Research Journal of Computer Systems and Engineering

ISSN: 2230-8571, 2230-8563

Volume 02 Issue 01 - 2021 (January to June)

Page 33:39

Improved Clustering-Based Energy Optimization with Routing Protocol in Wireless Sensor Networks

Sandeep Dwarkanath Pande
Computer Science & Communication Engineering
Dr.D.Y.Patil College of Engineering and Innovation Talegaon Varale Pune
ORCID ID-0000-0001-6969-0423
mondal.dipannita26@gmail.com

Dr Sk Hasane Ahammad
Computer Science & Communication Engineering
Koneru Lakshmaiah Education Foundation and Assistant Professor
ORCID ID-0000-0002-2587-4164
ahammadklu@gmail.com

Article History

Received: 22 January 2021
Revised: 14 April 2021
Accepted: 19 May 2021

Abstract

For designing any type of WSN with main parameters like rate of convergence, hop count, lifetime of network, consumption of energy, area for coverage in recent technology of wireless network. So this paper deals with the network coverage and energy optimization of the network.In large deployed network the transmission range is vital for data transmitting, this area coverage of the cluster can be within the transmission range using Glowworm Swarm Optimization (GSO) based clustering (GSO-C), network lifetime constraint can be optimized using the novel routing algorithm enhanced energy optimization based Ant Swarm optimization (EEO-ASO) that uses AH-HEED (adaptive heterogeneous- hybrid energy efficient distributed clustering) protocol for routing. The performance of clustering technique and routing algorithm has been represented in graphs.

Keywords: Wireless sensor networks (WSNs), Network lifetime (NL), GSO-C, routing algorithm, EEO-ASO, AH-HEED.

1 INTRODUCTION

A large number of few sensors have been organized in themselves in Wireless Sensor Network. Generally the power source in sensor node has complication in recharge when they are in inattentive hostile area [1]. Although many investigations has been done with varied techniques and algorithm in conserving energy of sensor nodes for extension of network lifetime [2]. Since sensor nodes have more limitations with different problem like deployment area of network, lifetime of network, data scheduling and data aggregation. The network size has been maximized through ineffective optimized algorithm classically. Due to its simplicity, good solution quality, capacity to escape local optima, and rapid convergence, particle swarm optimization (PSO), one of the effective nature-inspired algorithms, may be a preferable option for this NP-hard issue [3,4].The uniqueness in clustering with the transmission range and to route with the best energy conservation and extend the network lifetime

is demonstrated by the experimental findings in this article. The paper's structure is listed as follows.A literature review is described in Section 2. Section 3 provides a summary of the proposed work. The research methods and specifics of the proposed algorithm's implementation are described in Section 4.

2 LITERATURE REVIEW

This section describes literature review in direction of network coverage and energy optimization.Work [5]discuss PSO algorithm on basis of enhancing the lifetime of network. This can form cluster and its cluster head (CH).Author in [6]determines effective cluster head selection method which revolves the position of cluster head in between the nodes from higher level in terms of energy when contrasted with others. Work [7]discusses evolutionary algorithms in various two stages which develop more objective where the increase in coverage repetition issue: a lexicographic "a priori" algorithm and a NSGA-II "a posteriori" method.Author [8,9]describes a new and effective metaheuristicGA form where this overthrown most of the disadvantages in existing metaheuristic, that could calculate appropriate solution in operation for this problem. Work [10]proposes mobile wireless sensor network as the solution of both coverage and lifetime of the sensor network.

3 RESEARCH METHODOLOGY

This paper deals with the network coverage and energy optimization of the network. In large deployed network the transmission range is vital for data transmitting, this area coverage of the cluster can be within the transmission range using Glowworm Swarm Optimization (GSO) based clustering (GSO-C), network lifetime constraint can be optimized using the novel routing algorithm enhanced energy optimization-based Ant Swarm optimization (EEO-ASO) that uses AH-HEED protocol for routing. The architecture for proposed system is given below:

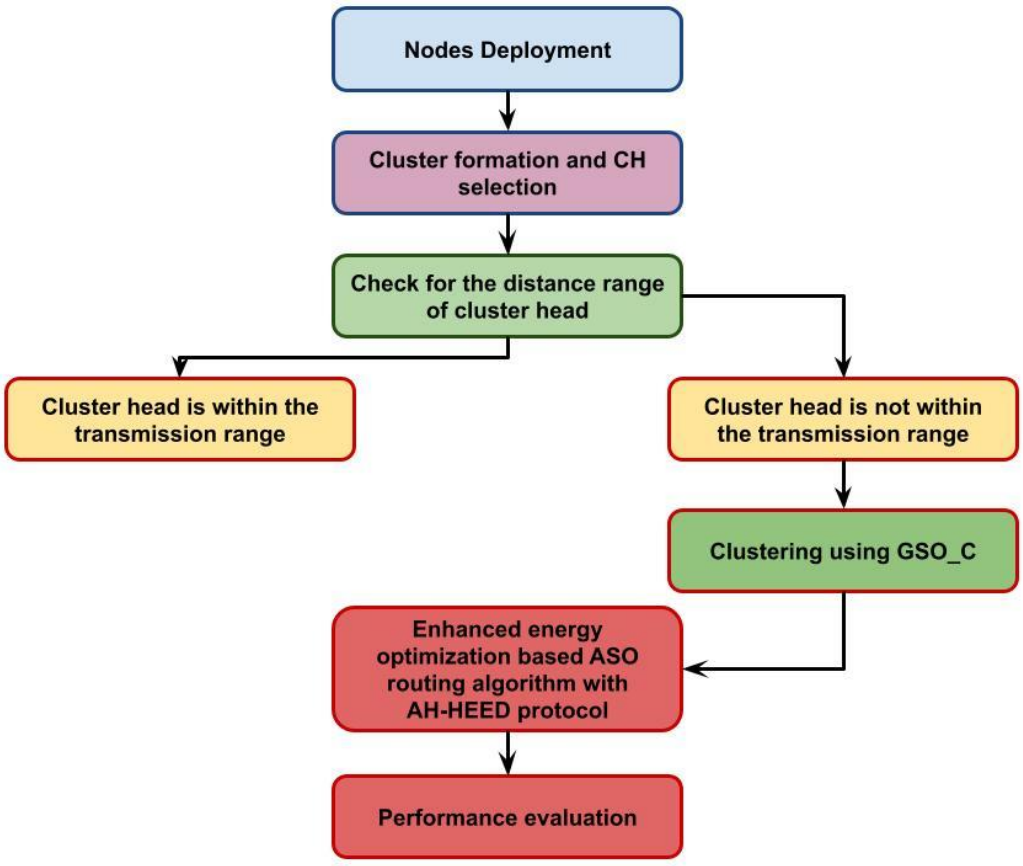

Figure-1: Proposed Architecture

3.1 Glowworm Swarm Optimization (GSO) based clustering (GSO-C)

For large area of the network the cluster need to be in range of transmission.This technique is used when the cluster head is not in the range of transmission with the base station. GWM*j* is assumed as level of luciferin with time *u* is represented by$M_j\ (v)$,the location of v is given by GWM*j*which have iteration $\rho^0$is decay constant for luciferin is $(0 < \rho < 1), M\ (x, (v))$is quantity in theGWM*j's*operative intention at time *v*and variable for enhancement of luciferin is given as ϒ.

While the mobilitystages every GWM utilize mechanism of probability for opting the nearby GWMhas maximum level of luciferin than its own for the mobility. In each GWM*j's*mobility, the possibility of the mobility in the direction ofnearby*k* is précised by,

$$P_{jk(u)} = \frac{M_k(v) - M_j(v)}{\sum_{l \epsilon o_{j(u)}} M_l(v) - M_j(v)} \tag{1}$$

Where$k \epsilon N_j(v), N_j(v) = \{k: d_{jk}(v), d_d^j(v); M_j(v) < M_k(v)\}$Represents nearby GWMgroup at time u, $d_d^j(v)S$ range of nearby constant correlated with GWM*j* at instanceperiod *v*,$d_{jk}(v)$ is the Euclidian distance between GWMs *j* and *k* at instance period v. For example GWM*j* select $GWk \epsilon N_j(v)$ with probability$P_{jk}(v)$. The discrete instance period model of the GWMmeasures will be distinct as,

$$y_j(v+1) = y_j(v) + s * \left(\frac{y_k(v) - y_j(v)}{\|y_k(v) - y_i(v)\|}\right) \tag{2}$$

