2021 7th International Conference on Advanced Computing & Communication Systems (ICACCS)

Improved Cluster Head Selection for Data Aggregation in Sensor Networks

G.A.Senthil[1], R.Prabha[2], D.Roopa[3], D.Vijendra Babu[4], Su.Suganthi[5]
[1]*Research Scholar, Vels University,*
[2,3,5]*Sri Sai Ram Institute of Technology,*
[4]*Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation*
[1]senthilga@gmail.com

2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS) | 978-1-6654-0521-8/20/$31.00 ©2021 IEEE | DOI: 10.1109/ICACCS51430.2021.9442048

Abstract **- Wireless Sensor Networks (WSN) are a difficult rising innovation because of their degree, low preparing power, and related low vitality. WSN directing contrasts from traditional steering in fixed systems. It needs foundation, has untrustworthy remote connections, sensor hubs may come up short and directing conventions need to meet extreme vitality sparing prerequisites. Information total in WSN successfully spares restricted assets. The objective of information total calculations is assembling and collecting information in a vitality proficient way so organize life is improved. Bunching is utilized to expand a sensor organize life by diminishing vitality utilization. This examination proposes a superior bunch head choice in sensor systems for proficient information collection. The proposed calculation depends on Local hunt and consolidated in Low Energy Adaptive Cluster Hierarchy protocol (LEACH).**

Keywords:Wireless Sensor Networks, Low Energy Adaptive Cluster Hierarchy protocol, Clustering, Cluster Head Selection, hierarchical clustering, Routing Protocol, Residual energy,multi hop-access.

I. Introduction

WSNs are hub assortments where each hub has its own sensor, processor, transmitter, and recipient. Such sensors are ease gadgets playing out a particular detecting task. Being of minimal effort, they are conveyed thickly all through a territory to screen explicit occasions [1]. Ongoing advances in "Micro-Electro-Mechanical Systems (MEMS) innovation, computerized hardware, and remote interchanges lead to the improvement of minimal effort, low-power, multifunctional sensor hubs little in size and imparting undeterred in short separations". Sensor systems are a significant improvement over customary sensors conveyed in the accompanying manners [2]: Sensors are situated a long way from a real marvel, i.e., something known by sense discernment. So enormous sensors with complex strategies are required to recognize focuses from ecological clamor. Sensors performing just detecting are conveyed. Their positions and interchanges topology are deliberately built. They transmit time arrangement of a detected marvel to focal hubs. Here, calculations are performed, and information combined [3]. Information conglomeration gathers and totals helpful information and is a crucial preparing method to spare WSN vitality. It is a viable method to spare restricted assets. The objective of information accumulation calculation is assembling and amassing information in a vitality proficient way to improve arranges life. WSNs have constrained computational force, memory, and battery power, so expanded application creates multifaceted nature which brings about applications firmly combined with arrange conventions [4].Data aggregation explains information driven directing implosion and cover issues. Information from numerous sensor hubs is totalled when they arrive at the equivalent steering hub enroute to the sink. Information collection is a WSN strategy. Security issues, information privacy, and trustworthiness become essential when a sensor organize is in a threatening situation. Information collection totals sensor information utilizing accumulation approaches [5]. Many routing algorithms were built up for remote systems [6]. WSN steering is trying because of highlights that separate them from different remote systems (portable specially appointed systems or cell systems).

Due to numerous hubs in these systems and the noteworthiness of overhead of ID upkeep, a world-wide tending to plot is outlandish for sensor hubs plan, in this way regular IP based conventions can't be utilized. Compared to different systems, all sensor organize applications need stream of detected information from various sources to explicit BS yet this doesn't forestall information stream in different structures. As sensor hubs are firmly solidified with respect to vitality, preparing, and capacity limits, they need cautious asset the executives systems where hubs are allowed to move, bringing about erratic and successive topological changes. Be that as it may, a few applications grant sensor hubs to move and change area.

