



Comparative Analysis on Different Clustering Protocols in WSN

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Abstract: In today's Environment the uses of Wireless Sensor Networks (WSNs) have developed colossally. In WSNs there is one component used to amplify the life expectancy of network and give more effective working methods that is clustering. Clustering is a procedure to subdivide the detecting field of sensor network into number of clusters. Each cluster chooses a pioneer called cluster head. A cluster head might be chosen by the sensor node in the cluster or pre relegated by the network planner. Improved Clustering can spare parcel of energy in the network. In this paper an attempt has been made to discuss various clustering techniques with different performance parameters lie deployment of nodes, clustering type and node heterogeneity.

Keywords: WSN; Cluster Head; Sensor node; SEP; LEACH and lifetime.

I. Introduction

To know about Wireless Sensor Networks or Sensor Networks, we should first know about its origin and history. The first WSN that has any resemblance to present wireless sensing system was the Sound Surveillance System (SOSUS) which was developed by US Military in 1950s for detecting and tracking the Soviet Submarines. These sensor networks used submerged acoustic sensors which were distributed in oceans. This technology is still in use but now for a peaceful job like for examining volcanic activities, aquatic life etc. After this further advancements were carried out in the field of sensing networks in the 60s and 70s [1]. It was in 1980 when the US defence agency started the Distributed Sensing Network program for exploring implementation challenges in the wireless sensing networks. After this many researches were carried out by researchers in the field of WSN as a result of which soon it was used by many governments, institutes, universities etc. for various purposes [2]. A wireless sensor network is a wireless network which consists of various sensor nodes the function of these sensor nodes is to sense or monitor the physical and environmental conditions. These sensor nodes are spatially distributed. In wireless sensor network sensor nodes communicate through radio signals. A sensor node consists mainly of sensing unit, converters, processing unit, memory, power supply and a communication unit. The below is given a schematic diagram of sensor node components [3].

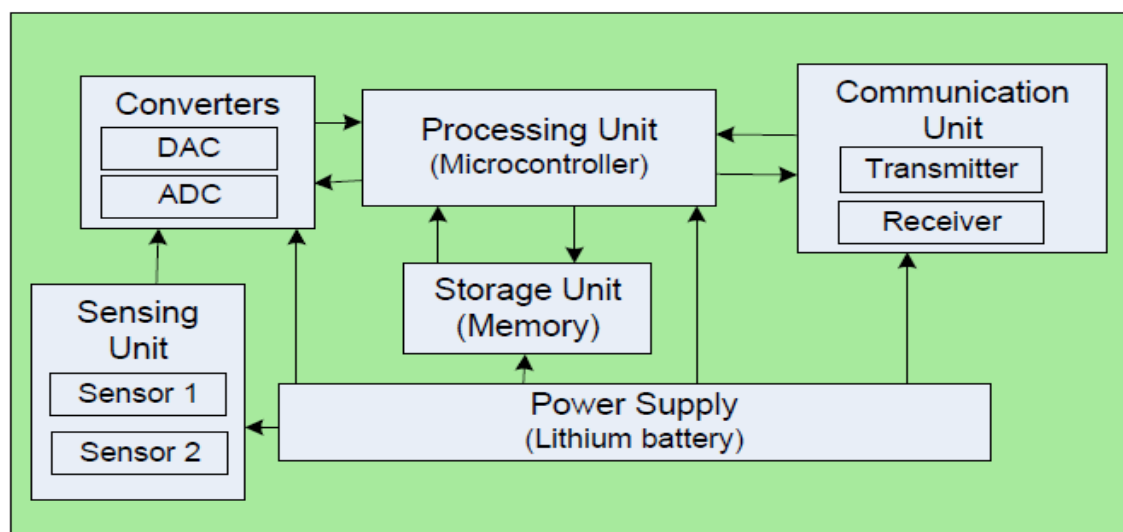


Fig: 1 The Components of a Sensor Node [3]

The data in the sensor nodes is sensed from the environment in which it is placed by through sensing unit. This sensed data is transferred to converters for converting analog data to digital data and digital data to analog data.

This converted data is then fed to processing unit where it is processed through a microcontroller in the processing unit. The processed data then moved to the communication unit where the transmitter transmits it to the cluster head or base station. This cluster head then further transmits this data to another cluster head or to the sink. In the same fashion the data received through the receiver in the communication unit is then fed to the processor unit for doing further processing. For this whole process of processing and conversion the energy source used is a lithium battery which is of small size and capacity. The most energy is consumed is in the process of communication unit and processing unit. When the battery level of a node or energy of a node vanishes, the node dies and known as a dead node [4].

