IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

Variable Power Energy Efficient Clustering for Wireless Sensor Networks

Meghavath Sudhakar Nayak,Mekala Prasanth,Meda Sudhakar, Kampa Ram Gopal

Department of ECE, Vasireddy Venkatadri Institute of Technology, Nambur, Guntur, Andhra Pradesh, India

ABSTRACT: In today's modern world, wireless sensor networks have many applications in areas like environment observation, target tracking, border monitoring and battlefield surveillance. To prevent the excessive utilisation of energy and to extend the lifetime of wireless sensor nodes, an effective clustering mechanism can be employed. In this paper variable power energy efficient clustering (VEEC) mechanism for WSN has been discussed. This is an energy efficient clustering algorithm which uses relay nodes and a single message transmission per node for setting up the cluster. The proposed scheme is then compared with LEACH and HEED clustering algorithms in this paper. Simulation results from this paper shows improvement in average communication energy and the total energy of the wireless sensor system. The results of this paper shows the reduction in node death rate and prolongation in network lifetime compared to the two already existing clustering algorithms.

KEYWORDS: Variable power energy efficient clustering, Wireless sensor Networks, LEACH, HEED.

I. INTRODUCTION

Wireless Sensor Network (WSN) is an infrastructure-less wireless network that is applied on a large number of wireless sensors that are connected in an ad-hoc manner which is used to monitor the system, physical or environmental conditions. These WSN's has many applications in real-time applications such as home automation, robot control, disaster relief, environmental monitoring and automatic manufacturing. Wireless Sensor Networks have been used in many remote areas like rivers, mountains and in harsh areas like deserts. These WSN have also been used to make alerts and prevent natural calamities. A wireless sensor network is composed of thousands of sensor nodes which are used to sense the target information and also used for transmitting them to the base station (BS) located far away from the sensing field. The main features of these networks include less mobility, less hardware capabilities, reduced memory and increased population density in the target area, when compared to ad-hoc networks.

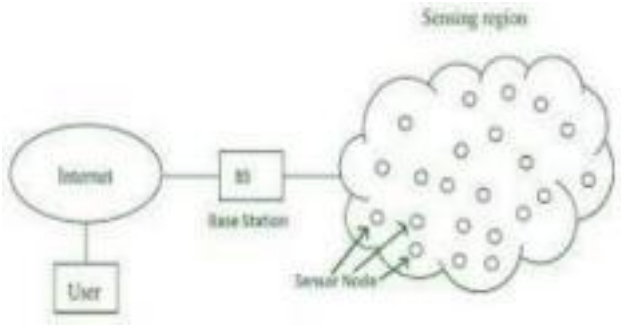

Fig 1

An efficient way is to arrange the network into several clusters and each individual cluster has a cluster-head (CH). CH is one of the sensor nodes which is rich in resources. Sensor nodes send their
sensed information to the CH during their TDMA time-slots. The CH performs a data aggregation process and forwards the fused data to the base station. Clustering follows some advantages like network scalability, localising route setup within the cluster, conserves communication bandwidth and maximises network lifetime. Since clustering uses the mechanism of data aggregation, unwanted communication between the sensor nodes, CH and BS is avoided.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

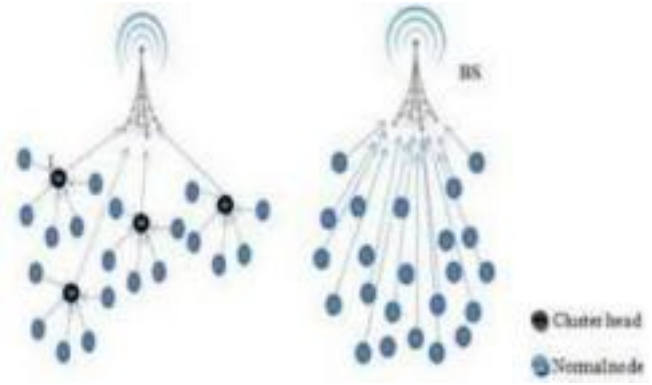

Fig 2

II. EXISTING METHODS

Considerable research efforts have been made to minimise the energy consumption and to prolong the lifetime of WSNs. One of the well-known clustering algorithm is Energy-Efficient Hierarchical Clustering (EEHC), a randomised clustering algorithm organising the sensor nodes into hierarchy of clusters with an objective of minimising the total energy spent in the system to communicate the information gathered by the sensors to the information processing centre. The main drawback of this algorithm is that some nodes remain.