978-1-6654-0521-8/21/$31.00 ©2021 IEEE

As information assortment depends on the spot, acknowledgment of sensor hubs position is significant. As information gathered by numerous WSN sensors depends on basic physical procedures, there is a high likelihood that information is excess. Remote systems directing calculations are topology based which is a customary methodology where sending choices depend on data about current accessible connections between arrange hubs [7]. Proactive steering systems: These track directing data of every single accessible way in any event, when they are not utilized, yet this procedure doesn't perform well when organize topologies change powerfully. Reactive directing procedure: This tracks just courses as of now being used because of gadget versatility or exchanging vitality saving rest cycles. WSN directing contrasts from regular steering from various perspectives for example there is no foundation, sensor hubs may fall flat, remote connections are questionable, and steering conventions meet precise vitality sparing prerequisites. Steering calculations are delegated [8]: Topology-based: Routing calculations with have based tending to perform start to finish message conveyance Position-based: If a goal is given by an ID or if goal is a geographic area. Data-driven: this depends on inquiries gave by a sink hub to demand information. Solicitations are not routed to specific sensor hubs, yet they convey mentioned information and answer the inquiry [9].

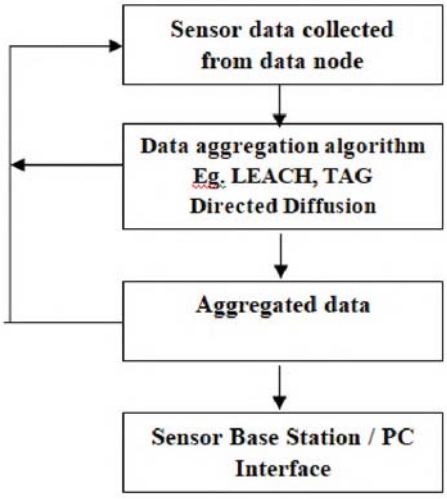

Fig 1. Architecture of data aggregation

Bunching broadens a sensor system's life by decreasing vitality utilization [10]. A sensor arrange is adaptable by shaping groups. A bunch chief is alluded to as Cluster Head (CH). A CH is chosen by a group's sensors or pre-appointed by a system planner. Many bunching calculations were explicitly intended for WSNs for versatility and effective correspondence. The group based steering idea performs vitality proficient directing in WSNs. In a progressive engineering, higher vitality hubs (CHs) process and send data while low vitality hubs perform detecting. Low Energy Adaptive Cluster Hierarchy convention (LEACH) [11], PEGASIS [12], APTEEN [13] and TEEN [14] are some grouping calculations.

i. Clustering lessens directing table size put away at singular hubs by confining a course set up in a group.
ii. Clustering rations correspondence data transfer capacity as it limits extent of between group collaborations to CHs keeping away from excess message trade among sensor hubs.
iii. CH can drag out individual sensors battery life and system life by executing enhanced administration methodologies.
iv. Clustering cuts on topology support overhead. Sensors care to associate with their CHs.
v. A CH performs information collection in its bunch and diminishes repetitive parcels.
vi. A CH lessens vitality utilization rate by booking exercises in a bunch [15].

Examination of different CH determination methodologies with respect to their help with CH choice, parameters utilized, required Re-Clustering (RC), even or reasonable Distribution of CHs (DCH), required bunch development and Creation of Balanced Clusters (BCC) guarantee a more extensive comprehension [16].

A bunch based steering convention is a gathering of sensor hubs where each hub bunch has a CH. Detected information is sent to CH and not to the BS; CH performs total on information and sends it to the BS where it is required. Drain [17] is a famous steering convention utilizing bunch based directing to decrease vitality utilization. Drain isolates a correspondence procedure into adjusts with each having a set-up stage and a consistent state stage. In arrangement stage, some sensor hubs are picked as CHs as indicated by rules and others join bunches as part hubs. Inside the consistent state stage, CHs gathers information from their own group individuals and total it before transmitting to the BS. Improvement gets the best outcomes under given conditions. The word 'ideal' signifies "most extreme" or "least" contingent upon conditions. System improvement

