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# Metaheuristic Artificial Bee Colony Algorithm for Energy Optimization of sensor node in IOTSN

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**ABSTRACT:** Wireless sensor nodes are used to measure environmental condition such as temperature, sound, humidity, pollution level and wind .WSNS are used in wide application such as agriculture, Real time monitoring system, Military surveillance, UV-based drones, Health care etc. Sensor nodes are operated by battery. The battery life of sensor nodes and their lifetime can be increased by means of clustering those sensor nodes. Energy Optimization Routing using improved Artificial Bee Colony Algorithm used for the clustering of sensor nodes and ring topology is proposed in this paper .Sensor node consumes more energy in transceiving unit. AODV is the reactive protocol, this minimizes the amount of broadcast by creating routes on demand, it sends a route REQ packet using broadcast. To improve routing efficiency and packet delivery ratio the delay in updating the energy source is minimized. With the evolution of bio-inspired algorithms, the CH selection has been enhanced considering the behavior of network. Ring topology used for the efficient routing of packets. Factors to be improved are packet delivery ratio, delay and energy consumption of nodes.

**KEYWORDS:** Wireless Sensor Networks (WSN), CH (Cluster Head), AODV (Ad-hoc On demand Distance Vector), PDR

## I. INTRODUCTION

Wireless sensor network technology represents a paradigm of networking and computing. It consists of Homogeneous or Heterogeneous sensor nodes that senses physical environment and transmit data to the base station [1].Sensor node consists of four units:

1.sensing unit 2. Processing unit 3. Transceiving unit 4. Power unit. The Transceiving unit consumes more energy while transmitting and receiving the data. The sensor nodes are randomly spread across the network area, efficiently managing the energy is the huge task [2].The main problem faced by wireless sensor node is its limited resources. Normally the resources available are low storage, less processing power compared to complex instruction set computer, antenna system with limited gain, low energy backup or battery, and low bandwidth for communication[3].The Wireless sensor nodes are used in different application such us Military Surveillance, Health Monitoring, Environment Monitoring , Green House Monitoring, Industries Logistics and Robotics, Smart city, Transportation system. Design challenges in WSNs are Scalability, Culpability Tolerance, Cost of Production, and Hardware limitations, Topology of the Sensor Network, The Media of Transmission, and Consumption of power. Related works was detailed explained in section 2,Artificial Bee Colony Algorithm is explained in section 3, Performance and analysis explained in section 4,Conlusion in section 5.

## II. RELATED WORKS

Though the design and implementation of energy efficient clustering protocol are demanded, there are number of issues raised during real time working. Designing an energy efficient routing based on the cluster scheme to support heterogeneity, scalability, and hierarchy in topology are the main goals in the wireless sensor network to prolong the network lifetime[2].Cluster head selection of the wireless sensor network during routing based on the technique called Hybrid Enhanced Artificial Bee Colony and Firefly Algorithm-Based cluster head selection, Fire fly algorithm is proposed in employed bee phase and onlooker bee phase ,based on the potential of the sensor node cluster head is selected[4].To select the best number of cluster for centroids using Artificial Bee Colony with variable length

representation, DBI to calculate the cluster’s average similarity[5].Data transmission and receiving consume energy, which may lead to the loss of whole network, to improve the network lifetime the Hybrid technique of ABC with Genetic algorithm and k-means algorithm besides LEACH protocol helps to prolong the WSN lifetime[6]. Basic DAACA eliminates the repetition of creating and preserving the WSN topology which results in preventing computational overhead and prolongs network lifetime by saving energy, in this paper Artificial Intelligence is used to meet the specific objectives for the WSN [7].Routing and cluster head selection based on LEACH protocol extends network longevity while eliminating intra-cluster collisions for large as well as small networks[8].The increase in the number of iterations increases, the number of packets delivered also increased by ABC algorithm[9].A stable energy stabilization clustering protocol with the reduced inter node distance and delay in order to maintained the predicted degree of WSN network life expectancy, FAO incorporated with ABC to improve operating process and avoid the problem of delay convergence[10].The scout bees not only stores the food sources but also food available that can be utilize at an initial state from an abandoned food source for the detection of malicious behavior of a network by using Adaptive Defense Approach with ABC[11].

### III. PROPOSED SYSTEM

#### System model and assumption:

Sensor nodes are randomly distributed in the network area to form the clusters, CH is selected based on the fitness value, CH gathers data from cluster member and aggregates the collected data and forward to the base station.

