



PARAMETRIC COMPARISON OF DISTRIBUTED CLUSTER HEAD TECHNIQUE

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Abstract— The WSN is a network that performs communication by dividing the network into sub-divisions named as clusters. The clusters are made up of group of sensor nodes. A node is elected from each and every cluster that represents that corresponding cluster. The cluster head selection is one of the major tasks that can affect the whole performance of the network. The most of the cluster head selection techniques choose the CHs on the basis of link cost function that evaluates only the distance of the candidate node with rest of the adjacent node, other factors such as energy of the candidate node, distance of the candidate node to the sink node were ignored.

This study presents a new mechanism for CH selection i.e. E-DECH (Enhanced-DECH). The improvements are introduced in the terms of parameters that are evaluated to measure the minimum link cost function. The proposed work evaluates the link cost function on the basis of distance of the candidate node from adjacent nodes as well as sink node also. The amount of residual energy is also considered as a major aspect for evaluating the link cost function. The results portrays the contrast among DSBCA-DECH and E-DECH in the terms of number of dead nodes, number of alive nodes and existence of first dead node in the network.

Keywords—Wireless Sensor Network, Cluster Heads, Link Cost, Energy, Distance.

1. INTRODUCTION

Wireless Sensor Network is one of the most trending topics now days. The WSN performs communication among sensor nodes without connecting them with physical wires. The data travels to the sink node by covering a route which is created by the clusters. Each and every cluster has its own cluster head which is a node that represents the whole cluster. The route is created via these clusters and it is a tedious task to select the node as a cluster head [1].

The task of cluster head selection has a great impact on the performance of the network. Other factor that affects the performance of the network is energy of the nodes. Energy is a power that is allocated to the nodes when the network is established initially [4]. If the nodes consume maximum energy than the network will become dead and will not be capable to perform any task [5]. Therefore the cluster head should be the most suitable candidate node. The node which has higher amount of residual energy, less distance from the sink should be the candidate node for cluster head [6].

A review study had been conducted in the past which presents the overview to the already existed cluster head selections protocols. The various cluster head selection protocol elects the cluster heads on the basis of different criteria such as distance, energy etc [9]. But most of the researches had been conducted only by considering the distance as a major factor. Therefore in this way the performance of the network is improved but not to the satisfactory level.

This work is organized specifically provide a novel approach E-DECH for cluster head selection which is an enhanced version of traditional DSBCA-DECH [1]. The previous two papers of this series addressed the various issues related to the cluster head selection in WSN and implement the DSBCA-DECH for efficient cluster head selection in WSN. Therefore to utilize the power in a professional way, the nodes are organized in Deterministic way. In Deterministic deployment, the network nodes are alienated into cluster [27]. This paper is the last and third paper of the series that provides a contrast study among DSBCA-DECH and E-DECH.

In this approach the cluster head selection is performed on the basis of three major parameters i.e. Energy of the node and distance of the node from its adjacent nodes. To implement this strategy first of all the structure of the network is improved by dividing it to the sub parts which comprise of equal number of nodes. Then the cluster heads are selected on the basis of the energy and distance of the nodes. In traditional WSNs the node had to travel for long distance to reach to the sink node and sometimes the selected cluster head nodes are selected in such a way that they are located near to each other. Clustering techniques is solution to use the energy of a node for long time .There is no need to transmit sensed data to base station from every sensor instead sensor nodes present in the cluster transmit the data to their cluster head and cluster head transmits the gathered data to the base station or sink [29]. Therefore the performance of the network gets degrades because the energy of the nodes gets exhausted earlier.

The proposed work provides a link cost function which is based on energy and distance instead of energy only. The link cost evaluated by measuring the distance of cluster head from node and then multiplying it to the distance between cluster head

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and sink node then this evaluated distance is divided to the $(n - 1) * E_i$. Here n depicts the total number of nodes and E_i defines the residual energy of the nodes. After this the *min* function is applied to this and is considered as the final link cost. The minimum link cost elects the cluster head in the center of the cluster from where it becomes easy to access the CH from every node of the cluster. Time interval from the beginning of the transmission of data till the death of the last alive node is the lifetime of network i.e. the full time once the operation begins before the rate of the sensor node fall beneath a certain edge [28].

