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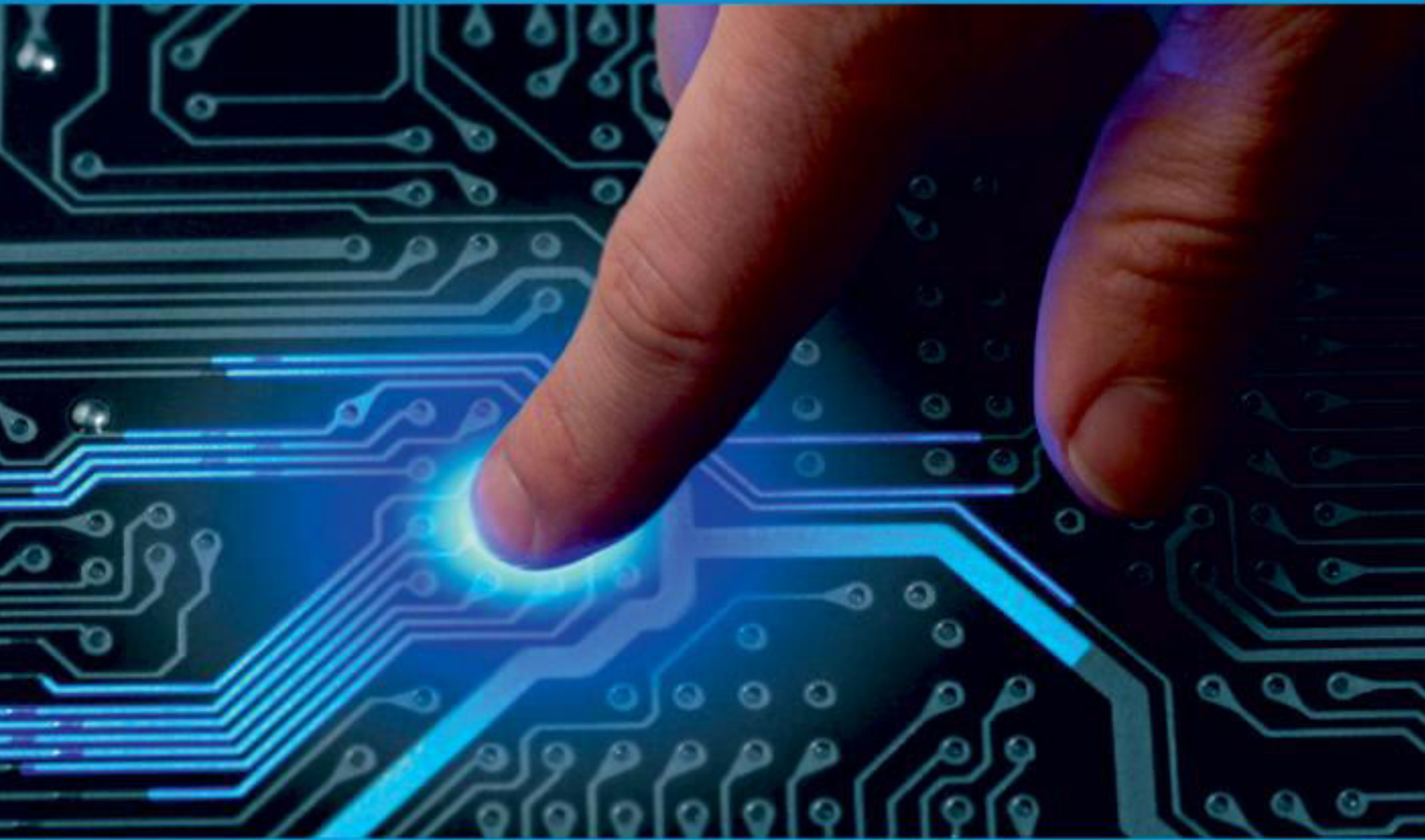