is basic, and the streamlining procedures accomplish organizing structure objectives. Vitality effectiveness, cost, and application prerequisite are difficulties to be taken consideration when structuring a WSN. This needs equipment and programming enhancement to make WSN effective. Programming tends to the issue of Network Life [18]. There are numerous advancement calculations to suit various issues. Picking an appropriate calculation is significant in an improvement procedure. Because of little foundation for WSNs, sensor hubs organization is either inside a checking zone or close to it [19]. Batteries in sensor hubs are difficult to supplant or revive as sensor hubs are in remote or threatening detecting regions. In this way, end of a battery's life in a hub implies the finish of a system. Proficient utilization of battery vitality is fundamental to improve organize life. Sensor organize conventions center around power preservation issues. Different issues incorporate low data transfer capacity, accomplishing top notch QoS, restricted handling and capacity [20]. This examination proposes improved CH determination for productive information accumulation in sensor systems. The proposed calculation depends on Local inquiry and consolidated in LEACH.

II. Literature survey

A bunch inside a group of sensor hubs was proposed by Deshpande and Patil [21]. The CH goes about as ace of a bunch and ace boat is turned among group heads after determined number of correspondence adjusts. This improved sensor system's vitality use, boosts arrange life, and makes a WSN deficiency tolerant somewhat. A technique for grouping utilizing fluffy rationale with appropriate information sources and joining it with great LEACH highlights proposed by Dastgheib et al., [22] is completely dispersed. So its speed is more, and its vitality utilization not exactly concentrated strategies. This technique settles LEACH's shortcomings, and is more effective than present strategies. An Energy Balanced Clustering (EBC) in WSN was proposed by Nazir and Hasbullah [23]. Calculations for CH determination, entomb bunch and intra group correspondence, and vitality adjusted bunch arrangement, in WSN were proposed. Utilizing OMNet-4.0 reproduction, the presentation of the new convention is contrasted and EEMC and LEACH utilizing parameters like throughput and vitality per parcel. Reenactment demonstrated that EBC is compelling in drawing out system life, and improving throughput, than LEACH and EEMC.

A multi bounce directing system utilizing lingering vitality to draw out hub and system life was proposed by Bhattacharjee and Bandyapadhyay [24]. This system produces a vitality effective steering way from each sensor to base station to send information. Recreation indicated that the methodology adequately preserved CHs vitality, and bunch individuals dragging out their life successfully. This technique additionally diminished bunches, and improved hubs lives fundamentally. The complete hypothetical parts of bunching issues to vitality streamlining in WSN were concentrated by Dutta et al., [25]. WSN sensor hub versatility is a key bit of leeway of remote over fixed correspondence framework. WSNs bunching methods contrasted with irregular examining is less exorbitant because of sparing time in ventures, decrease in transmissions, and gathering at each hub, recognizable proof, contacts and so forth. It is additionally important for expanding generally speaking system life and WSNs versatility.

A Cluster based Energy effective Routing (CBER) calculation, choosing CH dependent on hubs close to an ideal CH separation and hubs leftover vitality was proposed by Mammu et al., [26]. The ideal CH separation connecting ideal vitality utilization is determined. Akbari and Beikmahdavi [27] studied cell and bunch based design to continue organize activities during disappointment of vitality depleted hubs. Disappointment location and recuperation recoups the group structure in under one-fourth of time taken by a Gupta calculation and is additionally 70% more vitality effective than it. Recuperation and shortcoming location in a circulated way permits a disappointment report to be sent across cells. This calculation was contrasted with existing related works and end up being vitality productive. A heuristic methodology dependent on Eigenvector centrality for bunch size control which was called Ev-CSC proposed by Jain and Reddy is pertinent to any organization, traffic example and hub types. Results showed that the new strategy upgraded execution of particular equivalent bunching techniques

III. Methodology

A grouping calculation for sensor systems, called LEACH presented by Heinzelman, [11] is a famous progressive directing calculation. The thought is to frame sensor hubs bunches dependent on got signal quality and to utilize nearby CHs as switches to a sink. This spares

vitality as transmissions will be finished by CHs and not all sensor hubs. Ideal number of CHs is 5% of all out hubs [12]. All information handling like information combination and accumulation are neighborhood to a bunch. CHs change arbitrarily after some time to adjust hubs vitality dispersal. This choice is by the hub in picking an irregular number somewhere in the range of 0 and 1. It turns into a CH for current round when the number is not exactly the accompanying limit:

$$T(n)=\begin{cases}\dfrac{p}{1-p*\left(r \bmod \dfrac{1}{p}\right)} & \text{if } n \in G \\ 0 & \text{otherwise}\end{cases}$$

where p is a desired percentage of CHs, r - current round, G - a set of nodes not selected as cluster heads in the last 1/p rounds [1]. Nodes die randomly and dynamic clustering increases system life.

