International Journal of Future Generation Communication and Networking
Vol. 13, No. 4, (2020), pp. 571–580

# Load balancing and Bandwidth Optimization using EECP in Wireless Sensor Network with minimum energy

Yogesh Suresh Gunjal
Research Scholar
Shri. JJT University
Jhunjhunu (Rajasthan) Churella,

Yogesh Kumar Sharma
HOD, Research coordinator
Shri. JJT University
Jhunjhunu (Rajasthan)

Satish Ramchandra Todmal
Academic Dean
JSPM's Imperial College Churella,
Engineering and Research,
Pune, Maharashtra

***Abstract:***

*Wireless sensor networks (WSNs) have a broad variety of uses including traffic control, environmental tracking, manufacturing process tracking, and operational systems. Large-scale networks of wireless sensors have an expectation that it will play an increasingly significant role in future military and civilian use. Owing to low battery capacity and insufficient bandwidth with proper Load Balancing, developing protocol for wireless sensor network is a difficult task. To this end, a new approach for the processing of hierarchical data is introduced, known as the Energy Efficient Clustering Protocol (EECP). The approach of EECP aims at accomplishing the following goals: to reduce the overall energy usage by the network and to balance the energy dissipation between sensor nodes. The cluster heads as a matter of fact are determined in a better manner and properly distributed in the field of interest, allowing the participant nodes to meet the others with such an effective energy dissipation and proper use of load balancing. Alternatively, for a specified amount of time, the radio nodes are turned off according to sleep control guidelines for their energy consumption. In this paper we first outline the properties of the sensor network which are critical for the design of the EECP protocol. Finally, with respect to EECP protocols, we point out the problem of open testing. A consistency examination of the recommended procedure is performed on the famous simulator, NS2. Thus, during simulation process the sensor nodes residual energy was determined to determine the total number of live nodes per 20s.*

***Keywords:*** *WSN, Cluster, Energy efficient Clustering Protocol (EECP), Energy Efficient.*

## I. Introduction

In Networks of Wireless Sensor devices are being deployed to collectively monitor and disseminate information about a variety of phenomena of interest. A wireless sensor unit which is lightweight battery-operated computer having the capability of detecting physical ambient sizes and transmitting to a base station, the associated information. Advancement of integrated circuit design are increasingly responsible for reduction of scales, expense and weight of sensor devices while increasing their sensitivity and accuracy [1] at the same time. At the same time, new wireless networking systems allow for a vast number of such devices to be organized and networked [2]. A Wireless Sensor Network (WSN) consists of a wide number of mutual sensor nodes working to accomplish a shared goal. One or more sinks (base stations) are dedicated to storing and transmitting the data from all sensor nodes to the end user. This sink forms the mechanism by which the WSN communicates with the outside world. While nodes are capable of self-organizing and coordinating to create and sustain the network [3], they are operated by batteries, constrained in terms of computation, storage, and communication capacity. Challenges in WSN occur as many networks are deployed, there are too many controllable and uncontrollable parameters [4] which may seriously affect the operation of the wireless sensor network, such as energy conservation. These networks are gradually being considered for application in many areas of our everyday life. They are implemented in many fields with diverse implementations, from which we can cite: tracking of weather or volcanic eruption, infrastructure management, monitoring of health care and monitoring of industrial



ISSN: 2233-7857 IJFGCN

plans. A WSN is a network composed of a large number of sensor nodes sensing the environment and likely transmitting this information to one or more aggregation points called sink over several hops. Data is transmitted via wireless links. An example of a WSN is shown here. The sensor node contains one or more capture modules, a processing unit, a wireless transceiver and a power source as seen [10].

On wireless networks, the Bandwidth and Load balancing is shared between the clients, which mean that the available Bandwidth and balancing Load on network always fluctuates due to which we need to use the clustering Technique with load balancing [11].

