

RESEARCH ARTICLE

CLUSTERING METHODS FOR IMPROVED WIRELESS SENSOR NETWORK

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- HARP

ABSTRACT

Wireless Sensor Network (WSN) is a type of network in which the nodes are self-configured and infrastructure-less. With the use of Wireless Sensor Networks (WSNs) we can easily monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. After collecting all these aspects and data we analyzed and monitor them in main location and after monitoring and observation report is prepared.

The basic units of WSNs are sensors which are low-cost and low power. In this research paper, we are reviewing different Probabilistic clustering techniques to improve the network life time.

INTRODUCTION

A computer network is a combination of multiple nodes connected to form a system. In network, multiple hosts connected for successful sharing of information. WSN networks are the networks which are connected by no. of host called sensors in a distributed manner. Sensor nodes are the basic unit of WSN. These are limited battery power, cost, memory limitation, limited computational capability, and the physical size nodes.

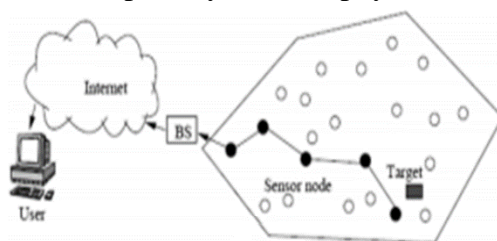


Figure.1. Wireless Sensor Network

The fundamental units of a sensor node are: Sensing unit combination of sensor and, processing unit combination of storage and processor, transmission unit made by trans-receiver and at last power unit. Components of sensor are shown in figure and there interconnection as well. From last few decades WSN became the one of the most interesting and active field for the researchers for research and development. Key areas of research are different protocols to minimize energy consumption, hardware's, power backups, battery reusability, distributed algorithms, synchronization etc. Because of its distributed nature

WSN has opened the challenge for distributed and cooperative computing and communication.

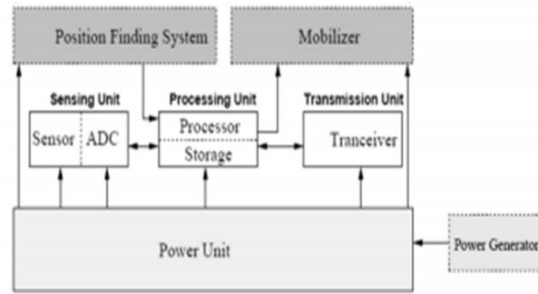


Figure.2.Components of Sensor

In WSN the sensor nodes form a group to communicate and this group is named as "cluster". The clusters are simply the collection of multiple sensor nodes. After making cluster "cluster head" is generated to govern the communication among different clusters. When communication is completed all information is stored in one place called as base station. Multiple techniques are used to create cluster some of them are as follows:

- Deterministic technique
- Base station dependent technique
- Fixed parameter technique
- Fixed parameter technique

Characteristics of WSNs

Characteristics of a WSN network are as follows:

- Ease of use
- Heterogeneity of nodes
- Mobility of nodes
- Scalability
- Easy to node failure

Applications of WSNs

The WSN plays an important role in day to day life. The applications of wireless sensor networks are ranging from military to agriculture, disaster control, health care monitoring, environmental, disaster control, industrial monitoring as well.

EVALUATION CRITERIA FOR WSN NETWORKS

Any computer system is evaluated by using no. of parameters. Evaluation process basically involves rating your WSN network. Different parameters are mainly effect to the performance of any WSN network to degrade life time and energy. Some of the evaluating parameters are as follows:

Secure mechanism: Security plays an important role in any network. Any network must be used some security mechanism to provide secure transmission between sender and receiver.

Deployment cost: The deployment cost should be low.

Delivery time: The delivery time / response time of any data packet should be fast in time.

Nature of node: Two types of nodes are used in WSN. One is homogeneous and other one is heterogeneous.

Distributed in nature: WSN is the collection of nodes, connected in the distributed manner to make a large network.

Scalable: The size of any WSN is scalable. Any no. of nodes connected to the network at any time. The working of network cannot be affected addition and deletion process of the node.