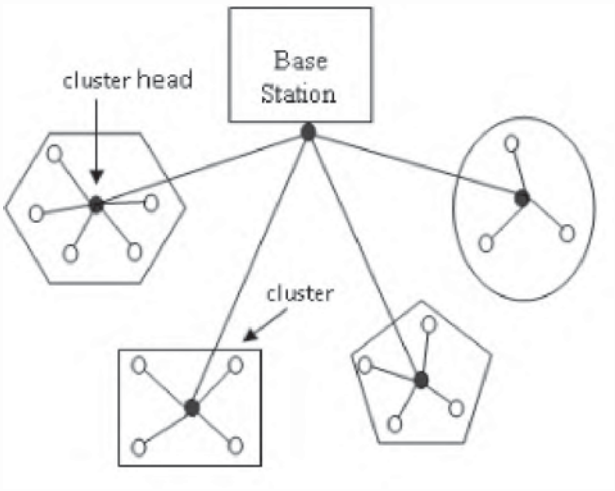

Figure 2. Clustering in LEACH

Figure 2 shows LEACH bunching. Drain convention runs with numerous rounds, each having two states: group arrangement state and consistent state. In bunch arrangement state, it structures groups and chooses CHs; in the consistent state, it moves information. The hour of second state is longer than the hour of first state, to limit overhead. Filter depends on adjusts and the framework continues bunching and transmission for each round.

A round has two phases:

Set-up phase:

"CHs are selected, based on T(n), threshold, CHs broadcast ADV message to non-CH nodesNon-CH nodes select CHs, based on RSSI of ADV messageAfter selecting cluster, the non-CH node sends Join-REQ to CH Now, CHs create TDMA schedule and sends it to all non-CH nodes"

Steady-state phase:

"Sensor nodes begin sensing and transmitting data to CHs as per a TDMA ScheduleOn receipt of data, CHs aggregates it to a BS in one-hop manner, reducing transmissions and saving energy

After some time, N/W reverts to set-up phase and enters another roundEach cluster communication uses different CDMA codes to reduce interference from other cluster nodes"

LEACH Protocol advantages are, it achieves a factor of 7 reduction in energy loss compared to direct communication and a factor of 4-8 compared to a minimum transmission energy routing protocol

Nodes die randomly and dynamic clustering increases system lifeLEACH is completely distributed and needs no global network knowledge".

Sensor nodes use irreplaceable power with limited capacity. Node's computing capacity, communicating, and storage is very limited, needing WSN protocols to conserve energy as the objective of maximizing network life. LEACH periodically changes cluster membership and CH to conserve energy. A CH collects and aggregates information from sensors in its cluster and passes this to a BS. By rotating a CH randomly, energy consumption is uniform. But, LEACH chooses too many CHs at a time or randomly selects those far from a BS without considering nodes' residual energy[28]. So, some CHs drain energy early and reduce WSN life.

In literature, there are many relevant energy preserving techniques, which prolong network life. In this study, Local search technique optimizes CH selection based on node's residual energy. The node energy model is based on [11]. The energy used to transmit n bit is computed by:

$$E_{diss\_Tx}=n(\text{Energy\_dssipated\_tranmitter\_electronics}+$$

$$(\text{Energy\_dssipated\_Transmitter\_amplifier}*\textit{distance squared})$$

The energy used up to receive n bit is computed by:

$$E_{diss\_Rx}=n(\text{Energy\_dissipated\_receiver\_electronics})$$

Power consumed for a given time period t is given by:

$$P_{consumed}=\frac{E_{diss\_Rx}+E_{diss\_Rx}}{t}$$

The probability of a node to become CH is one with the highest ratio of residual energy, which is computed as:

$$= \frac{E_{max} - P_{consumed}}{E_{max}}$$

Where Emax is the maximum energy of the battery of the sensor node.