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Cluster Transmission Energy Optimization using Cuckoo Search Algorithm

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ABSTRACT: Cluster Head (CH) can be chosen haphazardly or in view of at least one standard that straight forwardly make ready for expanding network lifetime. In any case, the choice of group head makes an enhancement issue, thus far, more exploration work have been acquainted with select the ideal bunch head under various enhancement models. Under this situation, this paper means to propose a new Cluster head (CH) determination by various leveled steering in WSN by another half and half advancement model. Further, the choice goes with specific measures like energy adjustment, minimization of distance among hubs, minimization of postponement during information transmission. The presented calculation is named as Cuckoo Search Optimization Algorithm (CSOA). Finally, the exhibition of the proposed work is contrasted and demonstrated with other regular models.

KEYWORDS: Energy calculation; Energy optimization; Energy model; Cluster node selection

I. INTRODUCTION

The information spread from the organization and sending it to the sink is one of the main jobs a sensor hub plays. There are many purposes going from military to clinical consideration, horticultural and climatic checking thus a lot more. Basically, the sensor hubs comprise of low battery assets, confined memory size reach, and limited scope computational abilities. On a very basic level, in antagonistic regions, these sensor hubs are intended to work, so the battery introduced in them is indispensable. It presents one of WSN's most significant worries, for example the energy-effective utilization of the sensor hubs. In 2019, Darabkh et al. [1] have proposed a BPA-CRP. In specific, a group based bunching and steering convention was presented in which the sensor field was isolated by the organization geography as equivalent measured groups and layers. BPA-CRP was doled out with four assorted scopes of transmissions for each sensor.

These techniques were created to further develop energy mindfulness furthermore load adjusting effectiveness. The outcomes have revealed the effectiveness of the presented model in regards to the lifetime and energy usage of the organization. In 2016, Ke et al. [2] have introduced a procedure called NEAHC directing convention which included two goals. The first objective was to limit the general energy usage and the next one was for guaranteeing the incomparability of energy use between hubs. Also, the picking of the hand-off hub was expected as a non-straight programming issue and considering that, the arched working model was formed to decide the best arrangement. Moreover, the presented strategy was assessed at long last and not set in stone outcome.

In 2018, Elhabyan et al. [3] have presented the detailing of single target and multi-objective issues and an endeavor to redress these two issues simultaneously for deciding the organization setup ideally. The executed methodology considered the count of bunched hubs, the count of CHs, the connection quality of the planned steering tree, and the connection quality among the CMs and CHs. Further, the took advantage of issue was settled utilizing the traditional MOEAs, and the examination of their presentation was made by two quality markers: the Epsilon pointer what's more the hyper volume pointer. Inferable from these, energy-proficient, solid and versatile steering convention was proposed, and their xecution was accounted for. In 2019, Xiuwu et al. [4] have proposed a UCRA-GSO for WSN to determine the energy balance issue. In this, CH nearness distance, CH energy, CH thickness, and the group smallness inside the GSO model were acquainted with decide the ideal grouping approach. The trial examination showed the adequacy of UCRA-GSO with expanded life expectancy and the energy scattering of the organization.

In 2018, Sabor et al. [5] have demonstrated an ARBIC for administrating the computational time and overhead bundles. The created strategy took advantage of an adaptation to internal failure model after each outline transmission for limiting the dropping pace of parcels by fulfilling the connection steadiness between the part hubs furthermore Ch's. The mathematical audit was performed to explore the overhead and computational intricacies of the presented

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approach. From that, obviously the created approach had productively improved the PDR with limited postponement and energy usage with flexible transmission levels. In 2019, Yarinezhad and Hashemi [6] have proposed a FPT guess calculation for LBCP with an estimation factor

of 1.2. Further, an energy-adjusted steering and an energy efficient approach have been produced for directing among the sink and the CHS. Hence, the investigational examination had clarified that the presented approach was reasonable for huge scope WSNs also performed better than those of other existing calculations. In 2018, Wang et al. [6] have presented a GA-based strategy, where the directing and bunching models have been joined as a fastidious chromosome to assess by and large energy use. Inferable from the general energy usage, wellness work had been exemplified, along these lines further developing energy productivity.