Rest of the paper is organized in a way that 2nd parts addresses the problem that was exist in traditional DSBCA-DECH protocol for cluster head selection, section 3 depicts an overview to the framework of proposed technique, and then the result section is organized to draw a contrast image between the performance of DSBCA-DECH and E-DECH. Then the last section of the study provides a conclusion to the study.

2. PROBLEM FORMULATION

As per study of previous work done in the existing systems to enhance their network performance is basically that the cluster head selection approach is enhanced with adding link cost scenario. In which randomly triggered nodes initiate the clustering process in the clustering protocol. Although some of the CHs may closely have been placed and they are not optimal, the proposed approach optimally places the randomly selected closest nodes on the basis of minimum link cost.

The issue that arise in it is basically the link cost is dependent on the distance only it is shown in the mathematical modal given in the paper

Let C be the network consists of ‘n’ number of clusters.

$$C = \{C1, C2, C3 \dots, Cn\} \dots \dots \dots (1)$$

The link cost of node ‘u’ with node ‘v’ can be calculated using the Eq. (2)

$$LC(u) = \{d(u,v) \wedge u \in C1 \wedge v \in C1 \ ||\ v \neq u\} \dots \dots (2)$$

LC(u) is the link cost of node u, where u, v are the nodes which lies in c1 and d(u,v) is the distance between node u and v. The distance d(u,v) is calculated by using RSSI. After the clusters are created, the CHs are checked to confirm that whether they are closely placed. The nodes of the closely placed CHs broadcast beacon signals to the cluster members. Using Receiver Signal Strength Indicator all the sensor nodes calculate its link cost with other nodes belonging to its cluster. The node having minimum link cost will be selected as the new cluster head and it initiates the clustering process. The node with low link cost can be selected using the Eq. (3)

$$Min \left\{ \sum_{j=1}^n \frac{d(ui,uj)}{n-1} : i = 1,2, \dots, n \right\} \wedge u \in c \dots (3)$$

This makes the CHs to be placed around the centre of the cluster on the basis of its cluster member’s location.

But distance is not the only factor on which the performance of the network dependent except this the energy, data packets etc are also the major sections of improving network efficiency.

3. PROPOSED WORK

As in problem it was discussed that the CH selection was the major issue in the network due to which the link cost was introduced in the present work in case of any two node been selected as CH which are nearer to each other, but only distance factor consideration is not a point that effects on performance of the network other parameter as distance with sink and node’s energy can also be considered because the main effect of this will be the energy model that is used in the EEP are directly proportional to energy and distance both. So there will be major effect of considering the energy factor in CH selection.

$$Min \left\{ \sum_{j=1}^n \frac{d(ui,uj) * d(ui,S)}{(n - 1) * E_i} : i = 1,2, \dots, n \right\} \wedge u \in c.. (4)$$

Parameter	Values
Sink Position	50*50
Efs (amplifier type)	10*10 ⁻¹² J
Emp (amplifier type)	0.0013*10 ⁻¹² J
EDA (aggregation enrgy)	5*10 ⁻⁹ J
Initial Energy E ₀	0.01J
Packet Length	2000 bits
Ctrl Packet Length	100 bits
Probability of CHs	0.1
Maximum rounds	500
Gamma	0.2
Phi	0.3

Psi	0.4
Beta	0.5

The proposed technique shows the concept of uniformity in the network rather than random distribution of nodes. The method works in the flow whose steps have shown below:

1. The very first step is to initialize the whole network where nodes will be deployed. Correspondingly, define the area and the location of sink node in the defined network. Moreover, the energy model will also define in this stage.
2. Now initialize the network and deploys the node in the network uniformly. In the uniformity, the whole network section has divided and then clusters are formed.
3. In each cluster, a cluster head has selected on the basis of traditional probability scenario. The selected CH will be used as an intermediate between sensor nodes and the sink as it forwards the information to the sink node.
4. Now evaluate the location of cluster heads. If any of two cluster heads are nearer to one another, then in that case link cost will be evaluated. The calculation of the link cost is done through three factors such as distance from one to another node, distance of each node with the sink node and lastly energy of the node.
5. In this stage, the energy model is calculated in order to dissipate the energy. Moreover, the data transmission from individual node to the sink is also performed in the step.

Lastly, calculate the performance of the proposed and traditional technique by making relevant comparison using the parameters number of dead nodes, no. of alive nodes and first node dead in the network.

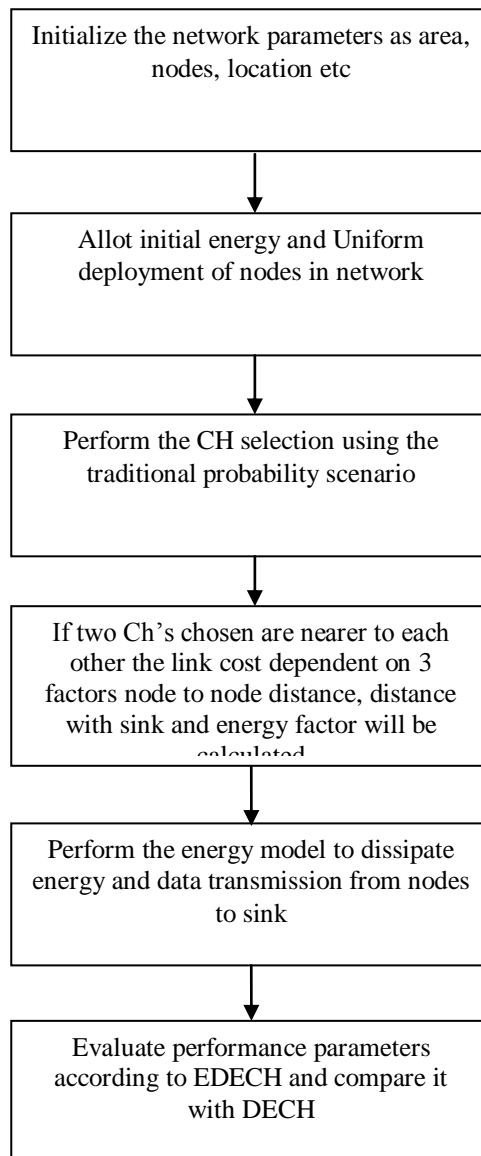


Figure 1 Block Diagram of the proposed work

4. RESULTS

This section of the study provides an overview to the contrast of DSBCA-DECH and E-DECH. The comparison is done in the terms of alive nodes, dead nodes and first dead node in the network.

The figure 2 shows the comparison between the traditional and proposed technique in terms of total dead nodes in the network. From the figure, it is crystal clear that proposed technique outperforms the traditional technique and produces less dead nodes.

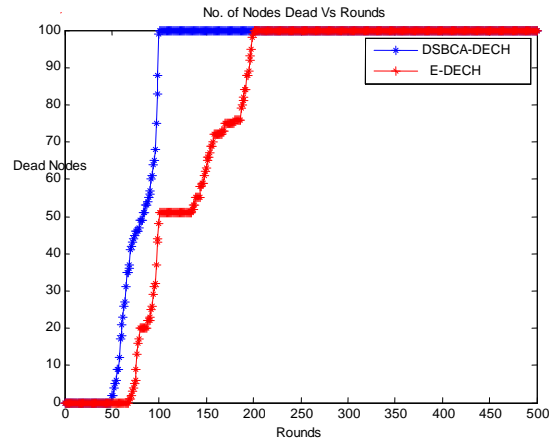


Figure 2 Comparison between traditional and proposed technique in terms of total dead nodes in the network

In the DSBCA-DECH, nodes are started exhausted after the 50th round and in E-DECH, nodes remains alive at 50th round and after 60th round the energy gets released. In the whole, all the nodes are dead before 100 rounds in the traditional technique. On the counter part, nodes remain full with energy till the round 200 and after this round all the nodes died.