The routing algorithms for WSNs have a very large design space and can categorize the routing algorithms for WSNs in various ways. Protocols for routing are known as center-node, data-center or location-aware protocols and QoS-based protocols for routing. Most Ad-hoc network routing protocols constitute no decent protocols that specify targets based on number node (or identification) addresses. In a geographical area, the routing nodes know where they are. Location information may be used to boost routing efficiency and to supply new service types. Data supply, latency and energy consumption are primarily taken into account in the QoS-based routing protocol. The routing protocols must have more data supply, fewer latencies and lower energy consumption if they are to achieve good service quality. It is also possible to classify protocols based on if they are reactive or proactive. A proactive protocol establishes routing paths and specifies them prior to a routing demand exists. There is even no traffic flow at the time, paths are maintained. Routing actions are triggered with reactive routing protocol when data is also to be transmitted and distributed to other nodes. When inquiries are launched, paths are setup on request here. Usually, WSNs consist of sensor nodes which senses the data and transports it to the sink node. The reason for this function is a jointly controlled, common sensor network system, used simultaneously, for example, for multiple systems in a building where sensors are installed in each room and the role of which is to detect data such as ambient temperature or light or acoustic monitoring conditions. This network is used simultaneously with numerous applications, including one that tracks temperature in office and computer rooms and one that measures light use. The relative importance of sensor data sources in such sensor applications also depends on the nature and values of the data being sensed, and how the data from various sensor sources interact with each other [10].

There is a requirement to use a bandwidth allocation method to assimilate the network bandwidth to streams of the sensors in the shared sensor network infrastructures. When a group of known nodes nearby all detect events of interest, the assignment method has to manage traffic which shows high levels of spatial correlation. Based upon the observed phenomenon it must be able to adjust the network bandwidth allocations.

Increased efforts to design and grow the wireless sensors network are becoming increasingly important with the advancement of wireless communication technologies: low-powered architectures, low-sensing interfaces, efficient access of wireless media and dynamic routing protocols, services quality and load balance services [11].

**Characteristics of a WSN include**

- Imperatives of power consumption for nodes which use batteries or collect electricity. Supplier instances include ReVibe Energy and Perpetum
- Adaptability to node faults (resilience)
- Any nodal mobility (see MWSNs for highly mobile nodes)
- Nodal heterogeneity
- Nodal homogeneity
- Scalability of delivering to large scale
- Capability to survive extreme ecological conditions
- Ease of utilization
- Cross-layer streamlining

## II. Objectives:



ISSN: 2233-7857 IJFGCN

i. To analyze the existing Wireless Sensor Network technologies available.
ii. To compare the existing algorithm related to Load Balancing and Bandwidth Optimization.
iii. To design a Load Balancing and Bandwidth Optimization algorithm that would perform better than the existing ones.
iv. To implement a Load balancing and Bandwidth Optimization algorithm using simulator.
v. To compare the experimental results of the implemented algorithm with the existing algorithms.

## III. Proposed work:

WSNs are confronted with different problems, such as: the coverage of the area of interest that sensors monitor or track, the distance measurement problem between sensor positions, sensors energy conserving problems that actually affect the achievement of the WSN mission, safety information, and vulnerability that can lead to end-users' problems. The main challenge in WSN, therefore, is the power issue, because the actual technological progress in the battery design provides poor node energy budgets. In contrast to sensing and data processing, most node energy is used in the transmission and receipt of data. Here, we suggest the Energy-Efficient Clustering Protocol EECP Protocol with data collection and QoS. The aim is to improve the equilibrium of large WSN clusters and achieve clusters so that each one will have the lowest energy consumption topology and quality of service, such as delays, error data and performance data. There are many requirements for our clustering algorithm: a clustering algorithm must be fully distributed, and a central control approach cannot be possible within a large WSN [10].

• The cluster heads must be spread across the entire monitoring region in order to ensure that power usage is equalized across all sensor modules.

• Energy efficiency should be the clustering algorithm itself.