Furthermore, load boundaries were expected while taking advantage of the wellness work. Accordingly, energy use among the hubs was changed. The result uncovered that the carried out approach acquired the heap adjusting ideally over the CH's in various situations. It not set in stone to give prevalent energy effectiveness with diminished energy utilization. In 2019, Yarinezhad and Hashemi [7] have embedded an estimate calculation for tackling the issues connected with an estimate proportion of 1.1. This model worked inside fixed parameter manageable time. In this, a virtual matrix foundation was utilized inside the organization, making the calculation sensible for huge scale WSNs. In addition, a steering calculation was presented based on this plan. The directing model took advantage of the reasonable and diminished energy utilization over the organization by deciding the suitable course among each sink and CH. The investigation uncovered that the presented model was practical for colossal scale WSNs and had better execution when separated over other existing models.

BPA-CRP [8] effectively took care of the hub demise and offered better organization life expectancy and organization use. Nonetheless, the principle disadvantage of this procedure is, it needs upgrade over the organization arrangement overhead. NEAHC [9] improved the energy productivity and expanded the organization lifetime at this point endures from duplication of information. MOEA [10] present better normal energy utilization per hub and improved throughput. It actually needs ideal transmission power assurance during grouping, and the cross-layer bunching convention was required. UCRA-GSO [11] offered further developed organization life expectancy and energy balance. Low precision calculation and simpler to fall inside neighborhood ideal are the two primary issues of this model. ARBIC [12] gave predominant utilization of energy and better bundle conveyance proportion, and normal start to finish delay. It actually needs a decrease in the overhead of the bunching system. FPT [13] represented a superior answer for load-adjusted bunching issues and offered a further developed estimation factor for LBCP. Still represent a few faults like runtime improvement of the calculation is required and Needs double bunch head for the proposed calculation. GECR [14] gains incomparability in load adjusting, expanded organization life cycle, and diminished energy utilization. Be that as it may, it needs testing and the application of proper meta-heuristic calculations with super durable CHs. RFPT [15] introduced better organization execution and more precise guess. However, this technique needs further improvement of this FPT-estimation calculation.

II. Existing Algorithms

By and large, there exist a few enhancement procedures like Linear Programming, Integer Programming, Quadratic Programming, Combinatorial Optimization and metaheuristic streamlining techniques. The traditional enhancement techniques utilized in logical applications includes hessian lattice based strategies and inclination based strategies. Be that as it may, metaheuristic calculations are created in addressing non-differentiable and nonlinear-objective capacities. The arrangement of issues is truly challenging by utilizing the traditional enhancement procedures. The metaheuristic streamlining calculations that are most broadly utilized in logical applications are GA, PSO, DE, ABC, CSA, GSA, HS and so forth

A. *Cuckoo Search Algorithm (CSA)*

The cuckoo search algorithm, it is a novel technique developed for solving continuous and non linear optimization problems. This algorithm was developed from the lifestyle of cuckoo bird family. The basic incentive for developing algorithm is special life style of cuckoo birds, characteristics in egg laying as well as breeding.

From the life style of cuckoo bird it is well known that cuckoo lays eggs in the host bird nest due to similarity between cuckoo and host bird eggs. Whenever cuckoo laid eggs in the host bird nest only some number of eggs will hatch up and turned into cuckoo chicks and remaining will be killed by host bird. The nest in which more number of

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cuckoo chicks will survive that nest will be the best nest in that area. The best habitat in any area with more number of egg survival rate gives best profit of that area.