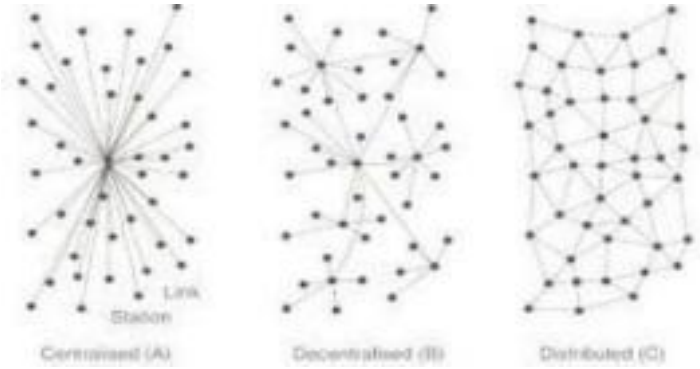

Fig 3

Another clustering algorithm, Linked Cluster Algorithm (LCA) (Barker et al., 1984) was mainly implemented to avoid the communication collisions among the nodes by using a TDMA time-slot. It uses a single-hop scheme, attains a high degree of connectivity when CH is selected randomly. It shows a great improvement in intra-cluster and inter-cluster energy consumption.
The main problem occurs due to much energy utilisation by several iterations until the nodes settle in most energy efficient topology.

The distributed clustering algorithms which have fallen into the scope of this paper are LEACH and HEED. These algorithms organise networks with different network topologies. The operations of LEACH and HEED are briefly discussed as follows

LEACH - Low Energy Adaptive Clustering Algorithm is a distributed clustering algorithm which uses two-hop topology to form multiple clusters. Initially, from each cluster one node is randomly selected as CH. As discussed earlier, a cluster-head (CH) collects all the remaining sensor nodes information during their TDMA time slot. Since the data collected is highly correlated, multiple data packets are combined into a single packet by aggregation mechanism that is by the process of data aggregation and the fused data will then be reported to the BS. It is studied that data transmission using the LEACH network will have a prolonged network lifetime when compared to direct transmission. The advantage of using this is it easy to implement. But the nodes are assumed to be static in this topology which is a drawback.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

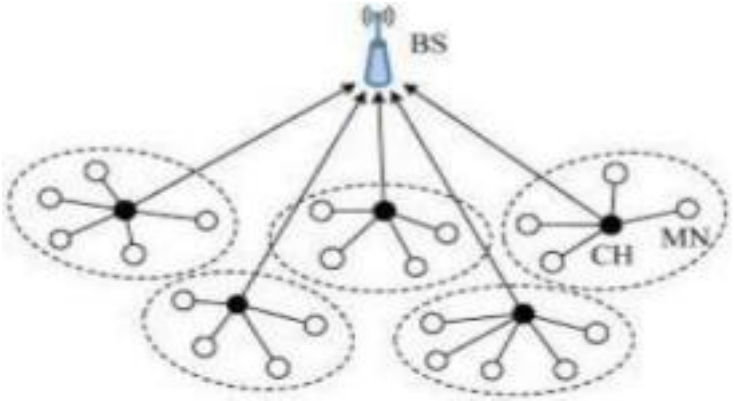

Fig 4

HEED – Hybrid Energy-Efficient Distributed Clustering (HEED) is a well distributed clustering algorithm where the CH is selected by taking residual energy and intra-cluster communication cost into consideration which leads to prolonged network lifetime. In (Y,2004), it is stated that the HEED algorithm will have a variable cluster count and heterogeneous sensor nodes are supported. The only drawback of HEED algorithm is it has only limited applications to work with. These applications include static networks, the employment of complex probabilistic methods and multiple clustering messages per node for CH selection.