• The heterogeneous energy circumstance needs a clustering algorithm. It is actually difficult to ensure that all nodes have the same battery capacity.

• Service quality is based on multi-hop wireless sensor network routing algorithms. Research proposes a routing protocol to provide QoS that represents changes in the reliability and delay of the network status, even in circumstances where node resources are lacking.

Our algorithm’s advantage is that it minimizes routing control messages and can work in a safe and energy-efficient manner.

### Energy efficient Clustering Protocol (EECP) Proposed Protocol:

The design of the network is one of the key factors which improve the life of the WLC. The proposed EECP approach is outlined in this section. The EECP approach uses a clustering system for energy efficiency. An energy efficiency system is referred to as a cluster system when the no. of clusters differs over time and the number of modules evolves. In EECP, the energy and communication residues of the BS are assumed to be unlimited. The BS is also believed to be located in or far from the sensor field at a fixed position. CH (Cluster-head) for containing data overload will serve as modules with special high-condition (Pch). All nodes can instead switch to CH to avoid early death due to overly costly resources. The option of CH must therefore address several factors. The following must be considered in the EECP: node-weight, residual energy, node-to - node distance and BS distance. The EECP protocol ensures that clusters are properly distributed (unresolved issue with many protocols) [10].

The cycles of "rounds" are pre-determined. The six round comprises of initialization, next door exploration, pch time, final election CH phase, cluster creation and transmission phase. Each round is composed of six phases.

### Cluster Formation Phase

Follow the cluster forming one after the election process. The CHs transmit Adv Msg to their neighboring nodes in this level. When you get Adv Msg, you have to estimate other non-CH nodes by using Join cond I CHj) then add a Join Msg cluster to your respective CH. Through Eq. (01).



ISSN: 2233-7857 IJFGCN

$$Join_{cond(CH,j)} = Max\left(1 - \frac{Pchj}{D_{i,chj} + D_{chj,bs}}\right) \quad \text{Eq. (01)}$$

Where Chj, bs is the Base Station distance from Chj.

Di, chj is the distance between node I and chj.

Joincond(CH, J) — the node of Max, Pchj — the node that has the larger and closer CH pch, the bs + Di, the CHj — the node of Min allows the choosing of the CH with the larger Pch.

In reality node clusters have been commonly employing to enable faster efficiency and scalability through wireless sensor network applications as a consequence of inherent resources constraints in interaction and power consumption. Clustering gives an effective and scalable network design to organize modules into hierarchies. The hierarchical structures are built with various cluster approaches on specific network layers like the data link node and the network layer. Clustering has various uses in enhancing the efficiency of the wireless sensor network. Clustering preserves local network traffic, reducing energy dissipation and stored information routing at every sensor. This decreases the number of transmitters. EECP clusters can enhance power efficiency by using cluster heads (CHs) to carry out summation between the team members of local data and activity planning. Inactive participants resting or low-energy activities. Clustering also decreases maintenance costs in terms of topology as a result of complex topology changes. To order to be sensitive to changes to complex phenomena, a cooperative system must be configurable and adaptable. Just the cluster head stage is the topological reconfiguration of the clustered network and doesn't affect the local cluster modules [11].

This minimizes the overhead of adaptation of dynamic topology,

• EECP provides resource use optimization and has been proven successful to save time and resources. The configuration represents mainly the use of clustering techniques for assigning tasks and resources.

• EECP also increases scalability: large, unstructured ad hoc networks clustered into nicely structured groups to meet the various application requirements [10].

**IV. Simulation:**

In this section we test the efficiency of the proposed EECP via several simulation experiments. The configuration of the simulation is explained at first, and the effects are then discussed.