In an optimization problem, the population can be formed as an array. In cuckoo optimization algorithm such an array is called habitat.

$$Habitat = [x_1,\ x_2,\ \ldots\ldots\ x_n]$$

The profit of habitat is estimated by evaluating profit function as,

$$profit = F[habitat] = F[x_1, x_2, \ldots\ldots, x_n]$$

B. *Proposed Hybrid Cuckoo Search Algorithm (HCSA)*

It is the modified version of cuckoo search optimization method. Hybrid cuckoo search method is developed by combining GA with actual cuckoo search process by which it is observed that such method yields to better performance.

Sequential steps for hybrid cuckoo search algorithm are given as follows.

C. *Initialization*

Initial population of control variable is randomly generated by using,

$$x_{ab} = x_b^{\min} + rand(0,1) \times (x_b^{\max} - x_b^{\min})$$

Where,

$a = 1, 2, \ldots\ldots, n$

$b = 1, 2, \ldots\ldots, m$

$n =$ Number of nests

$m =$ Number of control variables

$x_b^{\min}$ *and* $x_b^{\max}$ are min. and max. limits of b^{th} control variable, $rand\ (0,1)$ is the random number generated between [0,1]

D. *Levy flights*

Levy flight is the search process of population of solution from the randomly generated initial population. After performing the levy flight cuckoo chooses the host nest position randomly to lay egg is given in below Eqns. for i^{th} cuckoo, latest solutions are generated using,

$$x_i^{(t+1)} = x_i^{(t)} + s_{ab} \times \alpha \oplus Levy(\lambda)$$

Where

α random number between [-1,1]

$\oplus$ is entry wise multiplication

$s_{ab} > 0$, it is the step size, based on this only new solution is generated. Step size can be calculated as

$s_{ab} = x_{ab}^t - x_{fb}^t$

Where $a, f = 1, 2, \ldots\ldots, n$; $b = 1, 2, \ldots\ldots, m$ and

$$Levy(\lambda) = \left| \frac{\Gamma(1+\lambda) \times \sin\left(\frac{\pi \times \lambda}{2}\right)}{\Gamma\left(\frac{1+\lambda}{2}\right) \times \lambda \times 2^{\left(\frac{\lambda-1}{2}\right)}} \right|^{1/\lambda} ;\ 1 < \lambda \le 3$$

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Levy walk of population will generate new solution around the best solution. Population vector is modified using levy flight equation x_{ab}^{t+1} i.e, belongs to a^{th} nest and b^{th} control variable. Here old value x_{ab} is updated with respect to f^{th} neighborhood's nest, using Eqn. (2.13) is used to select host nest position and the egg laid by cuckoo is evaluated.

E. *Crossover*

Recently an efficient operator crossover has been designed for searching process [170].

$$x_{ab}^{new} = (1-\lambda)\times x_{1b}^{ref} + \lambda \times x_{ab}^{old}$$

Where λ is the random number between [0,1]

Modified value x_{ab} is obtained by crossover of old value and its reference value. After crossover check the control variable limits for all the population. If upper limit is violated set to the maximum value, lower limit is violated set to the minimum value and if it is within the limit keep as such.

F. *Selection*

For this work sorting and ranking process is used. By comparing initial generation function vector and new function vector after performing crossover operator. Now modified function vector is obtained for new population, the minimum function value will be memorized. Now the function vectors sort by ascending order in which function values are ranked from minimum to maximum value. Then first rank function value and its corresponding population value are treated as best, and best population vector is given to the next generation.

G. *Stopping criteria*

Whenever the number of current generations equals to the maximum number of generations specified then final solution is obtained.

III. PROBLEM FORMULATION

The proposed methodology to minimize the energy consumption for data transfer can be expressed as follows.