CLUSTERING

As we discussed earlier group of sensor nodes is called cluster. After making cluster "cluster head" is generated this is used to govern the communication among different clusters. Due to the low energy of each node the life time of any WSN is major issue because after the exhaustion of all energy it is difficult to maintain the network. So, we should minimize over all consumption of the power so we can increase the lifetime of network. Most of the recent research is done mainly in this field for power utilization.

Clustering is the process of by which we can easily reduce the energy consumption by each node. Different clustering techniques are introduced to solve the problem.

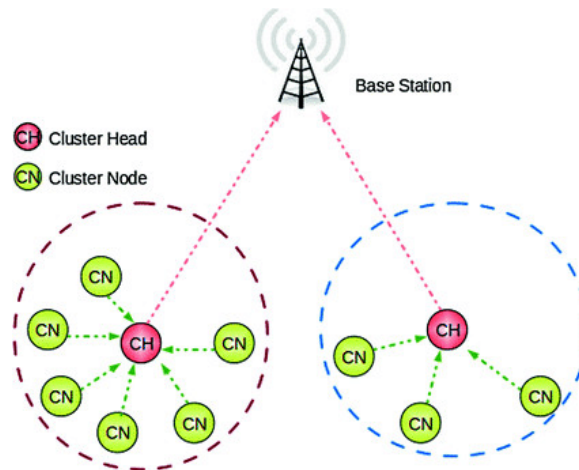


Figure.3. Cluster Communication in WSN

The main key points that should remember before the formation of any clustering algorithm is cluster size, cluster selection, life time of network etc.

CLASSIFICATION OF CLUSTERING PROTOCOLS

Based on various parameters the cluster algorithms can be classified in various categories. As shown in figure the clustering algorithm is basically divided in to two categories:

- Centralized Clustering Algorithms.
- Distributed Clustering Algorithms.

Centralized Clustering Algorithm:

It is the algorithm in which the selection process of any cluster head is depends on centralized system.

Distributed Clustering Algorithms

Each node in the network participates in the selection process to become as a cluster head. Distributed clustering is again divided in to sub categories:

- Probabilistic (random or hybrid) Clustering Algorithms
- Non-Probabilistic Clustering Algorithms

This paper is restricted only with distributed clustering algorithms.

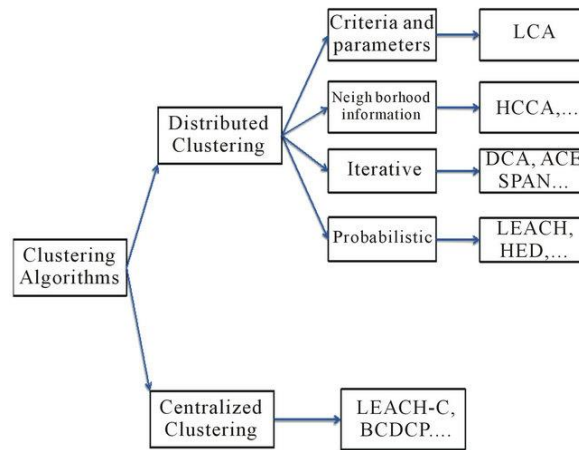


Figure.4. Classification of Clustering Protocols

PROBABILISTIC ALGORITHMS

The probabilistic algorithm further sub divided into following categories:

LEACH Protocol: WSN is the network where power consumption is one of the most critical factors. In network, the basic unit i.e. sensors are organized in a distributed manner to increase the scale of network. Because of that routing process between nodes is increased. Each node stores its neighbor node information. To resolve this problem and to provide less energy consumption we use centralized scheme in which all the information is send to the base station. This mechanism is firstly used in LEACH Protocol [Low Energy Adaptive Clustering Hierarchy].

In LEACH, random process is used to select CH. After selection is done it announces the information to all other nodes. Depends on received signal strength, nodes became part of cluster requiring least power to communicate with CH. Sensors communicate with CH and sends their information through time division multiplexing scheme. After aggregation result is transmitted to base station.

The working is done in rounds so we choose each round length such that each node became CH in its entire life.

Advantages of LEACH

- Nodes share overall load of network.
- Collision prevention techniques are used for collision free CH.

Limitations of LEACH

- LEACH cannot be used in networks spread over large distances.
- Dynamic clustering increases overhead.
- Various Improved LEACH Protocol

There are too many versions or modification was carried out to improve LEACH protocol, for inclusion of additional features. Some of them are discussed below -

Energy-LEACH Protocol: In energy – LEACH protocol more reliable and residual energy based selection procedure is used for CH. Selection.