50 nodes are distributed evenly and arbitrarily in an area of size 200 m 200 m in the example. Research the impact of scale on EECP results. We believe the BS is in the middle of the region. The other parameters for the simulation are summarized in Table 1,

| **Parameter** | **Value** |
|---|---|
| Area | 200 m × 200 m |
| Data packet siz | 4000 bits |
| Control packet size | 512 bits |
| Number of sensor nodes | 10/20/30/40/50 |
| Base station location | (50, 50) |
| Distance d0 | 87 m |
| Eelec | 50 nj/bit |

Performance Analysis of proposed system model namely **Energy efficient Clustering Protocol** (EECP) in WSN Network is evaluated and compared with AODV routing protocol based on Packet Delivery Ratio, Processing Delay , throughput and energy consumption to verify & how efficiently the implementation is carried out with proposed method [11].



ISSN: 2233-7857 IJFGCN

Following figure shows the outcome of our proposed model by using clustering method for sharing the information with proper bandwidth,

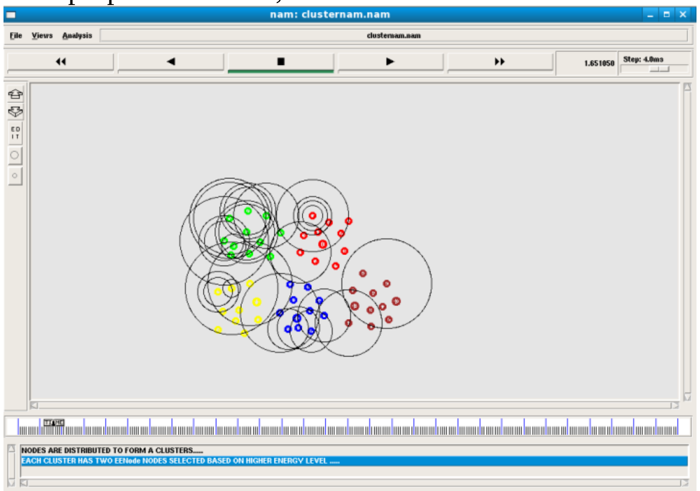


**Figure01: Cluster formation using our proposed method**

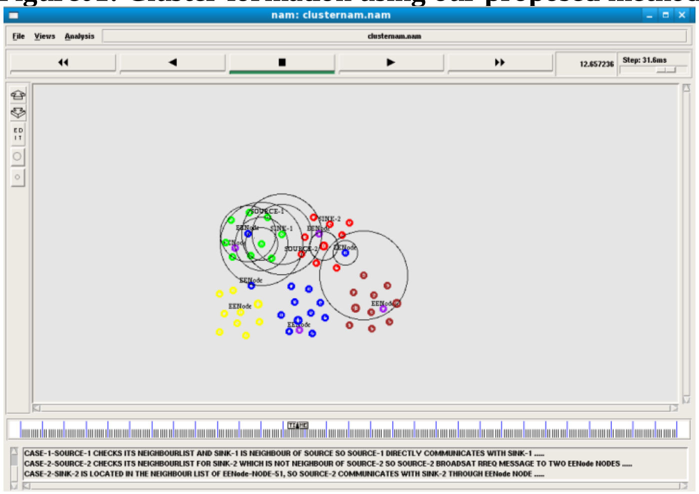


**Figure02: Energy efficient Clustering Node**

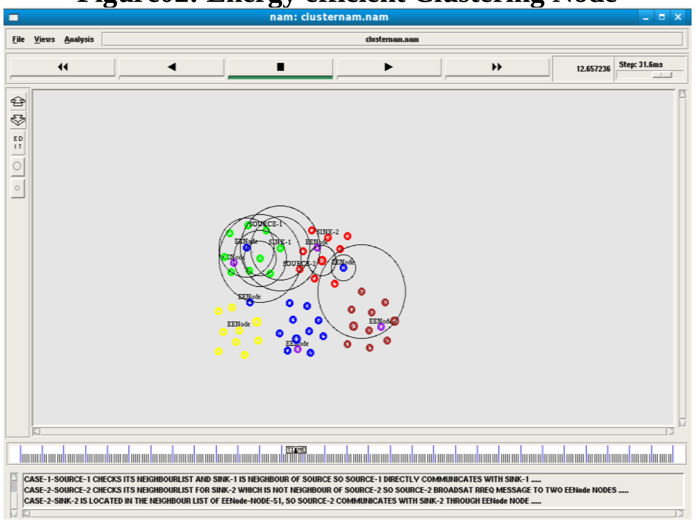


**Figure03: EECP based Broadcasting Messages**



ISSN: 2233-7857 IJFGCN