A. *Energy model*

The center issue connected with WSN is energy usage. Clearly, the recharged interaction isn't accessible inside the battery of WSN, so when the battery gets down, the energy supply will not be accessible. By and large, the information transmission to BS from whole sensor hubs is made effectively utilizing the extra energy. Thus, energy utilization is a lot of fundamental for transmission purposes. Clearly, more energy is used by the network as on account of assorted capacities like detecting, gathering, accumulation, and transmission. Along these lines, the energy necessity for the entire information transmission is portrayed according to given Eq.

Here, Eet expresses the electronic energy based on several modules involving digital coding, filtering, spreading, and so on and is stated by Eq and ETM(N: di) portrays the entire used energy that is important for transmitting N bytes of packets over distance di. Here Eea exemplifies the energy consumed at the time of data aggregation. The overall energy ERP that is important to receive N bytes of packets at a distance di is stated as per below Eqs depicts the needed energy for amplification Eam.

$$E_{TM}(N:di) = \begin{cases} \{E_{et}\times N + E_{rs}\times N\times di^2, \text{if } r < r_0 \\ \{E_{et}\times N + E_{pw}\times N\times di^4, \text{if } r > r_0 \end{cases}$$

IV. SIMULATION RESULTS

The optimization results when some of the control parameters in each of the following cases when N=100.
Case-1: Parameters such as di, ers and epw are optimized are presented
Case-2: Parameters such as ers, epw and Eet are optimized are presented.
Case-3: Parameters such as ers, epw, Eet and di are optimized are presented.

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Table -1: Optimization results for Case-1

Control parameters	Optimized value
E_{rs} (pJ/bit/m^2)	5.000
E_{pw}(pJ/bit/m^4)	0.001
di (m)	10.000
Optimal Energy (E_{TX}) nJ/bit	50000
Starting solution	110000
Number of iterations	17
Time (Sec)	4.786339

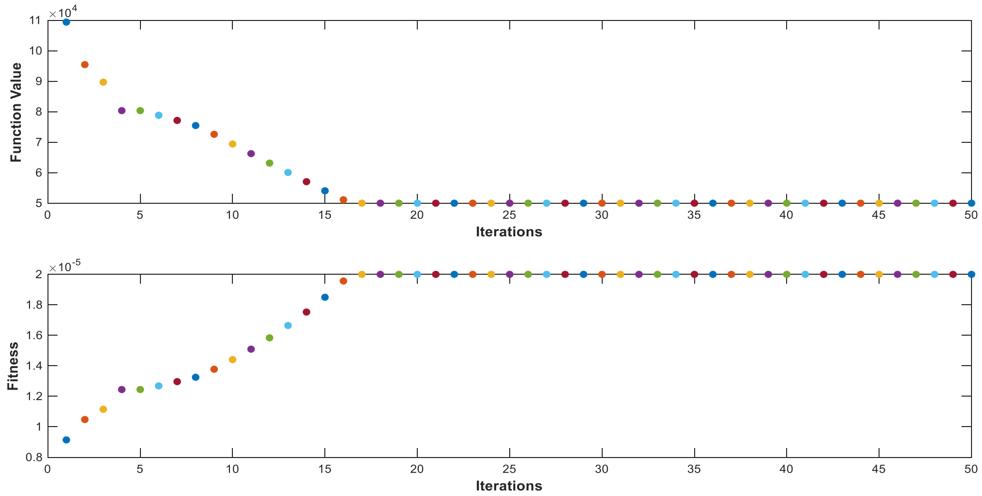

Fig -1: Convergence characteristics for Case-1

Table -2: Optimization results for Case-2

Control parameters	Optimized value
E_{rs} (pJ/bit/m^2)	10.000
E_{pw}(pJ/bit/m^4)	7.208
E_{et} (nJ/bit)	0.001
Optimal Energy (E_{TX}) nJ/bit	1000
Starting solution	1200
Number of iterations	5
Time (Sec)	5.379822

