

An energy efficient based hybrid clustering (EEBHC) approaches in wireless sensor network

V. Perumal^{1*}, K. Meenakshi Sundaram²

¹Ph.D Research Scholar, Department of Computer Science, Erode Arts & Science College (Autonomous), Erode, Tamilnadu, India.

²Associate Professor, Department of Computer Science, Erode Arts & Science College (Autonomous), Erode, Tamilnadu, India.

*Corresponding author E-mail: rishiperumal89@gmail.com

Abstract

Recently, much amount of research work has been carried out to improve the network lifespan in the Wireless Sensor Network (WSN) using Energy consumption process. In our proposed hierarchical based Hybrid clustering approaches has been designed, so as to limit the network traffic towards the Base Station. It reduced energy in the primary role of data transmission, reception, sensing and aggregation. To collect the data in the surrounding information based on hybrid clustering techniques. In this techniques are combination of equal and unequal Clustering. Even though equal and unequal clustering method is used to enable the routing of data to minimize the power consumption in the WSN. The hybrid clustering techniques are used the Cluster Head (CH) selection process depending on higher energy level and routing efficiency of the network. The proposed works NS2 simulator is utilize the data from the source to destination in efficient way of using EEBHC algorithm to minimize the energy consumption, reduced traffic occurrences, avoid packet losses and extends the lifetime of network.

Keywords: Sensor node, hybrid cluster, energy efficient, routing, energy consumption, WSN.

1. Introduction

Wireless Sensor Network consists of many sensor nodes that have the capability of Sensing, Computing and Wireless Communication. These nodes are implemented in a region of interest to be used in several applications like Smart Office Monitoring, Military Surveillance, Industry and other types of Monitoring Applications. As wireless sensor nodes are affected from restricted power, massive scale network designing has imposed a variety of issues. Multi hop Communication is very advantages for data collection for energy saving. Also, Clustering is a strategy, which has been extensively employed in WSNs. It can efficiently minimize the energy consumption of sensor nodes [1]. The wireless communication components of a sensor node is accountable for transmitting or receiving data captured from one sensor node to another sensor node on end user via the cluster head to the base station. Communication is performed generally from node to base station. The base station transmits request to get from Nodes. The result of certain node doesn't significant, but the Area of origins has to be combined by cluster head prior to its arrival at the Base Station. In this, aggregation of data in cluster head, the nodes hugely minimize the energy consumed in network by reducing the entire message to be send to base station [2].

Equal clustering is a randomly selection strategy of the low energy adaptive cluster head is not a good one for getting a balance of the energy consumption in the perspective that every node is provided with the same probability of being selected in the role of the cluster head [3]. But, the CH is located at a distance away from its sensor than it might have energy wastage for the data transferred from sensor to CH and Base Station. Unequal Clustering it is however hard to have the cluster size estimated. It has been used for removing the uncertainty by choosing the cluster size depending upon the distance from the base station [4].

The chief concept behind the development of cluster-based routing Algorithm is to minimize the network traffic passing towards the sink. To avoid the collusion and energy efficiency increase the WSNs are the main objective in designing the transmission protocol. So that the cluster head has more responsibilities compared to the cluster member since it is selected for each cluster [5]. Sensor network clustering and election of cluster head, whether it is distributed, hybrid (or) decentralized can be independent of clustering algorithm [6].

2. Related works

Choon-Sung Nam et al [1]. Cluster Head Selection for Equal Cluster Size in Wireless Sensor Networks Provide the cluster head selection technique for regular sizes of cluster in wireless sensor networks. It introduced multi-hop cluster formation technique with reduced communication range of nodes for adapting the newly introduced technique. A cluster head is reselected employing E-ACHS, with due consideration of the distance observed between cluster heads and sensor nodes, and a cluster is reorganized with fresh cluster heads creating consistent cluster sizes. The newly introduced strategy validated the formation of energy efficient cluster, minimizing the number of member nodes and the average hop count. It also attained consistent cluster division with no regard about bad-case-condition or good case- condition cluster creation. An effective cluster based Power Saving approach for Wireless Sensor Networks Chang J.Y et al.[2] provide a energy consumption in Wireless Sensor Networks. The chief concept behind this research work is reduced data transmission distance of sensor nodes in WSN by making use of the Uniform clustering concept. The lifespan of WSN is prolonged by employing the consistent cluster location and have a balance of the Networks loading amongst the cluster.