### 4.1 Simulation Result

Evaluate the proposed approach, namely **Energy Efficient Clustering Protocol (EECP)** performance in different network scenarios in terms of node moving speed, with different bandwidth and energy consumption. In this simulation, the number of multicast destinations is set from 5 to 20 radio nodes with proper bandwidth so can get maximum outcome. The traffic-generating rate is 10 packets per second.

**Packet Delivery:**

In this session we are going the calculate the performance on the basis of packet movements. Below Figure 04 illustrates the latency per packet over the number of nodes; the simulation results show that EECP protocol offers better results in terms of reduction of latency than other protocols like DEEAC and FEMCHRP

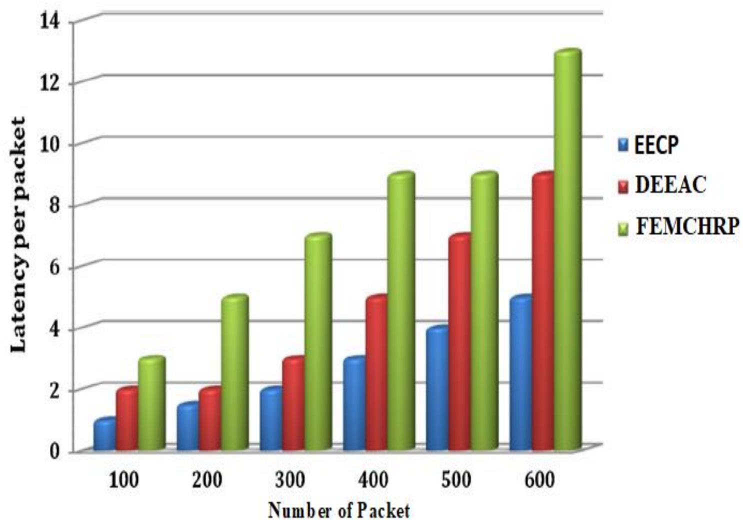


**Figure04: Latency per packet over number of nodes**

In below Figure 05 show the packets access from per cluster file where,

Number of packets = file size/packet size.

Time = function of number of packets, this figure illustrates EECP protocol with number of packets sending (4 pack/s, 16 pack/s, 32 pack/s).

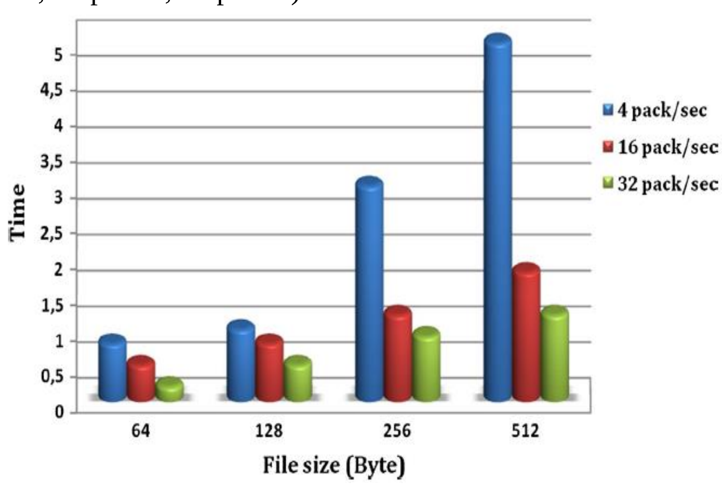


**Figure 05: Transmission time in different number of packets**



ISSN: 2233-7857 IJFGCN

Figures 06 and 07 show the results for the energy consumed by sensor nodes in EECP, DEEAC and FEMCHRP protocols. The energy consumed by sensor nodes for each round in EECP is much lower than that in DEEAC and FEMCHRP.

