

Clustering in Wireless Sensor Network: A Review

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Abstract

In recent wireless sensor network is in trends because of its applications in various fields or to the collection of data from the remote or unreachable areas. Clustering introduced in WSN to overcome the problems those are comes in traditional networks like the battery life of the sensors, lifetime of the networks, etc. These are the general problems in the traditional networks but with the help of clustering, we can reduce or overcome these problems. Clustering provides various advantages like Limited Energy, Network Lifetime, Limited Abilities, Secure Communication, etc.

Keywords- Wireless Sensor Networks (WSN), LEACH, Clustering Algorithms

1. INTRODUCTION

A wireless sensor network (WSN) is a distributed network that includes a large number of distributed, teeny, self-organized, low power devices that are called sensor nodes. Wireless sensor network (WSN) generally includes a large number of small scale, spatially distributed, battery-powered embedded devices those are used to form a network to support the collection, processing, and transmission of data to the end users, and it supports computing capabilities and computing in limited mode.

In recent days wireless sensor network becomes most popular to provide services in commercial and industrial applications, technology keeps going to advance in communication, processing and the uses of low powered devices. Sensor nodes are useful to sense or monitor the conditions of the environment in terms of pressure, vibration, temperature, position, humidity, and others [5].

In various real-time applications, the sensor node is useful to perform various tasks, as intelligent sensing, data storage, and processing, neighbor detection, target tracking, data aggregation, node localization, control and monitoring, efficient and synchronized routing between nodes and the base station [4].

There are various protocols given by the many researchers to enhance the lifetime of the wireless sensor networks by reducing the battery consumption of the each sensor nodes. LEACH was the first clustering protocol in wireless sensor networks to enhance the lifetime of the networks due to some problems many variants of the LEACH taken place in recent.

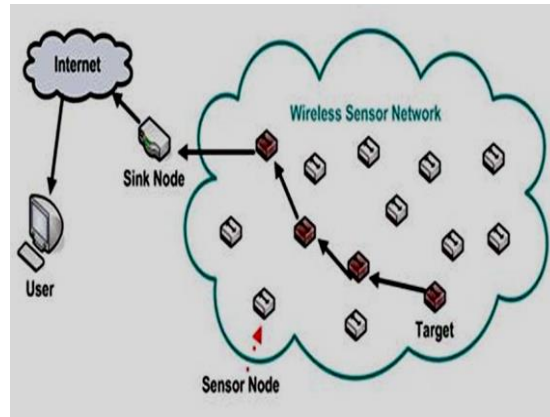


Fig. 1. Wireless Sensor Network [3]

The fig.1. above give us an idea of how wireless sensor networks look like with various WSN applications[3]. By the use of clustering wireless sensor networks becomes a very useful in data collection fields because with the help of clustering energy consumption of the sensors will decrease so the network lifetime will increase due to this facility wireless sensor networks become a very useful phenomenon in various commercial fields like in military for enemy detection or environment monitoring and etc. There are many challenges comes in WSNs to select optimize clustering due to deployment of the sensor nodes, connectivity in between the nodes and cluster heads, coverage of the nodes, self-adaptability of the nodes, density of the nodes, communication range of the nodes, final one is the energy of the nodes.

Wireless Sensor Network Components:

There are various components are described below those are useful in wireless sensor network for data communication from sender to receiver [6].

Sensors: sensors are small unit that is used to sense the data, data storing, routing the data, and processing the data.

Clusters: Clusters are used to simplify the tasks, large sensor networks divides into groups those are called clusters to easy the connection between (CHs) cluster heads the (BS) base station.

Cluster heads: Cluster head is a main member in the whole cluster. Aggregation of the data and organization of the clustered node all are processed by the cluster heads.

Sink node: Sink node is used to provide a communication in between sensor network and end user.

Transceiver: Communication schemes in sensors are optical communication also called laser, Infrared, and radio frequency also called RF.

A most usable scheme in sensors for communication is RF because laser provides high security and less energy consumption but it also requires sensitive to atmospheric conditions. Infrared also not required additional antenna like a laser but it is limited to its broadcasting area so RF is most usable schemes in sensors for communication purpose.

End user: End user is send the data queries to the WSNs and this data could be used for a various application or for future use.

2. CLUSTERING

In the clustering method, two main approaches are used to coordinating everything. The clustering process is distributed and centralized [2, 8]. At distributed clustering, where each sensor node can perform its own algorithm and decides to become a cluster head. In centralized clustering, centralized power groups nodes for the formation of clusters and heads of clusters. Sometimes A hybrid scheme can also be implemented.

Various protocols given by the many researchers to enhance the lifetime of the wireless sensor networks by reducing the battery consumption of the each sensor nodes. LEACH was the first clustering protocol in wireless sensor networks to enhance the lifetime of the networks due to some problems many variants of the LEACH taken place like LEACH-C, TL-LEACH and etc.

Clustering provides an effective solution in wireless sensor network to consider the various factors that are listed below [7]:

- Limited Energy
- Network Lifetime

- Limited Abilities
- Secure Communication
- Cluster formation and CH selection
- Synchronization
- Data Aggregation
- Repair Mechanism
- Quality of Services

Advantages of clustering:

Clustering routing protocols have various advantages over flat routing protocols like scalability, energy consumption, load, robustness, etc. [1]. Explanations of these factors are described below:

Scalability: Clustering routing topologies are more scalable as compare to the flat routing topologies because in clustering routing topology all the sensor nodes create a route within a cluster so the load of each sensor node to handle the routing tables decreases.