$Y_j(v)$is the location of the GWM*j*at time vand step size s (>0). In the nearby range update phase, nearby range of each GWM is updated with the following rule:

$$rd^j(v+1) = \min\{r_s, \max\{0, r_d^j(v) + \beta\left(n_t - \left|N_j(v)\right|\right)\}\} \tag{3}$$

Where β is a constant parameter andn_t is to control the number of neighbors.

3.2 Enhanced Energy Optimization Based Ant based Swarm optimization(EEO-ASO):

This is the novel method used for finding whether the cluster formed and the nodes in it have efficiency in terms of energy. The energy required for this type of l-bit packet transmission across distant d is estimated as

$$E_{TX}(l,d) = \begin{cases} lE_{elec} + l\varepsilon_{fs}d^2, d < d_0 \\ lE_{elec} + l\varepsilon_{mp}d^4, d \geq d_0 \end{cases} \quad [4]$$

$$d_0 = \sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}} \quad [5]$$

The energy spent for the radio to receive this message is

$$E_{RX}(l) = lE_{elec} \quad [6]$$

As a result, the physical and Mac layers of the WSN are developed with the transmission power and receiving power energy levels.

3.3 Routing by ASO

Creating the clusters with the support of GSO clustering, the sensor nodes are separated based on its locations. The CHs are discovered by the movements of sensor nodes. ASO routing is utilized to

obtain the shortest path within the CHs, based on its distance. There are two types in optimizing techniques for clustering and routing algorithms with energy efficiencywhich can enhance the network lifetime in WSNs. ASO with GSO in sensor networks are used in enhancing GSO;thatprogress the efficiency in clustering and routing algorithms here ASO and GSO has been used. In ASO with GSO method, there are randomly distributed sensor nodesthat have mobility in direction of clustering as well as and routing processes.

AH-AH-HEED (ADAPTIVE HETEROGENOUS- HYBRID ENERGY EFFICIENT DISTRIBUTED CLUSTERING)

This protocol is used in network for achieving optimal energy consumption while transmitting data from CH to the base station. Here AH-HEED protocol has been explained. Initially the parameters have been defined to proceed with the clustering process. Secondly design of protocol is determined and then with pseudo-code. After this finally, the proof for protocol achieves its maximum requirement has been determined.In clustering process of every node for all number of iterations required is referred to beNiter. Probability of becoming CH has to be determined at once before the simulation of nodes with AH-HEED, CH_{prob}, as given below:

$$CH_{prob} = C_{prob} \times E_{residual} / E_{max} \quad (7)$$

Where$E_{residual}$is residual energy for evaluated current in node, and Emaxis a maximum energy of reference node this is similar in every nodes. Value of node is CHprob, although below certain threshold value is not allowed pmin(e.g., 10−4), this is inversely proportional to Emax. CHprob of each node get maximized two times and move to following step.Here we assume when CH u could reach node v with its energy level I, then v reach u with energy level similar as level 1. Identification of nearby nodes is not required all the time when cluster is clocked. In stable network nodes will not die unexpectedly, every node in nearby clusterhas no modifications very often. When the node is chosen to be CH, it has to send a notice message msg, and its status for selection is uncertain group in CH.

4 PERFORMANCE ANALYSIS

Performance can be analyzed by based on shortest path, energy consumption, network lifetime. Shortest path will be derived from the region among the CHs.

4.1 Throughput

The frequency of successfully delivering messages through a communication connection is known as network throughput. The data to which these messages refer may be transmitted across a logical or physical link or via a specific network node. The standard unit of measurement for throughput is bits per second (bit/s or bps), while it can also refer to data packets per time slot or packets per second (p/s or pps).