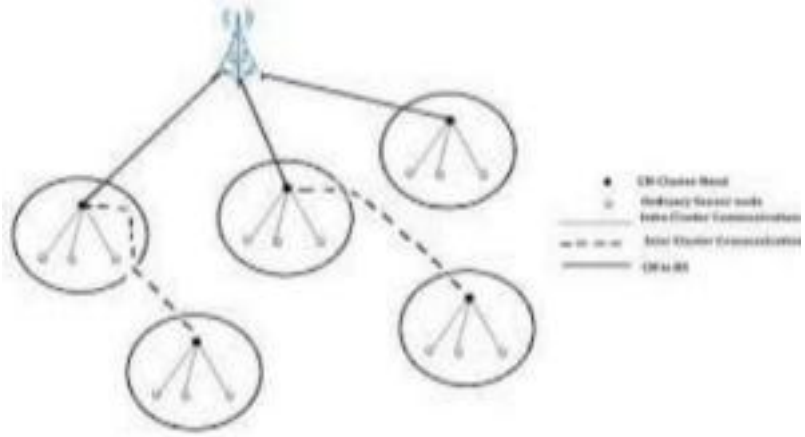

Fig 5

III.. PROPOSED METHOD

The proposed algorithm, Variable Power Energy Efficient Clustering (VEEC), is a well distributed clustering algorithm where the sensor nodes are deployed randomly to sense the target environment. The nodes are partitioned into clusters with each cluster having a CH. The nodes send the information during their TDMA time slot to their respective CH which fuses the data to avoid redundant information by the process of data aggregation. The aggregated data is forwarded to the relay nodes which in turn routes the data to BS either directly or forwarding through other relay nodes. Compared to the existing algorithms, VEEC has three distinguishing features.First, in many clustering algorithms CH forwards the data to BS directly, which leads to power wastage but in VEEC, CHs does not forward the data to BS. Instead CH forwards data packets to relay nodes and these richer resourced relay nodes routes data to BS thereby considerable energy utilization can be reduced. Second, VEEC uses variable transmission power. Nodes nearer to CH use lesser transmission power and nodes far away from CH use more power for transmission from nodes to CH or vice versa, which can reduce considerable power. Third, CH sends one message for every cluster nodes but many existing algorithms transmits several messages for cluster-setup.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

IV. METHODOLOGY

In the proposed algorithm VEEC, the network consists of N nodes.Node Identity represented by n and the number of clusters formed is represented by k.The entire algorithm executes in following four stages :

Stage I – Cluster-setup
In VEEC, the node with highest residual energy has the maximum probability of becoming a CH. Initially PCH compares the residual energy (RE) of the cluster nodes and transfers the CH to the node having highest residual energy within a cluster. If it does not find any node having higher pesidual energy PCH itself will become a CH. It broadcasts join-request to the nodes within R meters, where R is equal to the cluster radius. The broadcast message includes the NID of the CH, the total number of layers in the cluster and local communication radius Room. The objective of this message is to suppress other node's interest to become a CH. Nodes receiving this message will stop their action and joins to that CH.

Stage II – Data Aggregation
A CH will fuse all the incoming data packets together, those received from the sensor nodes in order to avoid redundant data transmission of highly correlated data. The fused data is then forwarded to relay nodes. In case when a node dies or does not transmit the data during its time-slot, it is regarded as unreachable and can be skipped from the data collection process. The aggregation is performed by spatial correlation measurement by measuring the offset between the two sensor readings. If the error is within the tolerable range, then the two readings are correlated.

Stage III – Functionality of Relay Node
In VEEC the relay nodes are static and only forward the data to BS. Every relay node has the same initial energy and transmission range. The MAC protocol puts the radio of the relay node in sleep mode if it is not the transmitter or receiver of the packet. The relay nodes are divided into different zones starting from the BS. The relay nodes in the zone nearer to the BS need to relay more packets and hence more number of relay nodes has to be placed in the zone nearer to BS. The zone farther from BS requires fewer nodes as there is need for only little amount of data to be forwarded. Also the power consumption of the relay nodes nearer to BS will be more compared to the relay nodes far away from BS. The BS will periodically broadcast a beacon message to the relay nodes. The relay nodes use the RSSI and LQI of the beacon message to estimate its distance from BS in order to maintain the transmission power.

Stage IV – Cluster head Re-election
The CH calculates the lifetime of the member nodes based on their residual energies. The estimated lifetime ILT of a node with NID represented by n, is expressed as the number of times it can be a CH. The CH uses the lifetime information to estimate the lifetime of the cluster.