Multi-hop LEACH Protocol: Cluster head and sinks are used for communication establishment between single hop and multi – hop. It is better than LEACH protocol.

TL_LEACH: It is the enhanced version of previously discussed LEACH protocol. The difference is only CH selection process used in this algorithm. In case of one CH in this algorithm two cluster heads are used one for communicating with sensor nodes called as

secondary head. The secondary head communicate with primary head and transmit all information he gathered from sensor nodes.

Hybrid Energy-Efficient Distributed Clustering (HEED): In HEED algorithm, the cluster selection process is based on its residual energy and intra cluster communication cost not randomly. The sensors are objected to only one cluster and different clusters are distributed. The working is divided into 3 phases:

Initial Phase: In this phase, each node selects probability C_{prob} to become CH.

Connection Phase: In this phase, node iteratively and repeat the process of findCH with low costs ends data to the CH. If node does not find any such node then it elects itself as a CH and sends this selection info to its neighbors. The initial node became iterative until its probability is high. The node having C_{prob} is selected as a permanent CH.

Final Phase: Finally, CH is generated.

Advantages of HEED

- It is a uniformly distributed cluster-based algorithm.
- There is load balancing in the cluster.
- High energy efficiency and scalability.

Limitations of HEED

- Energy consumption is not balanced.
- Overhead is more

EECS (Energy Efficient Clustering Scheme): In this each node present in the network broad cast its own residual energy in network energy. The cluster head selection process is done by selecting the node which has a highest residual energy i.e. the node having highest residual energy became cluster head.

Advantages:

- Better resource coverage
- Increased network lifetime

EEHC (Energy Efficient Hierarchical Clustering): It is one of the randomized and distributed algorithms. The cluster head nodes of each cluster in the network collect information and then send all the gathered information to the centralized station. The working of the algorithm is divided into two phases-

1. Initial phase
2. Extended phase

Initial phase: In the first phase, the nodes present in the network became cluster head by probability p and sends its information to other nodes under its radio range.

We can call cluster head as volunteer head as well. All the non-cluster head nodes who are presented in its range received this information by direct communication or by forwarding mechanism. After getting information regarding cluster head all the non-cluster head nodes chooses a cluster which are its range and closest one. If any node not selected any cluster and not received the announcement of selection process became forced cluster head.

Extended Phase: In the second phase, known as multi hop clustering builds h hops of cluster hierarchy. In the inter cluster communication it is insured that the energy consumed by CH away from base station is reduced.

Advantages of EEHC

- Efficient for large scale networks
- Energy consumption is less

Multi-hop routing protocol with unequal clustering (MRPUC): MRPUC is a distributed clustering scheme. The working of the protocol is divided into three phases. The phases are defined as:

- Set-up cluster
- Data transmission
- Inter-cluster multi-hop routing information

The node having higher residual energy is selected as cluster head. Now all the other nodes presented in the network collect information from its neighboring nodes.

Dynamic clustering and Distance Aware Routing Protocol (DDAR): In this protocol the most dynamic approach is used for the election of cluster head and super cluster head node. The cluster head selection is done by measuring distance between each node. We can select the super cluster head node which is near to the base station in the two-hop hierarchy. Dynamic selection process for the selection of CH is used in which in place of selecting large no. of CH. This algorithm is operating when the alive node in the network is less. The selection process is based on average distance from the base station.

If node having distance higher than threshold value (average distance) not be selected. The super cluster node divides the overall network in a two-level tree.

Advantages:

- Consume 15.5% less energy than LEACH.

HARP protocol: This is a clustering algorithm which uses inter and intra cluster hierarchical trees energy saving techniques. This is used in both types of nodes (homogeneous and heterogeneous). HARP also provides fault tolerance and mobility management of nodes in the network by adding additional feature like recovery slot. It is one of the most valuable energy optimizing protocol for energy consumption.

CONCLUSION

WSN is purely based on sensor node communication. Sensors are low power nodes whose batteries discharged in very few time. So, we should select such type of communicating algorithm in which less power is used. And by saving energy in communication process we may increase the life time of our system. In this paper, we have discussed several algorithms that focus on less energy consumption.

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