Energy-Efficient Lifetime Maximization Clustering Approach for "Wireless Sensor Networks": A survey

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ABSTRACT

WSNs are autonomous sensors that are distributed spatially than can supervise conditions that can be physical or environmental, such as temperature, sound, pressure, etc., and to transfer their data to a main location cooperatively through the network. Events are detected by Nodes and then sent to the Base Station(BS) relevant data. Replacing batteries quite often in remote locations is not feasible. Using the clustering approach, the energy consumption of such networks is minimised. One of the important methods to extend the life of the network in wireless sensor networks (WSNs) is clustering. For all the clusters, it involves grouping sensor nodes into clusters and choosing cluster heads (CHs). Cluster heads are subject to excessive battery drain in those near the BS. In this paper, therefore, approaches are discussed for increasing energy efficiency and network lifetime.

KEY WORDS: SENSOR, ENERGY EFFICIENCY, CLUSTERING, LIFETIME, WIRELESS SENSOR NETWORK

INTRODUCTION

Because of its potentially large application area, the WSN is rising as a main research subject. The WSN consists of nodes, from a few hundred to even thousands, in which each node is constructed. It has one (or sometimes several) sensors connected to it. Every node has restricted capabilities. But a useful network catering to disaster applications can be created collectively such as management, detection of forest fires, tracking of vehicles, habitat monitoring, etc. Deployments in real life is mostly done with 30-40 nodes due to scalability, conservation, reliability and energy issues. [P. Corke, 2010] In order to deal with issues such as network lifetime and energy,

clustering over a distributed method is progressing. "Communication connectivity" in a clustered WSN, various nodes are shown in Figure 1. There is one or more Cluster Heads (CHs) in every cluster. Near a sink node, sensor nodes suffer from the heavy traffic load imposed on them and their energy is strongly depleted. This phenomenon is called the energy hole problem. One way of reducing energy depletion is by aggregating data. To solve many problems such as scalability, energy and lifetime problems of sensor networks, clustering into sensor nodes is very important [V. Katiyar, 2011].

The objective of this algorithm for clustering is to partition the network into several clusters. The benefits of an algorithm for clustering are:

- "reducing routing table size,
- reducing the redundancy of exchanged messages,
- reducing the energy consumption, and
- extending the networks lifetime."

II. Related Work: Algorithms can be fully sequenced in, "i) Probabilistic, (ii) Deterministic, (iii) Fuzzy logic"-based algorithms and cluster range are computed by selecting CHs.

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Figure 1: A clustered WSN

Algorithms Probabilistic: The clustering algorithms based on probability are straightforward and have little complexity of time and communication. With quicker convergence, they have been discovered to be efficient in energy.

i. LEACH [W. R. Heinzelman,2000]: This is a hierarchical protocol that transmits most of the nodes to cluster heads, also the aggregation of data and compression by cluster heads forwarded to the base station (sink). In each round, each node uses a stochastic algorithm to determine if the cluster head will become the cluster head in that round. Global energy is minimized by the protocol which is clustering-based routing protocol and load is distributed to all nodes at different times. LEACH surpasses static cluster algorithms. Each node has the load of obtaining data from cluster nodes at different times, merging data to acquire the aggregate signal, and transmitting the aggregate signal to the base station. "LEACH" is fully distributed in order to operate LEACH, that require no control information from BS & nodes.

ii. Stable Election Protocol (SEP) [G. Smaragdakis,2004]: In order to become the cluster head which is dependent on the energy which is remaining in each node ; is based in each node on the weighted election probabilities. The stability period and higher average throughput are always extended to SEP than one obtain using existing clustering protocols.

iii. Unequal Clustering Driven by Energy (EDUC)[J. Yu,2011]: In EDUC, cluster heads use different spans of contention to construct clusters of different sizes. In principle, clusters at a long distance from the BS have small sizes to conserve some energy for long-distance data transfer. The energy consumption surrounded by cluster heads, therefore, is constructively stabilised. An energy-driven cluster head alternation scheme is formulated on this clustering arrangement to reduce the avoidable waste of energy. During the entire life of the network, each node serves as the cluster head no more than once. The additional costs are minimised by EDUC and high energy efficiency is achieved.

iv. Efficient Unequal Clustering for Energy (EEUC) [C. Li,2005]: The EEUC protocol is used in wireless webwork

for systematic data collection. The clusters are divided into uneven clusters and smaller than those far off the base station near the base station. The clusters are smaller. This means that cluster heads can conserve energy to redirect inter-cluster information near the base station. The unequal clustering process stabilizes the use of energy well in the midst of all sensor nodes and attain a clear network lifetime development.

Algorithms Deterministics: Selection of CHs and cluster formation take into account standard metrics in deterministic algorithms such as residual energy, node degree, centrality of the nodes, distance from BS.

i. Energy-aware Algorithm for Routing (ERA)

[Pawandeepkaur,2015]: Instead of the minimum energy consumption path,ERA helps each sensor to connect its cluster head to find a direction with the most amount of energy left behind. Simulations are carried out to test efficiency in terms of network life and allocation of energy between nodes. Over current WSNs protocols, ERA shows fairly significant results, but the use of node waiting time to become CHS is neglected. For a long time, certain nodes may not become CHS.