Vrinda Gupta et al.[3] suggested by An energy aware distributed uneven clustering protocol has been extended so as to enhance the lifespan of WSN. The cluster formed is uneven size by making use of unequal competition radius. The nodes are allocated with unequal competition radius through the usage of several factors. The distance to BS remaining energy and number of neighbour's .In that way of energy consumption amongst the cluster head node is more efficiently balanced.

Rajesh Purkait et al.[4] suggested a Fuzzy based Unequal Energy Aware Clustering (FBUEAC) Algorithm is because of unequal node distribution , the energy consumption amongst the nodes are mostly not balanced in cluster based wireless sensor networks. The energy consumed by a head node is greater for it does increase the usage. Hence, the dying procedure of such kind of nodes is very quick in comparison with the rest of the nodes. Clustering is controlled by fitness base multi-hop intra and inter cluster tree routing Architecture, so as to prevent avoid the death of relay CH's nearer to the BS.

Li.C et al.[5] provided an Energy efficient uneven clustering approach, used on unequal size of cluster , in which cluster heads employ a multi-hop system for the transmission of data to the base station. The important issue is higher traffic load on CHs to BS. As a result, their energy will reduce sensor and ne twork lifetime decreases.

T.Meddah et al.[6] developed an algorithm called Energy Efficient and Density Control clustering (EEDCA).Where seek to select the finest node in the network to be cluster heads. Next step, it groups the network into clusters. On this approach, the select of the cluster head depends of residual energy, distance and density. Each node examines its residual energy according to other nodes located on its range. The simulation result of EEDCA algorithm show that its increase the lifetime of the wireless sensor network, and network more efficiently.

Energy Efficient Hierarchical Cluster-Based Routing For Wireless Sensor Network is suggested by Shideh Sadat Shirazi et al.[7] The issue of imbalanced energy dissipation happening in cluster based and proposes a new cluster based data aggregation protocol. The newly introduced technique has been used in a heterogeneous distribution of energy consumption of nodes and network partition tends to become more balanced and their lifespan is nearly same as that is conducted when this assessment was performed. By forming a hierarchical structure, the energy consumption of nodes is optimized and minimized.

A new cluster based protocol (LCP), which presents a novel inter cluster scheme for increasing the network lifespan Mohamed Eshaftri et al. [8] This novel protocol continuously performs the rotation of the Cluster Head (CH) in every cluster, and chooses the node with the greatest residual energy in every round. Elaborate simulation experiments indicate that this new scheme provides an efficient balance between the energy consumption amongst all the sensor nodes and prolongs the network lifespan in comparison with other clustering protocols.

Amjad k. et al.[9] studied about energy efficient routing in cluster dependent wireless sensor networks (WSNs) by linear programming formulation for the problem of minimizing energy consumption in such networks. This formulation considers energy consumption at different sensor nodes present within a cluster and jointly optimizes the transmission energy of the sensor nodes to transmit data through a route with minimum energy. The proposed formulation results show that clustering reduced the traffic flow, minimize the energy consumption, increase the remaining energy and extend energy lifetime of the sensor network.

A Geographical multi-layered energy efficient clustering approach used for ad-hoc distributed wireless sensor network is suggested by Saman Siavoshi et al.[10] where the cluster size differs, the cluster close to the base state has small size rather than the farther ones. Fuzzy rules will be followed by every cluster and a new sub tree mechanism is defined in a decentralized manner. Additionally, these adaptable methods reduce the issue of Hotspot which results from the multi-hop communication with the base station. The 47 %

of energy is saved through the Geographical multi-layered energy efficient Clustering approach.

3. Proposed method

The proposed Energy Efficient Based Hybrid clustering (EEBHC) Algorithm is a distributed in hierarchical clustering communication between the sources to destination. It acquires the hierarchical clustering structure in order to achieve energy efficient in hybrid clustering communication.