A. Characteristics of WSN

Currently WSN is used in real world for measuring various parameters, so for the efficient deployment of the wireless sensor network we should consider various characteristics of the wireless sensor networks [5]. There are various characteristics of the wireless sensor network and some of them are described as follows:-

Distributed Sensing and Processing: In wireless sensor network various nodes are randomly distributed and each of these nodes is capable of processing, aggregating, collecting and sending data to the sink. As a result of which this distributed sensing and processing provides robustness to the system

Energy Efficient: In WSN energy is used for different purposes like processing communication and storage. This energy is provided by a lithium battery in the sensor nodes. Different amount of energy is used for different processes some require more whereas some require lesser energy. The protocol and algorithm must be considered in the design phase for the power management as this source of energy may run out of power and resulting in a dead node.

Low Cost: As wireless sensor network consists of hundreds to thousands of sensor nodes for measuring physical or environmental conditions. So for reducing the overall cost of the network the number of nodes should be kept low as much as possible.

Security and Privacy: For preventing unauthorized access, attack and unintentional damage to the data in the sensor nodes each node should have some security and privacy mechanism.

B. Challenges of WSN

As the use of the wireless sensor networks is increasing and growing at a rapid pace. Some challenges are also being faced by developers at the same time. Some such issues and challenges related to wireless sensor networks are as follows [6]:

Self Management: The wireless sensors once deployed should be able to function without any human intervention. It should be able to perform operations like adaption, configuration of network and maintenance by itself.

Issues Related to Data Collection and Transmission: The main objective of sensor nodes is to collect the sensed data and then transmit it to the sink. The issue related with data collection and data transmission is that sometimes data collected by the sensors is redundant in nature and there is no use of transmitting such data as it will only consume energy. So care must be taken during the process of data collection and data transmission.

Issues Related to Deployment: From deployment we mean the implementation of the wireless sensor networks in real world locations. The deployment process is hard and difficult to carry as it depends on the demographic locations. On locations which are difficult to reach sensors are placed by dropping them from the helicopters and on some locations sensors are placed in accordance with the related topologies. It is hard to replace batteries of such sensors due to which energy related issues arises.

Limited Memory and Storage Space: As sensor nodes are tiny devices with a limited memory and storage space in order to have an effective security mechanism the software written for such nodes must also be smaller in size which is a challenge related to the wireless sensor networks.

C. Applications of WSN

In wireless sensor networks different kinds of sensors are used for different purposes some of the different kinds of sensors are magnetic, seismic, thermal, acoustic, radar, visual, infrared etc. Some of these sensors are used for magnetic sensing some for sensing heat and some for sensing sound these different kinds of wireless sensor network are useful in different fields some such applications of wireless sensor network are as follow:-

- Air pollution monitoring
- Forest fire detection
- Landslide detection
- Area Monitoring
- Military applications
- Health applications
- Commercial applications [7]

II. Clustering Protocols

LEACH: LEACH is a Low Energy Adaptive Clustering Hierarchy protocol. It is a type of hierarchical routing protocol. LEACH is a self organizing, adaptive clustering protocol which uses the process of randomization to evenly distribute the energy load. Here all nodes assumed to be Homogeneous and one node with the highest energy is chosen as the cluster head of the cluster which forwards node to another cluster head or to the sink. There are two phases in the LEACH namely set-up phase and steady- state phase. In set-up phase cluster head is chosen and in the steady-state phase cluster head is maintained and data is transmitted between two nodes. The limitation of LEACH is that here all nodes are capable of communicating each other and reaching sink so it is suitable for only small size networks [8].

SEP: A SEP is a stable election protocol for clustered heterogeneous wireless sensor networks. The main idea behind SEP is to increase the stability period. SEP is used to overcome the limitation of the LEACH protocol as SEP is used for heterogeneous WSN whereas LEACH is used for homogeneous WSN. In homogeneous WSN there are different kinds of nodes with each with different energy the node with highest energy is chosen as the cluster head. The nodes with the lower energy are called normal node they have a weighted election possibility

$P(nrm)$ which is lower than the advance nodes [9].

