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Review Paper on MSEEC: Energy Efficient Clustering Protocol in HWSN

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***Abstract*— In Wireless Sensor Networks (WSNs), classical clustering protocols assume that all nodes are equipped with the same amount of energy. In addition, the extension to multi-level of SEEC is presented. The performance of the proposed protocol is examined and compared by existing homogeneous and heterogeneous protocols. Simulation results show that the proposed protocol provides a longer/more stability period, more energy efficiency and higher average throughput than the existing protocols**

Keywords- Wireless sensor network, Cluster Head, Lifetime network, stability

I. INTRODUCTION

A **Wireless Sensor Network** is a self-organizing and self-reconfiguring network of a small sensor nodes communicating among each other using radio signals, and deployed these to sense, monitor and understand the physical world. WSN provides a bridge between the virtual and real physical worlds. Allow the ability to observe the previously unobservable at a fine resolution over large spatio-temporal scales. Sensing nodes in WSN have many uses like monitoring physical or environmental conditions, such as sound, humidity, temperature, and motion etc.

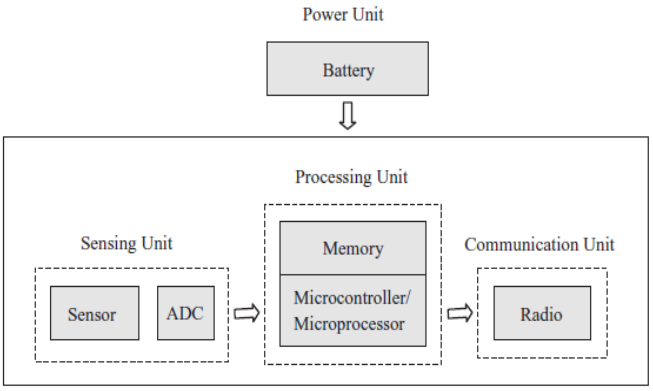

Fig. 1 Sensor Node Structure [1]

Wireless Sensor Networks (WSNs) permit us to use these small sensor nodes for various applications like military applications; area monitoring, manufacturing, end user applications, and under deep water monitoring, etc.

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Having a wide range of potential applications to potential applications to industry, science, transportation, civil infrastructure, and security. Fig. 1 shows the sensor node structure in which power unit consist of a battery for supplying power to operate other components of the system like Sensor, ADC, Memory, Microprocessors, Radio. Typically, wireless sensor node comprised of computing, sensing, actuations, communication, and power components [1].

The main aim in wireless sensor network is to find ways for energy-efficient route setup and reliable send data from the sensor nodes to the sink so that the network lifetime is maximized. Once nodes deployed in field or in a zone, is not possible to replace or recharge battery [2]. The power of Sensor nodes are limited and irreplaceable. That's why the main focus of sensor network protocol is primarily on power conservation. After initial deployment sensor nodes are accountable/ reliable for self-organizing an appropriate network structure often with multiple hop connections between sensor nodes. The location and positioning information of sensor nodes can also be obtained by Global Positioning System or local positioning algorithm. The era of WSN's is highly anticipated in the near future.

Clustering is effective and important criteria for prolonging the network lifetime in wireless sensor networks (WSNs). It entails grouping and collection of sensor nodes into clusters and electing/ choosing cluster heads (CHs). CHs gather the data from respective cluster's nodes and forward the aggregated data to base station. A major challenge in WSNs is to select appropriate cluster heads. In each and every cluster, a sensor node is elected, called as the Cluster Head (CH). The CH is not only responsible for the general request but also receiving the collected and sensed data of other sensor nodes in the same cluster and routing/moving

(transmitting) these data to the sink [3]. Therefore, the energy consumption of the CH is higher than of other nodes. In order to balance the energy consumption for extending the lifetime of this WSN, the CH in a cluster is interchange or alternate among sensor nodes.