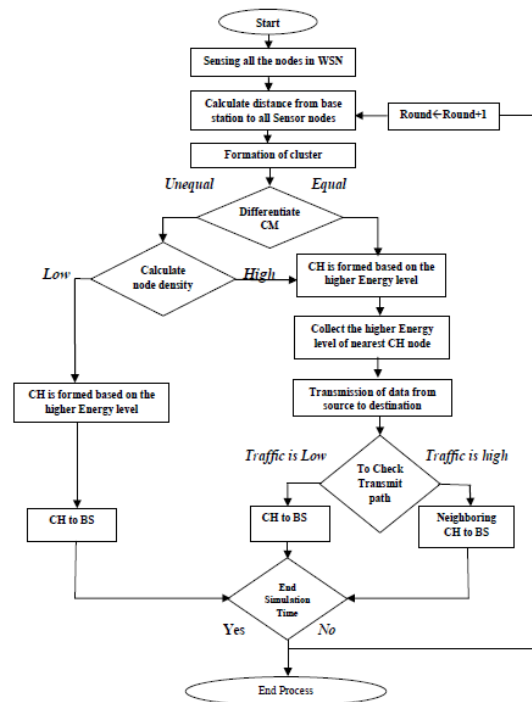


Fig. 1: Hybrid clustering process in WSN

The hybrid cluster Architecture is described as following the Wireless Sensor Networks depends on the number of sensor node in the cluster, it is divided into equal and unequal clusters. In my proposed work is combination of equal and unequal clustering process is called hybrid clustering. The hybrid clustering method is Exchanging the information in two ways. First one is, when the node density is found to be more (or) less than the limit there may sometimes occurs high collision/Traffic in intermediate path that the results to more packet losses and energy wastage. Because, the packet takes long time to reach the base station. In order to avoid this cluster member with high energy chosen as CH and data is send through CH to Base Station (or) otherwise neighboring high energy cluster member is chosen as CH to send data to BS. This new technique is elimination's of high packet losses and time delay in WSN. Also when traffic is low the data is sent directly from cluster head to BS to improve the scalability and lifetime of WSN. Second way, both equal and unequal cluster when the node density is detected to be low, the cluster head transmits the data directly to the base station. Therefore unnecessary packet losses and adequate amount of data is transferred in a short time. The hybrid cluster caters both cluster technique covering the greater amount of data aggregation available in WSN

Additionally hybrid cluster overcomes the energy consumption and data aggregation problem. This is resolved and increase the networks lifetime. In point of fact the hierarchical clustering structure is created where cluster near to the base station are tinier compared to those that are beyond from it. In this hybrid cluster algorithm to choose higher energy level nodes and suitable distribution as cluster heads some condition are think about inclusive of Remaining energy.

Energy consumption model

Energy function can be divided into two parts. Therefore clustering energy and remaining energy

The energy consumption for cluster member is specified as

$$E_{CM} = \sum_{i=1}^K \sum_{j=1}^N E_{Tx}(l, d(CH_i, N_j)) \times x_{ij} \quad (1)$$

Where k refers to the number of chs, N is the number of nodes, l is the packet size and d refers to the distance between the ith CH and jth node.

The energy consumption for cluster head is expressed as

$$E_{CH} = \sum_{i=1}^K l \times |C_i| \times (E_{DA} + E_{RX}) + E_{Tx}(l, d(CH_i, B_s)) \quad (2)$$

Where |C_i| refers to the number of members, who belong to the ith CH and E_{DA} stands for the energy consumed for data aggregation. It is assumed that the data from various nodes can be compressed and then aggregated into l bits.

The total energy consumption in each round is

Table 1: Energy Efficient Based Hybrid Clustering (EEBHC): Algorithm

Step 1: Initialization
Step 2: To sense all the nodes in Wireless Sensor Network (WSN)
Step 3: Calculate the distance between base station and all sensor node using equation
Step 4: cluster formation is generated based on sensor node's distance
Step 5: cluster head (CH) is formed based on higher energy node
Step 6: Then, to collect higher energy level of neighboring CH node
Step 7: Transmission of packets between source to destination
Step 8: differentiate the cluster depending on node in the cluster
Step 8(a): If cluster member is equal and traffic is high
Then, follow the step 6 and 7.
Else
Cluster member is equal but traffic is low
Then, packets are directly sending from CH to BS.
Otherwise
Step 8(b): If cluster member is unequal and node density is high
Then, following step 6,7 and 8(a).
Else
Cluster member is unequal and node density is low
Then, packets are directly sending from CH to BS.
Step 9: To check Simulation Time
If Simulation time is End
Then, end process.
Else
Round → Round + 1
Then, following step 2 to 8(b).
Step 10: End Process

4. Simulation results

The Suggested Hybrid clustering methodology is proved by Network Simulator (NS2) Environments.