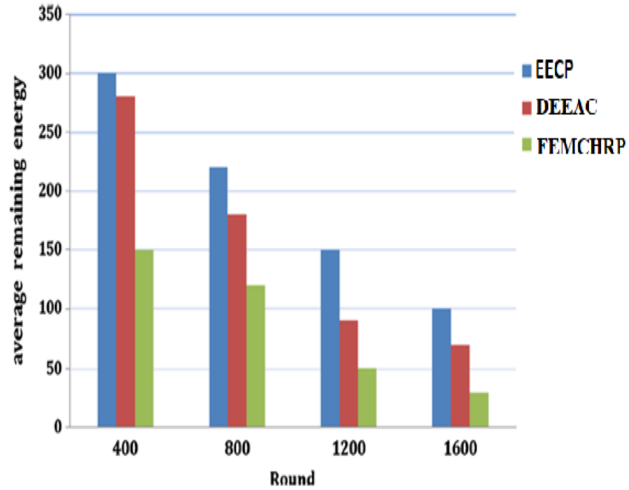


**Figure 06: Average remaining energy**

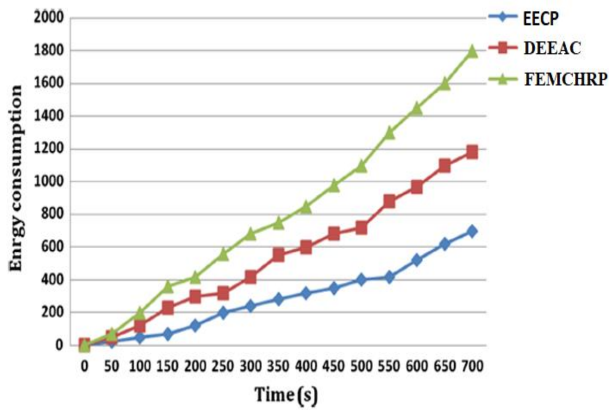


**Figure 07: Comparison of energy consumption**

As per the data provided in these statistics, EECP's energy consumption is less when compared to the other two protocols, as cluster heads are regularly selected as per their combination of residual gap of energy between BS and node in this protocol, weight-node is the number of neighbouring nodes, such as proximity of the node to their neighbours or node degree. The key explanation for this finding is the appropriate number of clusters in the network and their distribution. As predicted, FEMCHRP has variable energy consumption in consecutive rounds which is important to the pendulous number of its clusters. While DEEAC has reasonably spread clusters throughout the network, as the number of clusters in DEEAC is high, energy usage is growing across the entire network. Therefore, EECP has the energy use which is the lowest of the 2 protocols and, in comparison to the other protocols, has more energy utilization. Other big factor EECP uses inter and intra-clusters multihop communication. -- ordinary node is scanned by its parent node directly and the data is transmitted to its parent node before the cluster head is hit by the data and a multihop connection among the base station and cluster head. Figures 04, 05 display the total energy remaining per round and this total energy remaining per round is larger in EECP than in DEEAC. The following conditions must be taken into consideration in order to obtain a successful result by using the alternative process:



ISSN: 2233-7857 IJFGCN

• Low tariff cycle operation is widely carried on indoor settings, where every node regularly switches from sleeping to awakened mode to save energy consumption.
• Clustering means dividing the nodes of the sensors into groups based on certain characteristics. Clusters are generally formed on the basis of location and the residual value of energy. Clustering in wireless sensors is a popular method to address the high density of nodes and the efficient conservation of energy Networks.
• Selection of the Head Cluster Metric.
• In several proposals, intercluster (and intra-cluster) communication is obtained by organizing a hierarchy of cluster heads, which will allow a better power distribution and total energy consumption.
• The aggregation of data was proposed as an important approach for the wireless routing of sensor nodes. The goal is to incorporate information from different sources to minimize redundancy, reduce transmission numbers and save resources.