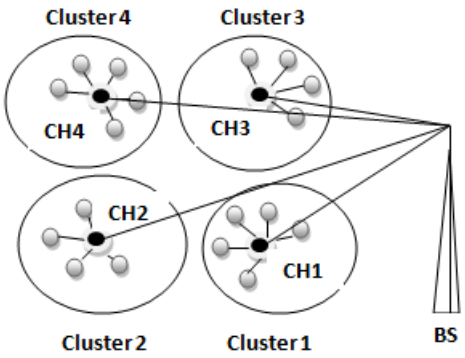

Fig. 2 Clustering Communication Hierarchy for WSN [4]

The CH collects and gathered data/ information from sensors in its own cluster and passes on information to the BS. By reeling the cluster-head randomly, the consumption in energy is expected to be uniformly distributed. Therefore, the CH selection and option manner will affect the lifetime of this network.

The main another problem in WSN is stability caused by the death of the first node in the network [5]. Therefore, all of the sensor nodes in the network must be alive to achieve the objective during that period. One of the major obstacles to ensure these phenomena is unbalanced energy consumption rate.

II. LITERATURE REVIEW

In [6] Gaganpreet Kaur et al: In this paper they discuss the Deploying an Optimized LEACH-C Protocol for Wireless Sensor Network. WSN is built of several nodes (from a few to several hundreds or even thousands nodes), each node is connected to one sensors. The cluster based routing protocols are most recognized and accepted to improve the network lifetime and to reduce the energy consumption of wireless sensor network. The main challenging task in this network is energy consumption and lifetime reliability. This paper represents the pollination based optimization algorithm also called OLEACH-C that is used to improve or optimize the performance of LEACH-C protocol. The PBO algorithm is used/useful for clustering in WSN. The node that has maximum remaining energy will be selected as a cluster head. If by chance the two nodes having the equal and same energy then cluster head will be selected/ chosed on the basis of distance. The node that has minimum/small distance from the base station will be selected as CH. The Simulation results show that the OLEACH-C protocol choose the best CHs that guarantee a route will optimized with the minimum energy consumption/taken and minimum communication links cost between each cluster .

In [7] Katiyar V et al: In this paper they discuss a Survey on Clustering Algorithms for heterogeneous Wireless Sensor Network. This Paper presents the impact of heterogeneity and study different clustering algorithms for heterogeneous WSNs highlighting their aim, complexity, objectives, features, etc. To expand the lifetime of a sensor network by reducing energy utilization clustering technique is used. It can also increase network scalability. Most of them are based on clustering. They are classified according to energy efficiency and stability of network. Finally conclude the applications of heterogeneous wireless sensor networks are more suitable as compared to the homogeneous wireless sensor network and more enhancement of network lifetime is there.

In [8] E Emary et al: In this paper they discuss a Flower Pollination Optimization Algorithm for Wireless Sensor Network Lifetime Global Optimization. As wireless sensor networks still struggling to extend its network lifetime , nodes clustering and nomination, or selection of cluster head node are proposed as solution. LEACH protocol is one of the oldest, best and remarkable clustering approaches that aim to cluster the network`s nodes and randomly elects a cluster head for each cluster. It selects cluster heads but it is not responsible for proper clustering formation. In this paper we use the Flower Pollination Optimization Algorithm (FPOA) to propose a WSN energy aware clustering formation making model based on the intra-cluster distances. The objective/aim is to achieve the global optimization for WSN network lifetime. Simulation results and performance analysis tells that applying flower pollination optimization on WSNs clustering is more efficient. It is effectively balance power utilization of each sensor node and hence extends WSN lifetime comparatively with the classical LEACH approach.

In [9] M Bani Yassein et al: In this paper they discuss a New Approach for Clustering in Wireless Sensors Networks Based on LEACH-C. LEACH-C is similar to LEACH protocol. In this, instead of nodes randomly self- selecting as a CH, the LEACH-C performs a centralized algorithm. The sink collects location data from the nodes and they broadcast its decision of which nods are to act as CH. The overall performance Of the LEACH-C is better than LEACH. But once the energy cost of communication with the sink becomes higher/greater than the energy cost for cluster formation, LEACH-C no longer provides good performance. Sinks may be situated far from the network in most of the

cases of WSN applications.