Data Aggregation: Data aggregation is used in clustering topologies to reduce the redundancy from the data. It is done by cluster heads of each clusters so that we minimize the consumption of energy that is used for communication purpose in between the Base Station (BS) and the cluster heads (CHs). Generally CHs uses a tree structure for communication purpose to the Base Station (BS).

Load: In clustering routing topologies load is less as compare to the flat routing topologies because in these topologies every cluster head is used aggregation techniques so that fused information to refer from the cluster head to the base station. Load is also less because in clustering topologies routes are setup within the clusters.

Energy: Consumption of the energy is less in clustering routing topologies as compare to the flat routing topologies because data aggregation helps to reduce the size of the transmission data by eliminating the duplicity from the data. In clustering routing topologies less number of sensors are used to communicate over large distance because of intra cluster, inter cluster communication used less energy consumption taken place over the entire network.

There are various clustering techniques as shown in Fig. 2 are used in WSN to enhance the lifetime of the network of the WSNs some of these are describe below [10]

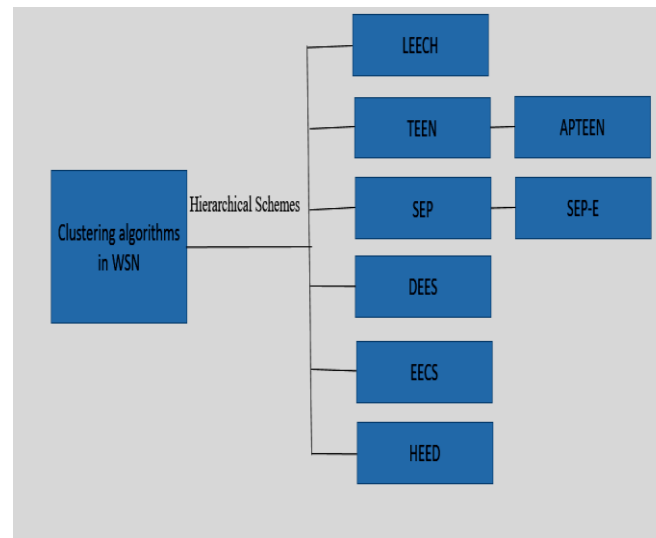


Fig. 2. Classification of Clustering Schemes in WSN

LEECH is the first clustering protocol in wireless sensor networks and it follows distributed clustering techniques due to distributed techniques LEECH suffers from various problems to overcome these problems LEECH-C comes to use in LEACH-C we use the parameter average residual energy for the selection of cluster head. In LEACH-C first calculates the average residual energy of the all the nodes and then those nodes have the higher energy to the average residual energy are only eligible to become a cluster head. LEACH-C is a centralized clustering techniques.

3. APPLICATIONS

There are various fields in recent where WSN as shown in Fig. 3 is useful to sense the useful information from the dangerous areas where normal monitoring is not possible over the data [9]. In recent days WSNs is an important phenomenon in various field to collect the information so that this information could be used for future predictions, forecasting, detection purpose. In military areas wireless sensor networks are very useful to enemy detection by the help of sensors those are placed in harsh areas we can collect the information and finalize the result based on the information that are given by the sensors. The figure is listed below to show the usefulness of the WSNs.

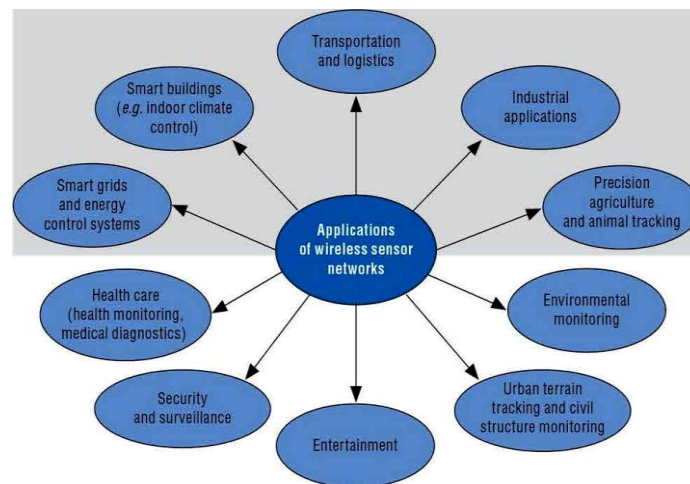


Fig. 3. Wireless Sensor Network Applications

Wireless sensor networks become a very useful in various fields due to its wireless property because in many areas it is not possible that to provide the connection through wire at those places wireless sensor networks are useful to gather the information from many areas like transportation and logistics, industrial uses, entertainment purpose, security and surveillance purpose, medical diagnostics or health monitoring, smart buildings for indoor climate control and etc. To achieve a good performance in all the applications cluster formation and cluster head selection should be very efficient because battery of the sensors are not rechargeable so the use of sensor nodes should be efficient.

4. COMPARISON OF CLUSTERING TECHNIQUES

Cluster Head(CH) Selection					
Algorithms	Distributed/Centralized	CH Distribution	Overhead in CH selection	Residual Energy	Delay
LEACH	Distributed	Nonuniform	Low	No	Low
LEACH-C	Centralized	Uniform	High	Yes	High
HEED	Distributed	Uniform	High	Yes	High
EECS	Distributed	Uniform	low	Yes	Low
PEACH	Distributed	Non uniform	Low	No	Medium

Table 1: Comparison Between Various Clustering Techniques

5. CONCLUSION

This paper gives the idea to focus on the load balancing algorithms by using clustering with considering the various factors that affect the energy consumption in wireless sensor network. We also discuss the components those are useful in consideration of the clustering algorithm in wireless Sensor network as compare to a traditional algorithm without clustering. We

compare the various clustering protocols those are useful to provide less energy consumption in the data collection in the wireless sensor network.

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