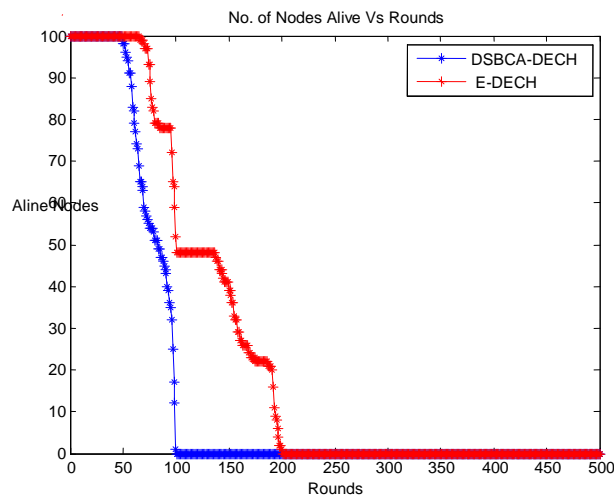


Figure 3 Total numbers of alive nodes in the network using existing and proposed technique

The total number of alive nodes in the network has shown in the figure 3. The comparison has performed between traditional and proposed technique where total number of alive nodes are considered. At round 50th, the nodes in the network are started depleted or out of energy in DSBCA-DECH technique whereas, the nodes in the proposed technique are more alive. So, the nodes in the traditional technique shows straight declined and ran out of energy quickly. On the other side, proposed technique has the capability to retain the nodes with more energy and enhances the lifetime of the network.

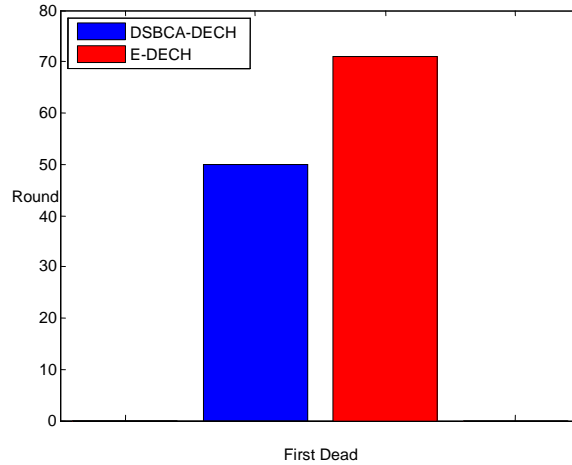


Figure 4 First Dead node in each technique

The figure 4 identifies the first dead node in the network in case of traditional and proposed technique. It has clearly shown in the figure is that node becomes dead at the 50th round in traditional technique whereas in the proposed technique, at 71th round, a node stays alive. Therefore, proposed technique is more effective in enhancing the lifetime of the network.

5. CONCLUSION AND FUTURE SCOPE

This study provides E-DECH i.e. Enhanced DECH for the purpose of CHs selection in WSNs. The motive of the study is to improve the network structure and to enhance the traditional cost function for CHs selection. The initialization of the network is done by using the principle of uniformity. The whole section is divided into four sections and then nodes are deployed in the area. The proposed technique is implemented and their results are evaluated to check its performance. Moreover, the proposed technique is compared with the traditional technique in terms of different performance parameters such as number of dead and alive nodes in the network and first node dead while transmission.