In [10] Fayez W. Zaki et al: In this paper they discuss a Multi-level stable and energy-efficient clustering protocol in heterogeneous wireless sensor networks and in clustering protocols in WSNs assume that all nodes are equipped with the equal/same amount of energy. In this paper, energy-efficient clustering (SEEC) and a stable protocol proposed for heterogenity. In addition to this, the extension to multi-level of SEEC is presented. It depends upon the structure of the network that is divided into clusters. Each cluster has a powerful advanced node and some normal nodes deployed randomly in this cluster. In the multi-level architectures, more powerful supper nodes are assigned to cover distant sensing areas. Each type of nodes has its role in the sensing, aggregation or transmission to the base station. The optimum/best number of powerful nodes achieves the minimum energy consumption of the network at each level of heterogeneity is obtained. Simulation results show that the proposed protocol provides a greater/longer stability period, observed more energy efficienct and higher/more average throughput than the existing protocols.

In [11] Neeraj Kumar et al: In this paper they discuss cluster-based data collection/aggregation architecture for structural health monitoring, and Mobile Computing in WSN. In the effective/effiecient use of Structural Health Monitoring (SHM), overwhelming data provision has another big problem. Data aggregation condenses/convert raw data into useful/meaningful information and reduces redundant/repeated data transmissions. Clustering is used in which the cluster is made while combining the sensor node and with the help of cluster head the data is transmitted to the base station and it enhances the efficiency and prolong the lifetime of wireless sensor network. Thus, significant energy and data storage have saved, and tasks can be completed more efficiently.

In [12] Vidya KS et al: In this paper they examined the Enhanced distributed Energy Efficient Clustering Scheme for heterogeneous Networks. This Paper described the optimizing the distributed energy efficient clustering scheme for heterogeneous networks. It contains three types of sensor nodes that is used to improve the stability of the wireless sensor network and to make longer the network lifetime. Sensor nodes are introduced that have extra energy as compared to NNs and ANs. So, that the energy level and heterogeneity of the entire network is increased. The result shows that the performance of EDEEC is better as compared to SEP.

III. PROTOCOLS

A. *Two Level SEEC Protocol*

SEEC is a stable and energy-efficient clustering (SEEC) protocol used for heterogeneous WSNs (HWSN). SEEC consist of two-level HWSN that combines the features of both energy efficiency oriented protocols and stability oriented protocols. Network is divided into clusters: AN (Advance node), aggregates all data. NN(Normal node), makes the sensing operation. The clusters are formed in the first round and do not change. Then, the consumption energy for all the NNs is restricted for sending the data only. Therefore, SEEC saves more energy than the others protocols. Also, the location of ANs affects the performance of the network; this implies that we achieve the balance of energy consumption of all nodes. SEEC is more efficient as it always prolongs the stability period, achieves longest life time and more energy efficient than the other protocols.

$$t = \begin{cases} \dfrac{P}{1 - P \times [r \bmod 1/P]} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Where p is the percentage of cluster; r is the number of rounds; G is the collection of nodes that have not yet been head nodes on the first 1/P rounds.

Fig. 3 shows a network model in which 3 sensor nodes described, first one is base Station which is stationary and other are NN and AN sensor node. The area network is divided into several clusters and AN act as CH for one cluster. With that CH are not changed until the cluster lifetime is dead.

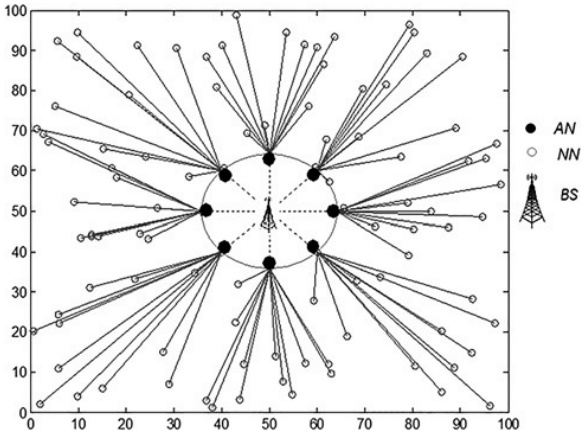

Fig. 3 Network Model[10]