Parameters	Values
Number of Node	50
Area Dimension	400 * 400(Meter)
Routing Protocol	AODV
Total Energy	150 Joule
Initial Energy	0.5 Joule
Packet Size	4000 bits
Number Of Round	500
Type of the MAC	802.11
Simulation Tool	NS2.34

The proposed algorithm of EEBCT and FBUEAC are highlighting on the network energy with new developed protocol EEBHC is simulated through NS2 simulator. Our proposed work of EEBHC is provide a good output in terms of the Packet delivery ratio, End to End delay time, Dead node occurrences in rounds, Packet losses and Energy saving.

$$E_{total} = \sum_{i=1}^K E_{CH}(i) + \sum_{j=1}^{N-K} E_{mem}(j) \quad (3)$$

Where K is the number of cluster heads and N refers the number of sensor in the network.

Calculating end to end delay model

The information is distinguished from the sender, the loss of time to go to the recipient and following the Queing delay (d_q), Propagation delay (d_p) and Transmission delay (d_τ).

$$D(S,R) = (d_q + d_\tau + d_p) \quad (4)$$

The link delay D (Sender(S), Recipient (R)) is a measure of the delay a packet experiences when traversing a link from node S to R node. The steps for our proposed algorithm are described in table 1

A wireless sensor network with sensor node is distributed in random in an area with dimensions of the sensing region.

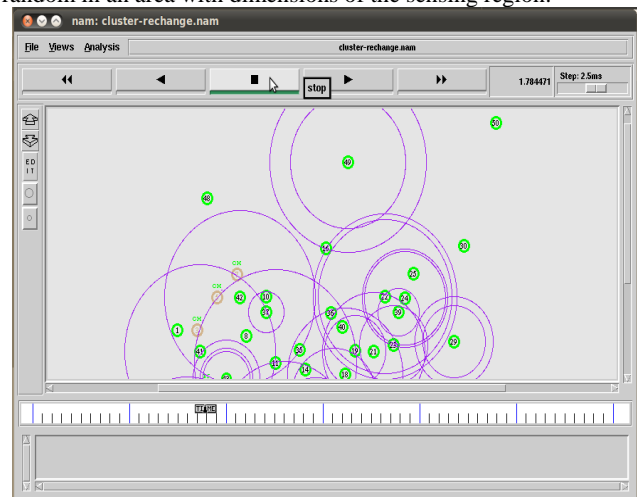


Fig. 2: Performance of packet delivery ratio

The figure.3 represents the hybrid clustering performance like high energy level based packet delivery characteristics. The packet delivery ratio represents, how much of packet should be transmitted from source to destination with proper routing path via evaluated the number of packets delivery in that WSN like hybrid CH approaches in any wireless network. Here packet delivery is evaluated with particular time.

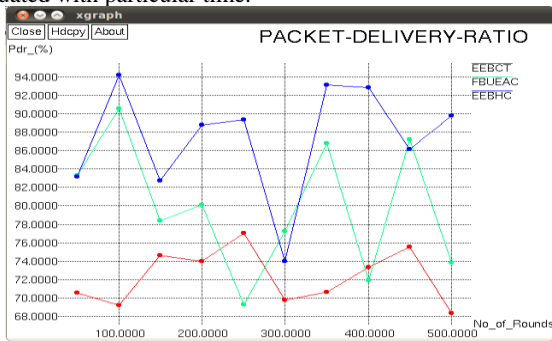


Fig. 3: Packet delivery ratio

When comparing with the existing method FBUEAC the result is 79.88% and another method of EEBCT RESULT is 72.30%. Now the proposed work is much better than the existing work. So the packet delivery ratio is 87.41% with the EEBHC method.

Performance of end to end delay

The packet delay is defined as the average time consumed by a data packet to get to the destination. It also comprises of the delay during the routing discovery process and the queue in data packet transmission. Just the data packets, which are delivered successfully to the destinations are counted.