Table 1 Comparative Analysis

Parameters	Units	DSBCA-DECH [1]	E-DECH
First Dead Node		At 52 Round	At 71 Round
Last Dead Node	Rounds	At 100 Round	At 199 Round
Alive Nodes	No. of Nodes	100	198
Stability Rate		1	2

From the results acquired from table 1, it has shown that the first node dead in the traditional technique is at 52nd round whereas in the proposed technique, the first node dead at 71th round. Furthermore, all the nodes in the network are run out of energy after 100 rounds but in the proposed technique, nodes remain alive till 199 rounds. The number of alive nodes in DSBCA-DECH is 100 till the completion of the whole communication rounds whereas in case of E-DECH there 198 nodes that found alive till the completion of communication. The table comprised of a parameter i.e. Network Stability which is used to evaluate the stability of the network with respect to the number of rounds and nodes. The network stability is calculated on the basis of the following formulation:

$$NS = \frac{R_{last\ node\ survive}}{Total\ number\ of\ nodes} \dots \dots (5)$$

The network stability of the E-DECH is double than the stability of DSBCA-DECH. Thus, overall the performance of the proposed E-DECH technique is far better than the traditional DSBCA-DECH technique.

In future, the present study can be improved and optimized using Swarm Intelligence approach. The fitness function used in swarm intelligence can optimized the process of cluster head selection in the network and the energy of each node in the network can be maximized to make them activate longevity.