## V. Conclusion:

In Energy exhaustion nodes in Wireless Sensor Networks in which devices have a relatively small energy cost with a usable non-chargeable battery must be eliminated. This unexpected energy failure could result in the successful completion of the network mission. This also applies if a sensor node sends incorrect information under an acceptable energy threshold. Thus, the issue of energy is increasingly attracting the attention of researchers so that sensor nodes can save as long as possible their energy consumption. That is the aim of our EECP proposal. Specific new measurements (assigning weight to a node, a predetermined node threshold, and a load balance) were used to ensure a powerful divide between nodes, thus enhancing the life of the system. The findings were obtained with the implementation of multi-hop intercluster routing. In the EECP, a well spaced clustered WSN with correct size clusters is used to separate the cluster heads. Several simulation scenarios have been conducted and the EECP findings outperform those provided by reference protocols. By using proposed method, able to maintain the bandwidth optimization with minimum energy utilization.

## References:

1. Ahmed Younes, “Multicast routing with bandwidth and delay constraints based on genetic algorithms”, 1110-8665 _ 2011 Faculty of Computers and Information, Cairo University.
2. Ali Amiri a,b, Reza Barkhi, “The combinatorial bandwidth packing problem”, 0377-2217,2010 Elsevier.
3. Allen L.Ramaboli n, OlabisiE.Falowo,AnthonyH.Chan, “Bandwidth aggregation in heterogeneous wireless networks: A survey of current approaches and issues”, Journal of Network and Computer Applications 35 (2012) 1674–1690.
4. Ameen M.Alkharasani n, MohamedOthman, “M2I2tswTCM:A new efficient optimization marker algorithm to improve fairness bandwidth in DiffServ networks”, 1084-8045, 2012.
5. Amjad Mehmood1, Akbar khanan2,3 ,Muhammad Muneer Umar5 , Salwani Abdullah1, Khairul Akram Zainol Ariffin2, Houbing Song4 ,” Secure Knowledge & Cluster-based Intrusion Detection Mechanism for Smart Wireless Sensor Networks”, 2169-3536 (c) 2017 IEEE.
6. Ashish Talikoti, Jayashree A. , “Bandwidth and Energy Management in Wireless Sensor Networks”, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 1, Issue 8, October 2012.
7. Awati J.S., Patil V.S. And Awati S.B: “Application of Wireless Sensor Networks for Agricultural Parameters” in the proceedings ofInternational Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 4, Issue 3, 2012, pp-213-215, April 03,2012.