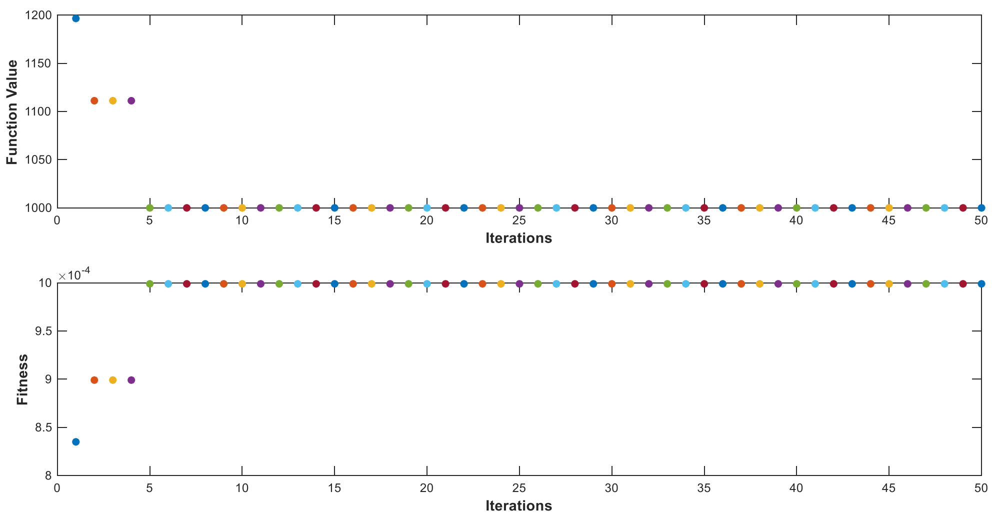

Fig -2: Convergence characteristics for Case-2

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Table -3: Optimization results for Case-3

Control parameters	Optimized value
E_{rs} (pJ/bit/m^2)	5.000
E_{pw}(pJ/bit/m^4)	0.001
E_{et} (nJ/bit)	10.000
di (m)	10.000
Optimal Energy (E_{TX}) nJ/bit	51000
Starting solution	160000
Number of iterations	36
Time (Sec)	5.071563

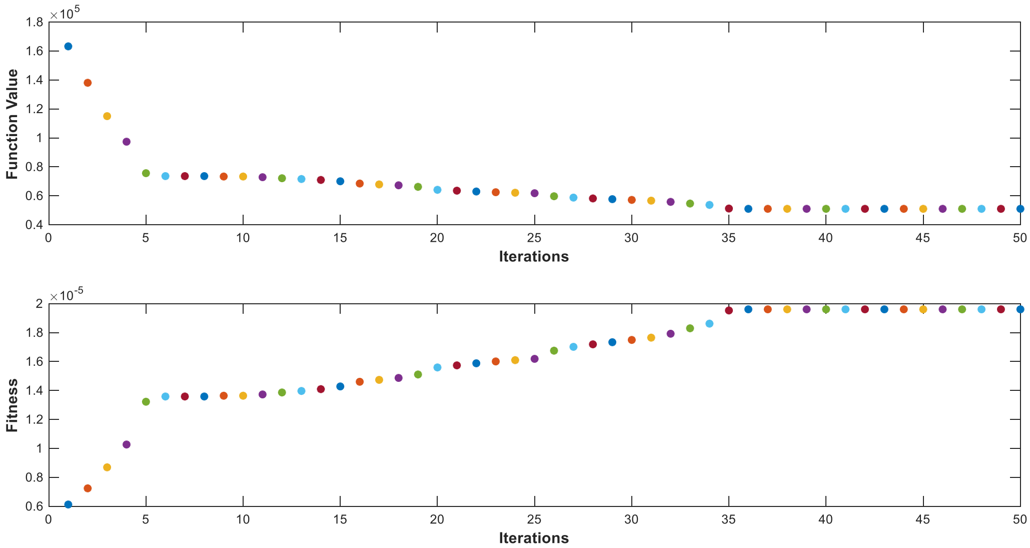

Fig -3: Convergence characteristics for Case-3

V. CONCLUSION

In this paper a methodology to minimize the energy consumption by the nodes in a cluster to transfer data from transmitter through wireless sensor network. The proposed cuckoo search based algorithm has proved its effectiveness in selecting optimal control parameters against the constraints for the same. Finally, the optimized energy value has been obtained. The respective convergence characteristics have been illustrated.