HEED: Hybrid Energy-Efficient Distributed Clustering enhances the LEACH protocol by utilizing remaining energy, node degree or thickness as a primary parameters for cluster development to accomplish control adjusting. This protocol was proposed with three primary parameters: First parameter is to improve network lifetime by dispersing energy utilization, second clustering ends inside a settled number of cycles third least control over head and fourth the cluster heads was all around appropriated. The calculations proposed in this protocol intermittently choose cluster heads in light of the two fundamental parameters. The principal essential parameter is the remaining energy of every node; second parameter is the intra-cluster correspondence given a role as a component of cluster thickness or node degree. The essential parameter chooses starting arrangement of cluster heads probabilistically which optional parameter is breaking ties. Notice is not ready to settle the cluster tally in each round and it is additionally not mindful of heterogeneity [10].

DWEHC: A dispersed weight based energy effective various leveled clustering protocol which goes for high energy proficiency by producing adjusted cluster sizes and enhancing the intra cluster topology. Every sensor node computes its weight subsequent to finding the neighboring nodes in its range. The weight is a component of the sensors remaining energy and the closeness to the neighbors. In a neighborhood, the node with biggest weight would be chosen as a cluster head and the rest of the nodes move toward becoming individuals. At this stage the nodes are considered as first level individuals since they have an immediate connect to the cluster head. A node continuously alters such enrollment to achieve a cluster head utilizing minimal measure of energy. Essentially, a node checks with its non-CH neighbors to discover their negligible cost for achieving a cluster head. Given the node's learning of the separation to its neighbors, it can achieve the cluster head over a two-bounce way. The protocol is not performing great in term of soundness period because of enormous measure of energy devoured in neighbors finding [11].

UCR: An unequal cluster-based routing protocol in wireless sensor networks for alleviating the problem area issue in WSNs. It is intended for source driven sensor network applications, for example, discovery of periodical information from condition. It is a self sorted out rivalry based calculation, where choice of cluster heads in view of nearby data as remaining energy of neighboring nodes. The cluster heads nearer to base station are relied upon to have littler cluster sizes, than those for their from the base station, along these lines the cluster heads will expend bring down energy amid the intra cluster information preparing and can assume some more energy for the bury cluster hand-off activity. The protocol is fulfilling the cluster head determination technique in two stages, which is tedious and cluster measure is uneven because of variable cluster check [12].

WEP: An energy productive protocol to upgrade the strength time of sensor network. Creator presents a clustering plan with an affix directing calculation to improve the energy and stable period limitations. In this a weight is appointed to the ideal likelihood for every node. This weight must be equivalent to the proportion between introductory energy of every node to the underlying energy of the ordinary node. Subsequent to relegating weighted likelihood, the cluster heads and cluster number are chosen in an indistinguishable path from in LEACH protocol. By utilizing the calculation a chain among the chose cluster heads have been developed. After this from the chose cluster heads, a chain pioneer is chosen arbitrarily. All non cluster head nodes send their information to their individual cluster head nodes. The cluster head nodes in each cluster at that point melded the information and send it to base station [13].

III. Comparative Analysis

In this section different existing clustering protocols with different performance has been compared. The parameters used for comparison are deployment of nodes, heterogeneity, clustering method i.e. centralized or distributed, location awareness and cluster head mobility.

Analysis shows that SEP is much better than other techniques.

Table 1: Comparison between Different Clustering Protocols

Clustering Protocols	Deployment of Nodes	Heterogeneous	Clustering Method	Location Awareness	Cluster Head Mobility
LEACH	Random	No	Distributed	No	Fixed
SEP	Random	Yes	Distributed	No	Fixed
HEED	Random	No	Distributed	No	Fixed
DWEHC	Random	No	Distributed	No	Fixed
UCR	Random	No	Distributed	No	Fixed
WEP	Random	Yes	Distributed	No	Fixed

IV. Conclusion

Clustering is a method to diminish energy utilization and to give steadiness in wireless sensor networks. For heterogeneous wireless sensor networks, a few clustering protocols are proposed. The majority of the current energy effective clustering protocols intended for sensor networks depend on leftover energy, normal energy, area, thickness and so forth which are powerful in energy sparing. In this paper comparative analysis between different clustering protocols such as LEACH, HEED, SEP and UCR has been presented. In future try to propose enhanced SEP protocol to increase lifetime of network.

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