Hill climbing is a numerical improvement strategy from the neighborhood search family. It is an iterative calculation beginning with a self-assertive answer for an issue, and attempting to locate an upgraded arrangement by steadily changing an answer's single component. On the off chance that the change delivers an upgraded arrangement, a steady change is made to new arrangement, rehashing till no further enhancements is found. Slope climbing is acceptable to locate a nearby ideal; an answer that can't be improved by thinking about neighboring design, however isn't ensured to locate a most ideal arrangement for example a worldwide ideal from potential arrangements (the hunt space). That lone neighborhood optima are ensured is overwhelmed by utilizing restarts for example rehashed nearby hunt, or increasingly mind boggling, emphasis based plans, as iterated neighborhood search, on memory, as receptive inquiry improvement or memory-less stochastic alterations, including recreated toughening. The calculation's relative effortlessness guarantees that it is a famous decision among advancing calculations. Slope climbing produces preferable outcomes over different calculations when time for a hunt is constrained, as with ongoing frameworks.

IV. Results and discussion

The simulations are conducted for varying number of nodes (60-300) with single BS spread in a 2 sq km area. The simulations are conducted for LEACH, Cluster formation using local search. The “Number of clusters formed, Average End to End Delay (sec), Average Packet loss rate, Lifetime computation, remaining energy computation are evaluated”.

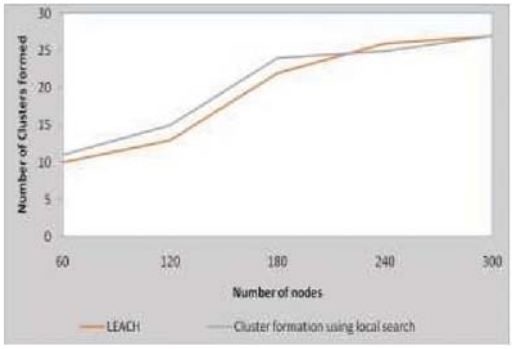

Fig 3. Numbers of clusters formed

From Figure 3 it is observed that Numbers of clusters formed increases for Cluster formation using Local search than LEACH. When number of nodes is 120, Numbers of clusters formed increases by 14.29% for Cluster formation using Local search than LEACH.

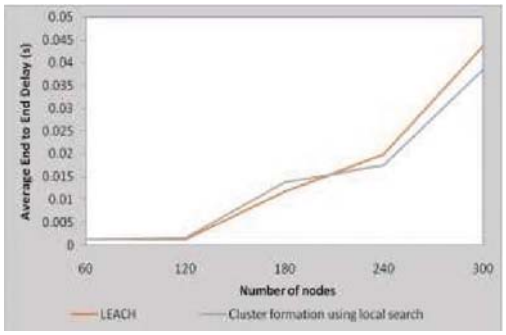

Fig 4. Average End to End Delay

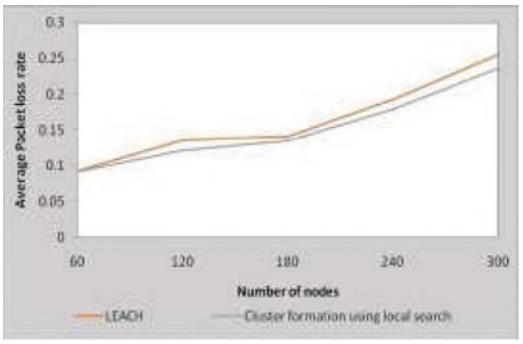

Fig 5 Average Packet loss rate

From Figure 4 it is observed that Average End to End Delay decreases for Cluster formation using Local search than LEACH. When number of nodes is 120, Average End to End Delay decreases by 19.89% for Cluster formation using Local search than LEACH.