V. RESULTS

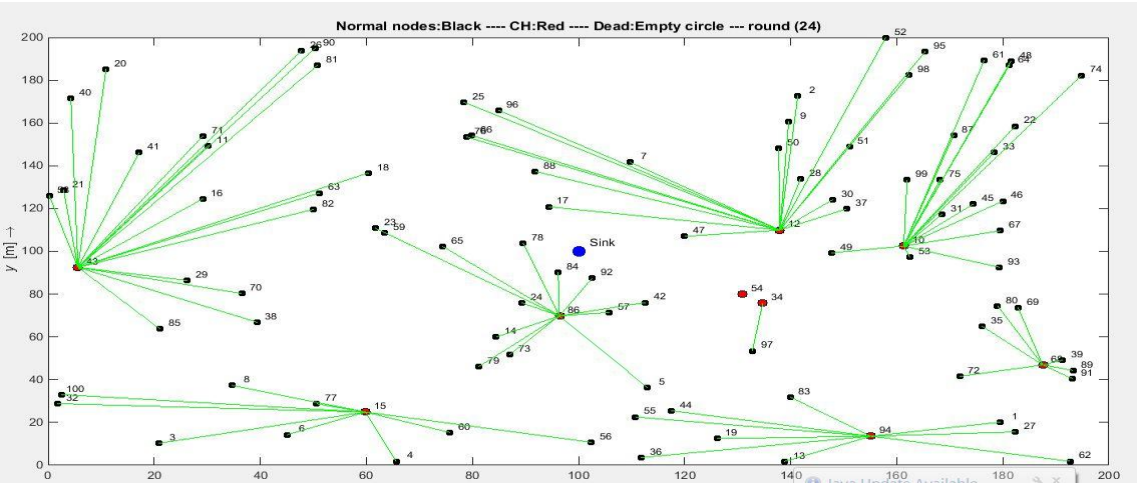

Fig 6 Articulation of VEEC

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

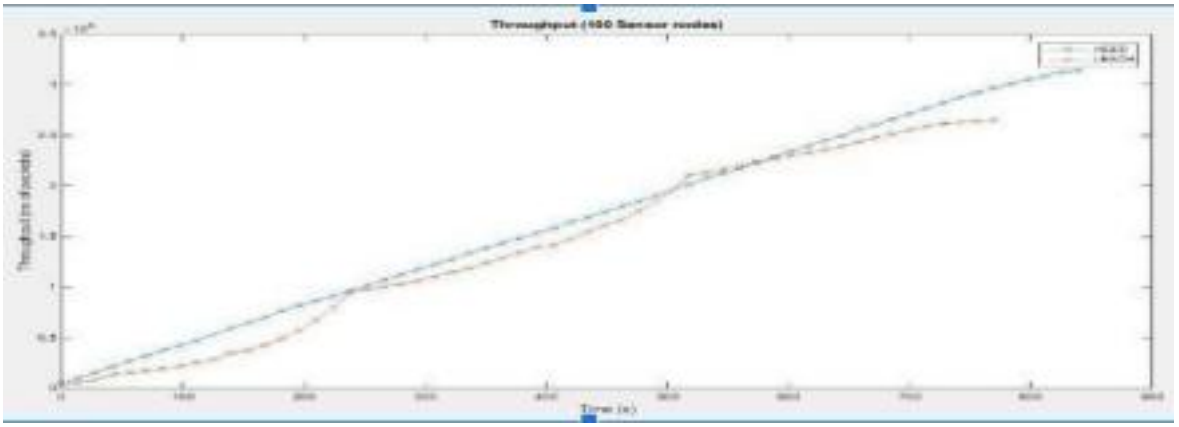

Fig 7 Throughput

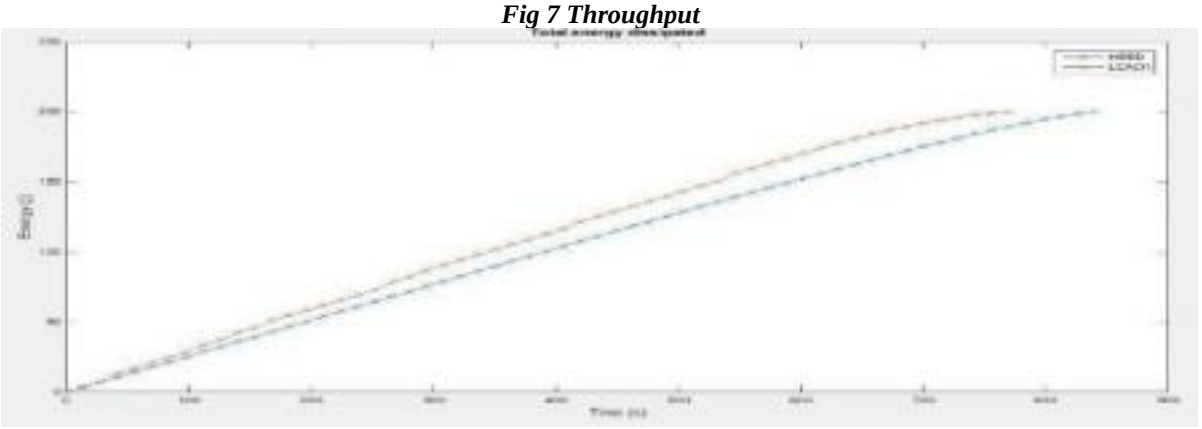

Fig 8 Total energy dissipated

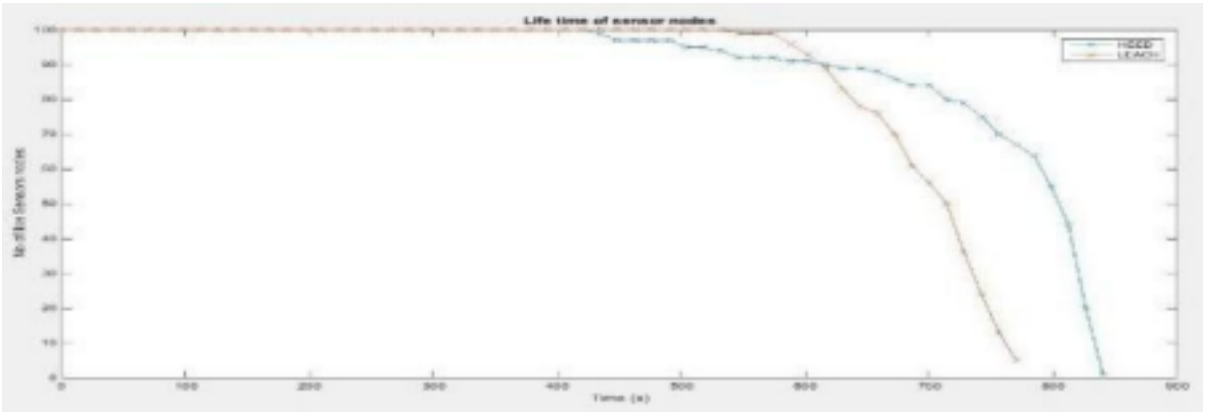

Fig 9 Lifetime of sensor nodes

VI CONCLUSION

In this paper a well distributed clustering algorithm, variable power energy efficient clustering algorithm has been proposed. Based on a single message for cluster-setup, variable transmission power and relay nodes, the algorithm VEEC has been formulated to form efficient clusters in a wireless sensor network. The algorithm is analyzed and the performances are compared with the two existing clustering algorithms LEACH and HEED. It is seen that the proposed distributed clustering algorithm has shown much improvement in communication energy over the two well evaluated algorithms. The performance of the proposed algorithm shows a drastic improvement in the total energy of the wireless sensor system. Nevertheless, the proposed algorithm can greatly minimise the node death rate and thus have prolonged network lifetime.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005297 |

REFERENCES

[1] Akyildiz, I., W. Su, Y. Sankarasubramaniam and E. Cayirci, 2002. A Survey on sensor networks. IEEE Communications Magazine, 40(8): 102-114.
[2] Bajaber, F and I. Awan, 2009. Centralized dynamic clustering for wireless sensor networks. Proceedings of the International Conference on Advanced Information Networking and Applications.
[3] Bandyopadhay, S and E. Coyle, 2003. An energy-efficient hierarchical clustering algorithm for wireless sensor networks. Proceedings of the 22nd Annual Joint Conference of the IEEE Computer and Communications Societies (INFOCOM 2003).