ISSN: 2233-7857 IJFGCN

8. Ayhan Akbas, Huseyin Ugur Yildiz, Bulent Tavli, and Suleyman Uludag, “Joint Optimization of Transmission Power Level and Packet Size for WSN Lifetime Maximization”, 1530-437X (c) 2015 IEEE.
9. Bora Karaoglu, Member, IEEE and Wendi Heinzelman, Senior Member, IEEE , “Cooperative Load Balancing and Dynamic Channel Allocation for Cluster-Based Mobile Ad Hoc Networks”, IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 14, NO. 5, MAY 2015.
10. Atul B Kathole, Dr.Dinesh N.Chaudhari, “Pros & Cons of Machine learning and Security Methods ”, 2019.http://gujaratresearchsociety.in/index.php/ JGRS, ISSN: 0374-8588 ,Volume 21 Issue 4
11. 12.Atul B Kathole, Dr.Prasad S Halgaonkar, Ashvini Nikhade, “ Machine Learning & its Classification Techniques ”,International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-9S3, July 2019.
12. Bret Hull, Kyle Jamieson, and Hari Balakrishnan, Bandwidth Management in Wireless Sensor Networks, in the proceedings of 1st international conference on Embedded networked sensor systems, Pages 306 – 307, New York, NY, USA, 2003.
13. Lindsey, S., Raghavendra, C.: PEGASIS: power efficient gathering in sensor information systems. In: International Conference on Communications, pp. 1125–1130 (2001)
14. Chatterjee, M., Das, S.K., Turgut, D.: WCA: a weighted clustering algorithm for mobile ad hoc networks. J. Cluster Comput. **5**, 193–204 (2002)
15. Liu, M., Cao, J., Chen, G., Wang, X.: An energy-aware routing protocol in wireless sensor networks. Sensors (Basel) **9**(1), 445–462 (2009)
16. Nurhayati, Choi, S.H., Lee, K.O.: A cluster based energy efficient location routing protocol in wireless sensor networks. Int. J. Comput. Commun. **5**(2), 67–74 (2011)
17. Wang, H., Zhang, X., Nait-Abdesselam, F.: Cross layer optimized MAC to support multi hop QOS routing for wireless sensor network. IEEE Trans. Veh. Technol. **59**(5), 2556–2563 (2010)
18. Keming, D.U., Yang, Y.: A QoS routing for maximum bandwidth in ad hoc networks. In: Second International Conference on Future Networks, pp. 343–345 (2010)
19. Jasani, H.: Quality of service evaluations of on demand mobile ad hoc routing protocols. In: Proceeding
International Conference on, Next Generation Mobile Applications, Services and Technologies, pp. 123–128 (2011)
20. Athreya, A.P., Tague, P.: Towards secure multi-path routing for wireless mobile ad-hoc networks: a cross-layer strategy. In: 8th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, pp. 146–148 (2011)
21. Shao, X., Wang, C.-X., Rao, Y.: Network coding aware QoS routing for wireless sensor network. J. Commun. **10**(1), 24–32 (2015)
22. Rana, S., Bahar, A.N., Islam, N., Islam, J.: Fuzzy based energy efficient multiple cluster head selection routing protocol for wireless sensor network. Int. J. Comput. Netw. Inf. Secur. **5**, 54–61 (2015)
23. Sajjanhar, U., Mitra, P.: Distributive energy efficient adaptive clustering protocol for wireless sensor networks. In: Proceedings of the International Conference on Mobile Data Management, pp. 326–330 (2007)
24. Weng, C.-E., Lai, T.-W.: An energy-efficient routing algorithm based on relative identification and direction for wireless sensor networks. Wireless Pers. Commun. **69**(1), 253–268 (2013)
25. Safia, A.A., Aghbari, Z.A., Kamel, I.: Phenomena detection in mobile wireless sensor networks. J. Netw. Syst. Manag. **24**(1), 92–115 (2016)



ISSN: 2233-7857 IJFGCN

26. Gherbi, C., Aliouat, Z., Benmohammed, M.: An adaptive clustering approach to dynamic load balancing and energy efficiency in wireless sensor networks. J. Energy **114**, 647–662 (2016)
27. Palani, U., Alamelumangai, V., Nachiappan, A.: Hybrid routing and load balancing protocol for wireless sensornetwork. Wirel. Netw. **22**(8), 2659–2666 (2015)
28. Cheng, Y., Xie, J.H., Yang, Z.M.: The clustering analysis method of the learning characteristics based on the virtual learning community. Int. J. Inf. Educ. Technol. **7**(1), 66–70 (2016)
29. Darabkh, K.A., Ismail, S.S., Al-Shurman, M., Jafar, I.F., Alkhader, E., Al-Mistarihi, M.F.: Performance evaluation of selective and adaptive heads clustering algorithms over wireless sensor networks. J. Netw. Comput. Appl. **35**(6), 2068–2080 (2012)
30. Niu, W., Lei, J., Tong, E., Li, G., Chang, L., Shi, Z., Ci, S.: Context-aware service ranking in wireless sensor networks. J. Netw. Syst. Manag. **22**(1), 50–74 (2014)



ISSN: 2233-7857 IJFGCN