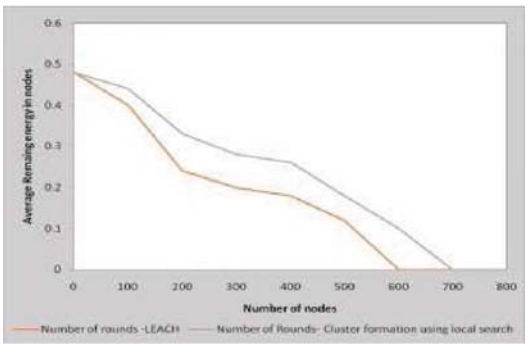

Fig 6. Percentage of nodes alive

From Figure 5 it is observed that Average Packet loss rate decreases for Cluster formation using Local search than LEACH. When number of nodes is 120, Average Packet loss rate decreases

by 10.68% for Cluster formation using Local search than LEACH.

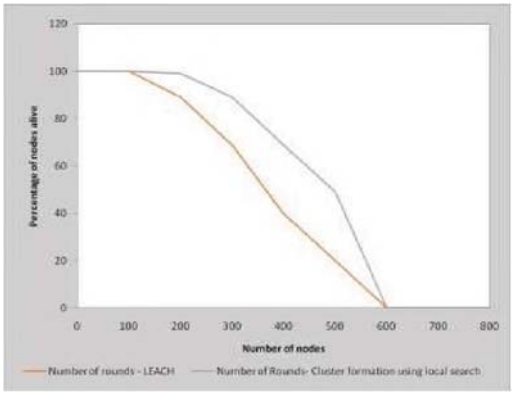

Fig 7. Average remaining energy in nodes

From Figure 7, it is observed that Average remaining energy in nodes increases for Cluster formation using Local search than LEACH. When number of nodes is 500, Average remaining energy increases by 40% for Cluster formation using Local search than LEACH.

V. CONCLUSION

Tiny sensor hubs having detecting, information handling, and imparting segments, make the possibility of sensor systems dependent on the coordinated effort of numerous hubs. A CH is chosen by sensors in a group or pre-alloted by a system originator. Many grouping calculations are intended for adaptability and proficient correspondence in WSNs. An improved CH choice for productive information total in WSN is proposed. The new calculation depends on Local pursuit and fused in LEACH. Reenactment demonstrated its adequacy in improving the proposed technique's life. More examination to improve life utilizing streamlining methods should be done.

REFERENCES

1. Sen, J. (2010). A survey on wireless sensor network security. arXiv preprint arXiv:1011.1529.
2. Intanagonwiwat, C., Govindan, R., &Estrin, D. (2000, August). Directed diffusion: a scalable and robust communication paradigm for sensor networks. In Proceedings of the 6th annual international conference on Mobile computing and networking (pp. 56-67). ACM.
3. Akyildiz, I. F., Su, W., Sankarasubramaniam, Y., &Cayirci, E.(2002). Wireless sensor networks: a survey. Computer networks, 38(4), 393-422.
4. Tripathi, A., Gupta, S., &Chourasiya, B. Survey on Data Aggregation Techniques for Wireless Sensor Networks.
5. Dagar, M., & Mahajan, S. (2013). Data Aggregation in Wireless Sensor Network: A Survey.
6. Misra, S. C., &Woungang, I. (2009). Guide to wireless sensor networks (Vol. 7). S. Misra (Ed.). New York, NY:: Springer.
7. Karlof, C., & Wagner, D. (2003). Secure routing in wireless sensor networks: Attacks and countermeasures. Ad hoc networks, 1(2), 293-315.
8. Akkaya, K., &Younis, M. (2005). A survey on routing protocols for wireless sensor networks. Ad hoc networks, 3(3), 325-349.
9. Al-Karaki, J. N., & Kamal, A. E. (2004). Routing techniques in wireless sensor networks: a survey. Wireless communications, IEEE, 11(6), 6-28.
10. Younis, M., Youssef, M., &Arisha, K.(2003). Energy-aware management for cluster-based sensor networks. Computer networks, 43(5), 649-668.
11. Prabha R, Ramaraj N, An Improved Multipath MANET routing using link estimation and swarm intelligence-EURASIP – Journal on Wireless Communication and Networking, vol. 173, 2672,2015, pp. 1-9.
12. Lindsey, S., &Raghavendra, C. S. (2002). PEGASIS: Power-efficient gathering in sensor information systems. In Aerospace conference proceedings, 2002. IEEE (Vol. 3, pp. 3-1125). IEEE.
13. Manjeshwar, A., & Agrawal, D. P. (2002, April). APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks. In Parallel and Distributed Processing Symposium, International (Vol. 2, pp. 0195b-0195b). IEEE Computer Society.
14. Manjeshwar, A., & Agrawal, D. P. (2001, April). TEEN: a routing protocol for enhanced efficiency in wireless sensor networks. In Parallel and Distributed Processing Symposium, International (Vol. 3, pp. 30189a-30189a). IEEE Computer Society.
15. Prabha R, Ramaraj N, Link Availability Estimation for Modified AOMDV Protocol, World Academy of Science,