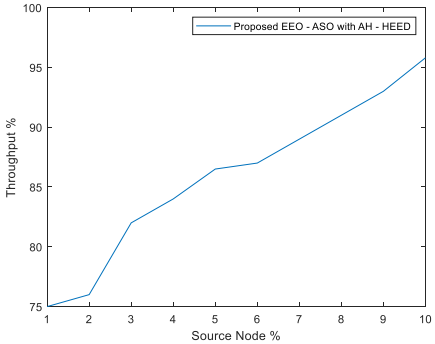

Figure 3: Throughput of EEO-ASO with AH-HEED

The above figure-3 shows the throughput performance of proposed technique EEO-ASO with AH-HEED. Initially the value is at 1 and it gradually increases as per source node performance. X- axis represents % of source node and Y- axis represents throughput performance.

4.2 Energy consumption:

It is described as the energy used up by the sensor nodes when data transmission is first initiated. Since the lifespan of sensor nodes is dependent on their limited energy supply, the energy consumption of the sensing device should be kept to a minimum. Wireless sensor nodes often turn off both the radio transmitter and the radio receiver when not in use in order to save energy.

The below figure-4 shows the energy consumption of proposed technique EEO-ASO with AH-HEED. Initially the value is at 1 and it gradually increases as per source node performance. X- axis represents % of source node and Y- axis represents energy consumption. This shows the proposed technique has optimized the energy consumption from all the existing techniques.

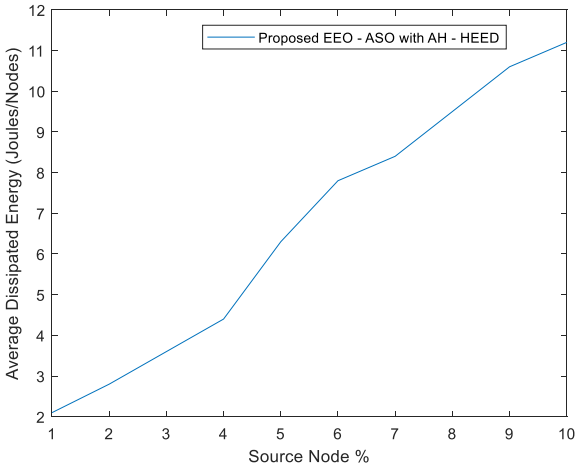

Figure-4: Energy consumption of EEO-ASO with AH-HEED

4.3 Routing performance

The process of choosing a path for traffic within, between, or across networks is called routing. In general, routing is carried out in a variety of network types.

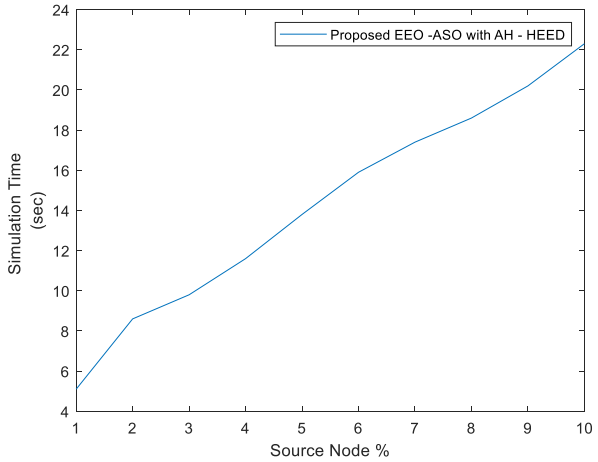

Figure- 5: Routing Performance of EEO-ASO with AH-HEED

The above figure-5 shows the routing performance of proposed technique EEO-ASO with AH-HEED. Initially the value is at 1 and it gradually increases as per source node performance. X- axis represents % of source node and Y- axis represents simulation time. Since the energy consumption has been optimized, the routing performance is also enhanced based on their source node.

4.4 Packet Delivery Ratio

While throughput refers to the ability of a link or network to successfully through/pass data, packet delivery ratio refers to the ratio of the number of packets successfully received to the total number of packets sent by the sender.