Then, (2) formula interprets the optimal number of ANs in which it is directly proportional to the dimensions of the field and only depends on the number of nodes n1[10].

$$m_{\text{AN opt}} = 0.7668\sqrt{n_1} \tag{2}$$

Below shown formula (3), shows required energy for ANs and α is directly proportional with R_1^2 $(\alpha \propto R_1^2)$ and inversely proportional with d_{toAN}^2 $(\alpha \propto 1/d_{\text{toAN}}^2)$. [10].

$$\alpha \geq \left[\frac{n_A \cdot E_{\text{elec}} + n_A \cdot E_{\text{DA}} + E_{\text{elec}} + \varepsilon_{\text{fs}} \cdot R_1^2}{E_{\text{elec}} + \varepsilon_{\text{fs}} \cdot d_{\text{toAN}}^2}\right] - 1 \tag{3}$$

B. *Three Level M-SEEC*

MSEEC is a multi search engine for web documents with post processing capabilities to merge and condense information in the form of cluster trees. Most processing steps of MSEEC can be controlled through parameters. The query interface of MSEEC accepts a query consisting term, parameters for multi search engines and various parameters controlling the cluster generation.

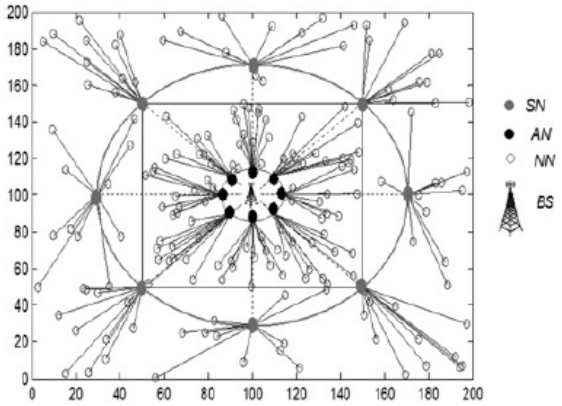

Fig. 4 Three Level Heterogeneity Network Model [10]

Fig. 4 depicts network model, having three level heterogeneity that means three types of sensor nodes Advanced Nodes, Normal Nodes and Super Nodes. In Fig. 4 the nearest nodes towards base station is Advanced node which sends aggregated data from Normal node to base station. Normal node only aggregate and forward to advanced node and at the outer circle these are super nodes, helps in aggregation of data from different locations.

$$E_{\text{total}} = n \cdot E_0 + m_{\text{AN}} \cdot (1+\alpha) \cdot E_0 + m_{\text{SN}} \cdot (1+\beta) \cdot E_0 \tag{4}$$

(4) formula shows the total energy of the three level hetereogeneous network. Advanced nodes have more energy rather than normal node.

$$R_{i-1} = \frac{\sqrt{2}}{0.765} R_{i-2} \tag{5}$$

In above formula (5), i shows the level of heterogeneity, each level is calculated by this formula.

$$m_{\text{SN opt}} = 0.7668\sqrt{n_2} \tag{6}$$

(6) tells about the optimal number of super nodes require in the network. We used super node like that it takes minimum energy consumption in the network.

$$\beta \geq \left[\frac{n_{\text{SN}} \cdot E_{\text{elec}} + n_{\text{SN}} \cdot E_{\text{DA}} + E_{\text{elec}} + \varepsilon_{\text{fs}} \cdot R_2^2}{E_{\text{elec}} + \varepsilon_{\text{fs}} \cdot d_{\text{toSN}}^2}\right] - 1 \tag{7}$$

IV. CONCLUSION

New SEEC for HWSNs is proposed in this paper. The sensing area consists of a fixed number of clusters and fixed CH for each cluster. Each cluster has a powerful AN and some NNs deployed randomly in this cluster. This guarantees the fair distribution of energy. This protocol is extended to multi-level HWSN. M-SEEC assigns more powerful nodes called SNs to cover the distant parts of the sensing area. The performance of our protocol in its cases SEEC and M-SEEC is compared by the existing two-level and three-level protocols; respectively. The proposed protocol provides high throughput, prolongs the stability period of the network, consumes less energy, and provides less overhead than the existing homogeneous and heterogeneous protocols. In our paper we are laying stress to increase the network life time and for the improvement of performance of existing protocol further we will use Pollination based optimization and increase the heterogeneity level.

