basically check for the residual energy of the nodes. The fitness function in this case is a function which is presented via the following diagram.

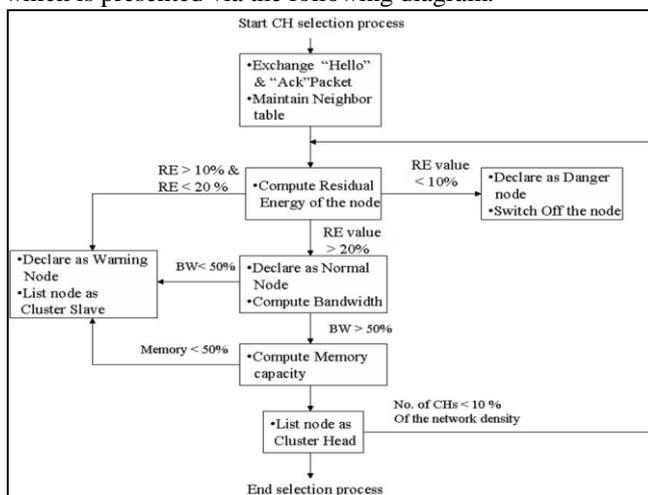


Fig. 2: Flow Chart

### III. DESIGN AND IMPLEMENTATION ISSUE

Clustering play very important Role in WSN. It offers wide range of benefits to WSN. But still it has its own problem and challenges. Various Design and implementation issue regarding WSN are given below: [9].

#### A. Node Mobility

In most architecture Nodes are stationary but some time it is required to support Mobility of BS. It is a challenging task because Node membership will dynamically change.

#### B. Traffic Load:

Sometimes the events monitor by Sensor Network can be either continual or irregular. Irregular event generates traffic in the network irregularly whereas continual event generate event traffic at frequent intervals. Irregular events do not reflect any change in CH. It irregularly loads CH relative to the Nodes in the Clusters. CH is randomly picked from the sensor Population.

#### C. Overlapping Cluster

CH is elected by the Sensor in Network and after that there is possibility that the member of one cluster may become the member of another cluster. This is called overlapping of Cluster and comes under Design issue.

#### D. Load Balancing

It is also main issue in the Sensor Network where CH is picked from the available Sensor Nodes. The members of Sensor Nodes will be consistently distributed among different CHs available. If it is fail will be overloaded to a particular CH and intimates the failure of that Node. So it is necessary to design a equal size cluster for Load Balancing.

#### E. Dynamic Cluster Control

It is essential to organize a self configuring clustering mechanism with network. It is an important issue where CH is determined using Membership of Nodes in the Cluster as the process goes on. When the target is away from the sensing range of CH, another round is necessary for head election to find a new CH.

#### F. Data Aggregation

The CH needs to carry out the task of aggregating the data from the Nodes in Cluster and for this reason it consume more energy. Therefore, it is necessary to take proper care while deciding the CH.

#### G. Fault Tolerance

Some sensor Nodes fails due to power failure, environment interference etc. The failed Node may be CH or a member of Cluster. Thus there is an urgent need for identifying the solution for this problem.

#### H. Number of Cluster

It is another Design issue in the Sensor Network. It is important that the Cluster added should be optimal so that the it makes the Network energy efficient.

#### I. Cluster Formation Time:

Cluster formation time should be minimal. It includes Cluster choice, Selection of CH. All should be done in minimal time.

### J. Self-Configuration and Reconfiguration

Self Configuration is one of the most important phase of cluster formation. The Cluster should have ability to self configure themselves. To maximize the network life time, self organizing should be short and energy efficient. On the other hand, reconfiguration can be defined as the process of adding new sensor nodes with full energy reserve to replace with old sensor nodes.

### IV. CONCLUSION

In this paper various issues w.r.t. design and implementation of WSN have been identified through the literature. It has also been identified that GA can prove to be very useful tool for solving most of the issues in WSN. Therefore in future researcher will try to use GA for solving various issue in WSN particularly the file time of network.

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