6. REFERENCES

- [1] P. Sundareswaran, K. N. Vardharajulu, R. S. Rajesh, "DECH: Equally Distributed Cluster Heads Technique for Clustering Protocols in WSN", SPRINGER, Pp 1-15, 2015
- [2] Yiping Yang , Chuan Lai, Lin Wang, Energy Efficient Clustering Algorithm for WSNs "10th IEEE International Conference on Control and Automation (ICCA) Hangzhou, China, June 12-14, 2013
- [3] Mahmoud M. Salim, Hussein A. Elsayed, Salwa H.El Ramly," PR-LEACH: Approach for Balancing Energy Dissipation of LEACH Protocol for WSNs" in 31st National Radio Science Conference (NRSC2014), April 28-30, 2014 Ain Shams University, Egypt.
- [4] Nilesh Goriya, Indr Jeet Rajput and Mihir Mehta, "IOSR Journal of Computer Engineering", Vol. 17, No. 1, PP 34-39, February 2015
- [5] B. A. Correa, R.C. Hincapie and Laura Ospina, "Survey on Clustering Techniques for Mobile Ad Hoc Networks," Revista Facultad de Ingenierí, No. 41, 2007.
- [6] C. R. Lin and M. Gerla., "Adaptive Clustering for Mobile Wireless Networks," IEEE Journal on Selected Areas in Communications, Vol. 15, No. 7, 1997, pp.1265-1275.
- [7] S.Banerjee, S. Khuller, "A clustering scheme for hierarchical control in multi-hop wireless networks," in: Proceedings of Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings (INFOCOM 2001), Anchorage, Alaska, vol.2, pp.1028-1037, April 2001.
- [8] J. Yu, P. Chong, "A survey of clustering schemes for mobile ad hoc networks," IEEE Communications Surveys & Tutorials, vol. 7, pp. 32-48, January 2005.
- [9] Ephremides, A.J.E. wieseltheir and D.J. Baker, "A design concept for reliable mobile radio networks with frequency hopping signaling", IEEE, Vol 75, Issue 1, Pp 56-73, 1987.
- [10] Adamou, M., I. Lee and I. Shin, " An energy efficient real time medium access control protocol for wireless ad-hoc networks" WIP session of IEEE real time systems Symposium, 2001.
- [11] Parekh A., "Selecting routers in ad hoc wireless networks", proceedings of SBT/IEEE International Telecommunication Symposium, 1994..
- [12] Mainak Chatterjee, Sajaj K. Das and Damla Turgut, "WCA: A weighted clustering algorithm for mobile Ad Hoc networks, cluster computing", Pp 193-204, 2002.
- [13] Chuangang Wang, Yanping Yu, Yuanxin Xu, Minjue Ma and Shibin Diao, " A multi hop clustering protocol for MANETs", International conference on wireless communication, networking and mobile computing", Wicom, Pp 1-4, 2009.
- [14] Jing An Chang Li and Bin Li, "An improved weight based clustering algorithm in mobile ad hoc networks", IEEE Youth conference on Information, computing and telecom, Pp 220-223, 2009.
- [15] Muthuramalingam, S., R. raja ram, lothai pethaperumal and V. karthiga devi, "A Dynamic Clustering Algorithm for MANETs by modifying weighted clustering algorithm with mobility prediction", International journal computer and electrical engineering", Vol 2, Issue 4, Pp- 709-714.
- [16] Amis, A., R. Prakash, T Vuong and D. Huynh, " Max-Min Cluster Formation in Wireless Ad Hoc Networks", 2000
- [17] Muneer Bani Yassen, Shadi Aljawaerneh, Reema Abdulraziq, "Secure Low Energy Adaptive Clustering Hierarchal based on the internet of things for wireless sensor network(WSN): Survey", IEEE, Pp:1-9, 2016.
- [18] Yu Xiuwu, Fan Feisheng , Zhou Lixing , Zhang Feng, "Wsn Monitoring area Partition Clustering Algorithm for Energy Balanced", IEEE, Pp:80-84, 2016.
- [19] R. Giridhar , et al, "Cluster based Certificate Authority Scheme in WSN", "IEEE, Pp:367-371, 2016.
- [20] Xiang Gao, Yintang Vanq , Duan Zhou, "Coverage of Communication based sensor nodes Deployed location and energy efficient clustering algorithm in WSN", IEEE, Pp:698-704, 2010.
- [21] Haixia Peng , Shuaizong Si , Mohamad Khattar Awad , Ning Zhang , Hai Zhao , Xuemin Sherman Shen, "Toward Energy Efficient and Robust Large-Scale WSN: A scale free Network Approach", Pp:4035-4047, 2016.
- [22] Zhoxon Liu, et al, "An approach of Distributed joint optimization for cluster based wireless Sensor Networks", IEEE, Pp: 267-273, 2015.
- [23] Duc Chinh Hoang, Rasjesh Kumar , Sanjib Kumar Panda, "Realization of a Cluster based Protocol using Fuzzy C-means Algorithm for Wireless Sensor Networks", IEEE, Pp: 163-171, 2013.
- [24] Zhezhuang Xu, Liquan Chen , Cailian Chen , Xinping Guan , "Joint Clustering and Routing Design for Reliable and Efficient Data Collection in Large Scale Wireless Sensor Networks", IEEE, Pp:520-532, 2016.
- [25] Sunil Kumar Singh, Prabhat Kumar , Jyoti Prakash Singh , " A Survey on Successors of LEACH Protocol", IEEE, Pp:4298-4328, 2017
- [26] Anindita Ray, Debashis De "Energy Efficient Clustering Protocol based on K-means (EECPK- means)- midpoint algorithm for enhanced network lifetime in wireless sensor network", IEEE, Pp:181-191, 2016.
- [27] Manisha Dhawan, Er. Amarpreet Singh "Clustering Aspects In Wireless Sensor Network: A Review", International Journal of Latest Trends in Engineering and Technology Vol.(8)Issue(4-1), pp.051-056 DOI:http://dx.doi.org/10.21172/1.841.08 e-ISSN:2278-621X.
- [28] Ramandeep Kaur, Er. Amarpreet Singh "A review on energy efficient clustering protocols based on LEACH in wireless sensor network", Australian Journal of Information Technology and Communication Volume II Issue III ISSN 2203-2843.
- [29] Ramandeep Kaur, Er. Amarpreet Singh "Weighted Clustering Algorithm Based On O-Leach (WC-OLEACH) in Wireless Sensor Network", International Journal of Innovations in Engineering and Technology (IJJET), Volume 6 Issue 3 February 2016.