REFERENCES

1. Khalid A. Darabkh, Mohammad Z. El-Yabroudi, Ali H. El-Mousa, BPA-CRP: A balanced power-aware clustering and routing protocol for wireless sensornetworks, Ad Hoc Netw. 82 (2019) 155–171.
2. Wang Ke, Ou Yangrui, Ji Hong, Zhang Heli, Li Xi, Energy aware hierarchical cluster-based routing protocol for WSNs, J. China Univ. Posts Telecommun.23 (4) (2016) 46–52, (7).
3. Riham Elhabyan, Wei Shi, Marc St-Hilaire, A Pareto optimization-based approach to clustering and routing in Wireless Sensor Networks, J. Netw.Comput. Appl. 114 (2018) 57–69.
4. Yu Xiuwu, Liu Qin, Liu Yonga, Hu Mufang, Zhang Ke, Xiao Renrong, Uneven clustering routing algorithm based on glowworm swarm optimization, AdHoc Netw. 93 (2019).
5. Nabil Sabor, Sabah M. Ahmed, Mohammed Abo-Zahhad, Shigenobu Sasakil, ARBIC: An adjustable range based immune hierarchy clustering protocol supporting mobility of wireless sensor networks, Pervasive Mob. Comput.43 (2018) 27–48.
6. Ramin Yarinezhad, Seyed Naser Hashemi, A routing algorithm for wireless sensor networks based on clustering and an fpt-approximation algorithm,J. Syst. Softw. 155 (2019) 145–161.
7. Tianshu Wang, Gongxuan Zhang, Xichen Yang, Ahmadreza Vajdi, Genetic algorithm for energy-efficient clustering and routing in wireless sensornetworks, J. Syst. Softw. 146 (2) (2018) 196–214.
8. Ramin Yarinezhad, Seyed Naser Hashemi, Solving the load balanced clustering and routing problems in WSNs with an fpt-approximation algorithmand a grid structure, Pervasive Mob. Comput. 58 (2019).

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

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9. Liang Zhao, Shaocheng Qu, Yufan Yi, A modified cluster-head selection algorithm in wireless sensor networks based on LEACH, EURASIP J. Wirel.Commun. Netw. (287) (2018).
10. D. Binu, B.S. Kariyappa, RideNN: A new rider optimization algorithm-based neural network for fault diagnosis in analog circuits, IEEE Trans. Instrum.Meas. (2018).
11. M. Mareli, B. Twala, An adaptive Cuckoo search algorithm for optimisation,Appl. Soft Comput. 37 (2015) 332–344.
12. Dr.T. Senthil Murugan, Amit Sarkar, Cluster head selection for energy efficient and delay-less routing in wireless sensor network, Wirel. Netw.25 (1) (2019) 303–320.
13. T. Senthil Murugan, Amit Sarkar, Optimal cluster head selection by hybridisation of firefly and grey wolf optimisation, Int. J. Wirel. Mob. Comput. 14 (3) (2018).
14. M. Praveen Kumar Reddy, M. Rajasekhara Babu, A hybrid cluster head selection model for Internet of Things, Cluster Comput. (2017) 1–13.

BIOGRAPHY

Kaki Ramya Sree completed M.Tech in Embedded systems from KIET college, Kakinada. She works to optimize the system performance with different objectives related to wireless sensor networks. Her interesting areas are Data Communications, Digital Networks, Computer Networks, Communication Systems, Sensors, IoT and allied fields.

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