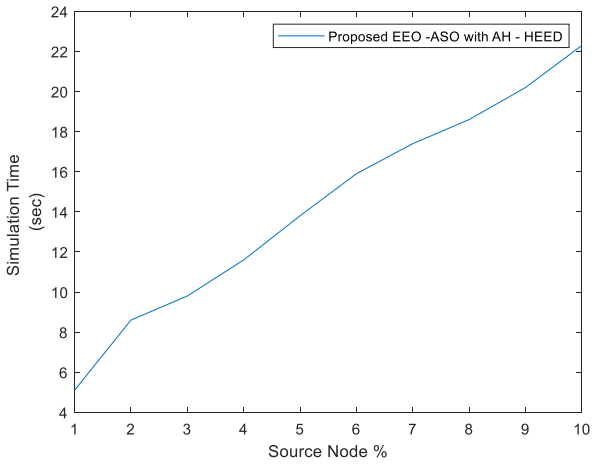

Figure-6: Packet delivery ratio of EEO-ASO with AH-HEED

The above figure-6 shows PDR of proposed technique EEO-ASOwith AH-HEED. Initially the value is at 1 and it gradually increases as per source node performance. X- axis represents % of source node and Y- axis represents packet delivery ratio. When the routing in network is optimized there will be optimized packet delivery ratio.

5 CONCLUSION

Hence from the performance analysis results the proposed technique has shows that energy consumption has been minimized in proposed GSO-C- EEO-ASO with AH-HEED. Along with energy conservation, packet transmission has been optimized in large network area within the range of transmission. The network lifetime constraint has been overcome using novel routing algorithm enhanced energy optimization based ASO (EEO-ASO) that uses AH-HEED (adaptive heterogeneous-hybrid energy efficient distributed clustering) protocol for routing.This proposed work is compared with existing with existing Hybrid Combinational Particle Swarm Optimization (HCPSO), Gravitational Search Algorithm (GSA) for better analysis,

REFERENCES:

[1] C. Vimalarani,1 R. Subramanian, “An Enhanced PSO-Based Clustering Energy Optimization Algorithm for Wireless Sensor Network”, Hindawi Publishing Corporation Scientific World Journal, Volume 2016, Article ID 8658760, 11 pages

[2] Noor Zaman,1 Low Tang Jung, “Enhancing Energy Efficiency of Wireless Sensor Network through the Design of Energy Efficient Routing Protocol”, Hindawi Publishing Corporation Journal of Sensors, Volume 2016, Article ID 9278701, 16 pages

[3] Amita Yadav1, Suresh Kumar, "Network Life Time Analysis of WSNs Using Particle Swarm Optimization", Procedia Computer Science 132 (2018) 805–815, International Conference on Computational Intelligence and Data Science (ICCIDS 2018)

[4] TruptiMayeeBehera, Sushanta Kumar Mohapatra, "Residual Energy Based Cluster-head Selection in WSNs for IoT Application", IEEE INTERNET OF THINGS JOURNAL, VOL. …, NO. …, MONTH 2019.

[5] Elivelton O. Rangel, Daniel G. Costa, "On redundant coverage maximization in wireless visual sensor networks: Evolutionary algorithms for multi-objective optimization", Applied Soft Computing Journal 82 (2019) 105578,

[6] Nguyen ThiHanh, "An efficient genetic algorithm for maximizing area coverage in wireless sensor networks", Information Sciences 488 (2019) 58–75.

[7] Jean-MatthieuEtancelin, "DACYCLEM: a Decentralized Algorithm for Maximizing Coverage and Lifetime in a Mobile Wireless Sensor Network", *Ad Hoc Networks* (2018).

[8] SribinduSattu, "A New Energy Efficient Clustering Protocol for Life Time maximization in Wsns", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue-11S2, September 2019.

[9] Balaji, S., Golden Julie, E., & Harold Robinson, Y. (2019). Development of fuzzy based energy efficient cluster routing protocol to increase the lifetime of wireless sensor networks. *Mobile Networks and Applications*, *24*(2), 394-406.

[10] Fanian, F., & Rafsanjani, M. K. (2019). Cluster-based routing protocols in wireless sensor networks: A survey based on methodology. *Journal of Network and Computer Applications*, *142*, 111-142.