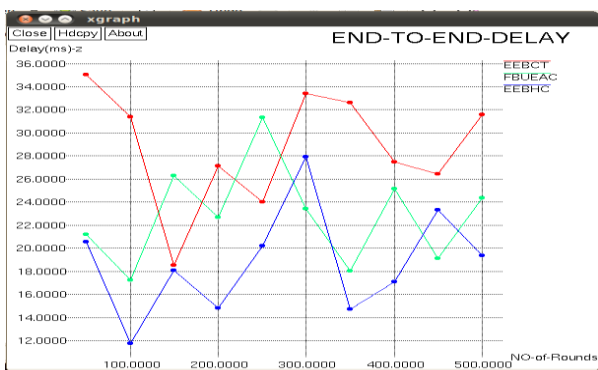


Fig. 4: End to End delay

When comparing with the existing method FBUEAC the result is 22.88 Mille Second (ms) and another method of EEBCT result is 27.76 ms. Now the proposed work is much better than the existing work. So the average end to end delay is 18.79ms with the EEBHC method.

Performance of dead node occurrences

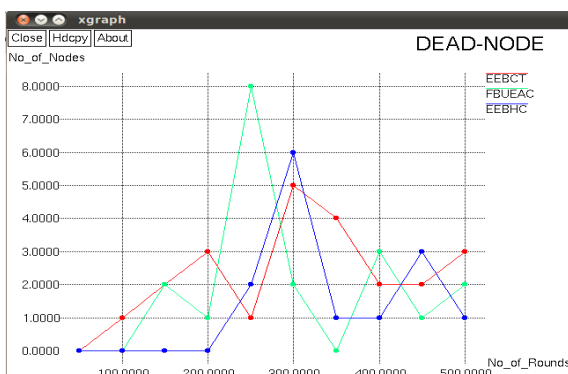


Fig. 5: Dead node occurrences

Fig .5 shows that the results of dead node occurrence. In the existing method EEBCT the dead node occurs during the 97th round and the average of packet losses is 27.70% and another method FBUEAC the dead node occurred in 135th round and average packet losses is 20.13%.The proposed EEBHC method dead node occurred in 237th round and average packet losses is 12.59%. During the packet transmission while the dead node delay occurred means packet losses will be reduced for that proposed method is used in the effective manner.

Performance of remaining energy

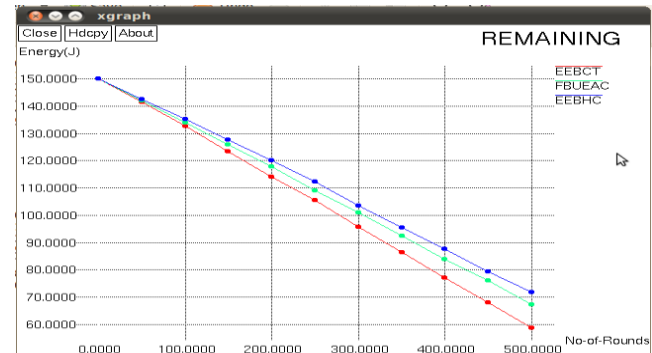


Fig. 6: Remaining energy

Initially, by comparing the remaining energy and joule by taking 100% and 150 joule as a sample for that, we get the following results the existing and proposed work. Therefore the result for the existing method FBUEAC is 44.81% and corresponding joule is 67.215J and another method EEBCT is 39.12% and the corresponding joule is 58.690J. The proposed proves that better for saving the remaining energy is 47.84% and the joule is calculated as 71.760J.

5. Conclusion

Using our proposed Hybrid clustering approaches that improve the high energy level depending on data transmission in Wireless Sensor Networks. In any network routing path selection is much important for maximum packet delivery. The working style of hybrid clustering approaches is cluster members are transferred their packet to cluster head and cluster is transmitted to base station through high energy level of the node.

The initially energy level of the node is being lower than 0.3J the node in noted as a dead node. So, the algorithm EEBHC is used. In that time data losses or data aggregation can be failed during the energy level is low. Finally delivered simulation results for Maximum packet delivery ratio, reduced the Packet losses and improve the network lifetime performance with respect to time.

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