[4] Barker, D.J., A. Ephremides and J.A. Flynn, 1984. The design and simulation of a mobile radio network with distributed control. IEEE Journal on Selected Areas in Communications, pp: 226-237.
[5] Chang, J.H. and L. Tassiulas, 2004. Maximum lifetime routing in wireless sensor networks. IEEE/ACM Transactions on Networking, 12(4): 609-619.
[6] Demirbas, M., A. Arora, and V. Mittal, 2004. FLOC: A fast local clustering service for wireless sensor networks. Proceedings of Workshop on Dependability Issues in Wireless Ad Hoc Networks and Sensor Networks (DIWANS'04).
[7] Deng, J., Y.S. Han, W.B. Heinzelman and P.K. Varshney, 2005. Balanced-energy sleep scheduling scheme for high density cluster-based sensor networks. Elsevier Computer Communications Journal, 28(14): 1631- 1642.
[8] Ding, P., J. Holliday and A. Celik, 2005. Distributed energy efficient hierarchical clustering for wireless sensor networks. Proceedings of the IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS'05).
[9] Heinzelman, W.B., A.P. Chandrakasan and H. Balakrishnan, 2002. An application specific protocol architecture for wireless microsensor networks. IEEE Transactions on Wireless Communication, 1(4): 660-670.
[10] Li, C.F., M. Ye, G.H. Chen and J. Wu, 2005. An energy efficient unequal clustering mechanism for wireless sensor networks. Proceedings of the Second IEEE International Conference on Mobile Ad Hoc and Sensor Systems (MASS).
[11] Lianshan Yan., Wei Pan., Bin Luo., Xiaoyin Li and Jiangtao Liu., 2011. Modified energy-efficient protocol for wireless sensor networks in the presence of distributed optical fiber sensor link. IEEE Sensors Journal, 11(9): 1815-1819.

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.165

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details