Algorithms Fuzzy Based: Fuzzy logic is manipulated in the Wireless Sensor Mesh to effectively select CHs. For CH, Fuzzy logic chooses input specifications such as surplus energy, distance to BS, distance from neighbours, degree of node, similarity, assumed surplus energy, and the CH selection option and cluster size is the output framework. In an unequal clustering algorithm, different fuzzy-based viewpoints are suggested to achieve energy efficiency.

i. A unequal clustering strategy based on fuzzy logic- has been suggested so that hot spot issue with the DFCR algorithm can be addressed [N. Mazumdar,2018]. Soaring preference is given to sensor nodes near to the BS and with higher energy that needs to be selected as CHs. Based on their current status, the CHs adapt their cluster radii dynamically. The CHs transmit the data to the next-hop CH, which correlate with minimum cost value, to balance the energy consumption.

ii. DECUC algorithm [J. Yu, 2011]: A distributed clustering algorithm that uses fuzzy logic to produce a trade-off between energy consumption and coverage specifications .In order to maximize coverage maintenance of the target area, cluster formation is considered in this algorithm as well as Energy and coverage parameters. In addition, unprecedented clusters are developed to confront with the hot spot problem, so that more CHs are accessible closer to BS to share large data forwarding loads, Network lifetime , protection of coverage and energy efficiency.

III . Issues in Previous Work: We have investigated various clustering algorithms and found that certain energy-efficient algorithms improve network existence and consume routing energy as well .While every attempt is made to include a full and reliable state-of-the-art

survey of energy-efficient clustering algorithms with LEACH and its advanced protocol, as relevant to WSNs. Issues addressed in previous work are:

- Some applicable algorithms for homogeneous WSNs.
- Bad performance (due to the problem of link breakage) when the nodes are mobile.
- On the base station, more overhead, so it's not suitable for large networks.
- Decreased level of energy.
- Sometimes, loss of data, such as when some CH hop dies.
- Inefficient consumption of energy.
- Inefficient data rate of delivery.
- Packet Loss when CH moves.
- It increases the use of energy, particularly when transmitting data to the base station. Provides the base station with increased overhead.

Fig 2, Fig 3, Table 1. Represents the correlative work of every considered algo with regard to various cluster parameters

Figure 2: No of alive nodes per round

Figure 3: No of alive nodes per round

Proposed Work: In proposed research, the virtual concept is used for the formation of cluster head assistance which will be helpful for pretty the life span of network and for communication between cluster head through different cluster head with the base station according to efficient energy. Hierarchical clustering can make a major contribution to system scalability, lifetime and energy efficiency in WSNs. Hierarchical routing is an important way to minimize the energy usage of the cluster and to gather and unify data for the sake of reducing the number of messages sent to the BS. Communication

and packet transfer between different nodes without forming cluster

- Communication and packet transfer between different nodes
- Communication and packet transfer between different nodes in single cluster out of any no. of clusters
- Communication and packet transfer between different nodes in all clusters
- Communication and packet transfer between different clusters multiple parameters
- Performance Analysis of both the Technique.

Figure 4: "Communication Process of WSN Network"

Figure 5: "Analysis of Delay vs Time"

Figure 6: "Analysis of Energy Vs Time"

with 1) Normal approach where no cluster head has been comparison of three approaches where we are routing

found; ii) Approach where only QoS included; and iii) Approach of QoS with cluster head included. Considering the routing of the QoS with the cluster head, the data transmission is only carried out by the cluster head in that case". The cluster head choose to check the energy levels of the individual nodes. Figure 4 shows the WSN communication process in which the source node begins

to transfer information using protocol to the sink node, using this process to find out the QoS parameters such as Delay, Jitter, Throughput, Energy, and Packet Delivery Ratio.

Analysis of delay vs time is shown in Fig. 5, and simulation process can reduce the delay .

Table 1. Comparison of Different Clustering and Routing Algorithm

Protocol	Cluster properties						
	Distributed/ Centralized	CH selection	Unequal cluster size	Intra- single hop	Inter- cluster multi-hop	Coverage aware	Fault tolerant
LEACH [3]	Distributed	Random	N	Y	N	N	N
SEP [4]	Distributed	Hybrid	N	N	Y	N	N
EDUC [5]	Distributed	Random	Y	Y	Y	N	N
EEUC [6]	Distributed	Hybrid	Y	Y	Y	N	N
ERA [7]	Distributed	Weight	N	Y	Y	N	N
DFCR [8]	Distributed	Fuzzy	Y	Y	Y	N	N
DECUC[9]	Distributed	Fuzzy	Y	Y	Y	Y	N

CONCLUSION

The above-mentioned clustering approaches fused with multi-hop routing in energy inhibited WSN possess remarkably decreased the use of energy. However, the network lifetime of such protocols is deteriorating due to the hotspot problem. The reshaping of the perspective of unequal clustering showed a significant refinement in network life. The multifaceted procedure of the fuzzy logic construct has shown the significance of numerous frameworks such as node degree, density, cluster formation energy and cluster range estimation. Considering various clustering parameters, all the algorithms discussed are explored and a simulated inspection is still carried out for few selected ones. A routing protocol approach combined with a clustering protocol for a network to be energy efficient for QoS is suggested by the ongoing proposed work.

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