Engineering and Technology International Journal of Computer, Electrical, Automation, Control and Information Engineering Vol:9, No:3, 20.2015.
16. Ramesh, K., &Somasundaram, D. K. (2012). A comparative study of clusterhead selection algorithms in wireless sensor networks. arXiv preprint arXiv:1205.1673.
17. Khamforoosh, K., &Khamforoush, H. (2009, August). A new routing algorithm for energy reduction in wireless sensor networks. In Computer Science and Information Technology, 2009. ICCSIT 2009. 2nd IEEE International Conference on (pp. 505-509). IEEE.
18. Yick, J., Mukherjee, B., &Ghosal, D. (2008). Wireless sensor network survey.Computer networks, 52(12), 2292-2330.
19. Chandramouli, H. (2014). Elephant swarm optimization in wireless sensor network to enhance network lifetime.
20. Adnan, M. A., Razzaque, M. A., Ahmed, I., &Isnin, I. F. (2013). Bio-Mimic Optimization Strategies in Wireless Sensor Networks: A Survey. Sensors,14(1), 299-345.
21. Deshpande, V. V., &BhagatPatil, A. R. (2013, July). Energy efficient clustering in wireless sensor network using cluster of cluster heads. In Wireless and Optical Communications Networks (WOCN), 2013 Tenth International Conference on (pp. 1-5). IEEE.
22. Dastgheib, S. J., Oulia, H., &Ghassami, M. R. S. (2011, December). An efficient approach for clustering in wireless sensor network using fuzzy logic. InComputer Science and Network Technology (ICCSNT), 2011 International Conference on (Vol. 3, pp. 1481-1486). IEEE.
23. Nazir, B., &Hasbullah, H. (2010, June). Energy balanced clustering in wireless sensor network. In Information Technology (ITSim), 2010 International Symposium in (Vol. 2, pp. 569-574). IEEE.
24. Dr.R.Prabha ,R.Sridevi , K Ramakrishnan , Dr.M.Nithya , Dr.B.Madhusudhanan "An Efficient Scheduling Algorithm Using Firefly Algorithm In Cloud Computing"JCR. 2020; 7(14): 58-64.
25. Dutta, A. R., Saha, B. S., &Mukhopadhyay, C. A. K. (2012, March). Efficient clustering techniques to optimize the system lifetime in Wireless Sensor Network. In Advances in Engineering, Science and Management (ICAESM), 2012 International Conference on (pp. 679-683). IEEE.
26. Mammu, A. S. K., Sharma, A., Hernandez-Jayo, U., &Sainz, N. (2013, March). A Novel Cluster-Based Energy Efficient Routing in Wireless Sensor Networks. In Advanced Information Networking and Applications (AINA), 2013 IEEE 27th International Conference on (pp. 41-47). IEEE.
27. Akbari, A., &Beikmahdavi, N. (2010, August). Cluster-based and cellular approach to fault detection and recovery in wireless sensor networks. InAdvanced Computer Theory and Engineering (ICACTE), 2010 3rd International Conference on (Vol. 5, pp. V5-148). IEEE.
28. Su.Suganthi & S.P.Rajagopalan(2017) Multi-Swam Partical Swarm Optimization for Energy- Effective Clustering in Wireless Sensor Networks, Wireless Personal Communication. Pp. 2487-2497.