REFERENCES

[1] Zheng, Jun, and Abbas Jamalipour. “Wireless sensor networks: a networking perspective” John Wiley & Sons Publications, 2009.

[2] Tripathi, Anand Mohan, and P. Velmurugan. "An Improved Stable Election Based Routing Protocol with Threshold Sensitiveness for Wireless Sensor Network." International Journal of Computer Science and Mobile Computing, Vol.3 Issue.5, May- 2014, pg. 280-287.

[3] Chen, Jong-Shin, Zeng-Wei Hong, Neng-Chung Wang, and San-Heui Jhuang. "Efficient cluster head selection methods for wireless sensor networks."Journal of Networks Journal, Vol 5, No 8 (2010), 964-970, Aug 2010.

[4] Ramesh, K., and Dr K. Somasundaram. "A comparative study of clusterhead selection algorithms in wireless sensor

networks", International Journal of Computer Science & Engineering Survey (IJCSES) Vol.2, No.4, November 2011.

[5] Al Islam, ABM Alim, et al. "Stable sensor network (ssn): a dynamic clustering technique for maximizing stability in wireless sensor networks."Wireless sensor network 2.07 (2010): 538.

[6] Kaur, Gaganpreet, Dheerendra Singh, and Sukhpreet Kaur. "Pollination based optimization for feature reduction at feature level fusion of speech & signature biometrics." Reliability, Infocom Technologies and Optimization (ICRITO)(Trends and Future Directions), 2014 3rd International Conference on. IEEE, 2014.

[7] Katiyar, Vivek, Narottam Chand, and Surender Soni. "Clustering algorithms for heterogeneous wireless sensor network: A survey." International Journal of Applied Engineering Research , 2010, pp. 273-287.

[8] Sharawi, Marwa, et al. "Flower pollination optimization algorithm for wireless sensor network lifetime global optimization." International Journal of Soft Computing and Engineering Vol- 04, Issue-03, pp. 54-59, 2014

[9] Xiangning, Fan, and Song Yulin. "Improvement on LEACH protocol of wireless sensor network." Sensor Technologies and Applications, SensorComm 2007. International Conference on. IEEE, 2007.

[10] Farouk, Fifi, Ramy Rizk, and Fayez W. Zaki. "Multi-level stable and energy-efficient clustering protocol in heterogeneous wireless sensor networks" Wireless Sensor Systems, IET Vol- 04, Issue-04, pp. 159-169, 2014.

[11] Mishra, Neeraj Kumar, Vikram Jain, and Sandeep Sahu. "Survey on recent clustering algorithms in wireless sensor networks." International Journal of Scientific and Research Publications, Vol- 03, Issue-04 ,2013.

[12] Vidya, K. S., and M. Arun Anoop. "Lifetime Enhanced Cluster Based Routing in Wireless Sensor Networks." International Journal of Engineering Science Invention, Vol- 02, Issue-07, pp. 69-72, 2013.

[13] Javaid, N., Qureshi, T., Khan, A., Iqbal, A., Akhtar, E., Ishfaq, M.: 'EDDEEC: enhanced developed distributed energy-efficient clustering for heterogeneous wireless sensor networks', Proc. Comput. Sci. , 19, pp. 914–919, 2013.

[14] Ali, M., Dey, T., Biswas, R.: 'ALEACH: advanced LEACH routing protocol for wireless microsensor networks'. Proc. Fifth Int. Conf. on Electrical and Computer Engineering (ICECE), pp. 909–914, .

Authors Profile

Mr. Atul Rana pursed Bachelor of Computer Science Engineering from Punjab Technical University, Punjab in 2012. He is currently pursuing masters and currently working as Executive in IT sector in reputed company, Punjab. He has 4 years experience in IT sector.

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