#### Assumptions:

- i. Nodes and BS in the network are static.
- ii. All nodes are homogeneous.
- iii. Nodes energy consumption is based on the distance between CH and BS.

#### Energy Model:

Energy consumption of the node depends on the transmitting and receiving of the data of n bit is calculated over the distance d is expressed as

$$ET_x(m, d) = \begin{cases} E_{cons} * m + \epsilon_{fs} * m * d^2, & d \leq d_0 \\ E_{cons} * m + \epsilon_{amp} * m * d^4, & d > d_0 \end{cases} \quad (1)$$

#### Proposed cluster head selection ERO- iABC:

The proposed algorithm performs two task 1) cluster head selection 2) cluster formation, AODV protocol is also proposed to transmit the data from cluster head through the possible route based on this protocol. Cluster members and cluster head are connected by Ring protocol, it stabilize the connection .At initial phase all the nodes are initialized with equal energy level. After the transmission of data every time energy level of the node is calculated and cluster head is selected based on the residual energy of cluster member.

#### Initialization phase:

In initialization phase, the number sensor nodes are assigned randomly as

$$\begin{aligned} X_i &= X_{i1}, X_{i2}, \dots, X_{id}, \\ i &= 1, 2, 3, \dots, n; \\ X_{(id)} &= x_d^{\min} + \text{rand}_n (x_d^{\max} - x_d^{\min}) \end{aligned} \quad (2)$$

Where  $\text{rand}_n$  is the random number ( $\text{rand}_n \in [0, 1]$ ) upper and lower geographic dimension d for the food source is given as  $x_d^{\max}$  and  $x_d^{\min}$ . The system enters into bee updating phases such as employed bee, onlooker bee and scout bee.

**Employed bee phase:**

In the employed bee phase, it searches the neighbor node  $v_i$  energy level and fitness value for the new energy node is calculated and compared with the node already connected in the network, if the fitness value of the new node is high, it will be connected to the network otherwise it searches for other nodes  $i \in \{1,2,\dots,N\}$ ,

$$V_{id} = x_{id} + \text{rand}(-1,1) \cdot (x_{imax} - x_{imin}) \tag{3}$$

**Onlooker bee phase:**

In the onlooker bee phase, the new node is selected for clustering based on the probability of each neighbor node

$$\rho_i = \frac{fit(x_{(i)})}{\sum_{n=1}^{FS} fit(x_{(n)})} \tag{4}$$

Where FS is the set of nodes in network  $k$ ,  $p_i$  is the fitness of the nodes. As the fitness value of the node is satisfied then it is connected to the cluster. If the fitness value is not satisfied then the cluster head is exploit as

$$\rho_i = x_{(i,d)} + \text{sign}(\text{rand}_D) \tag{5}$$

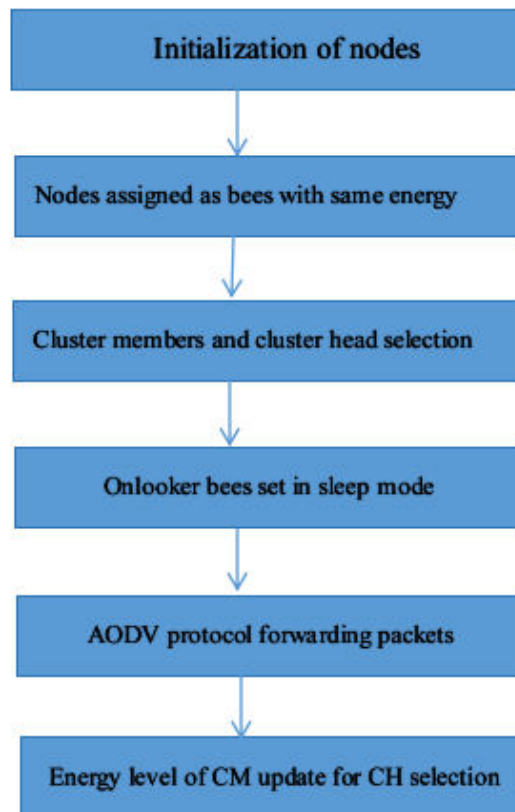


Figure 1:Flow chart of Artificial Bee Colony Algorithm

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$$\rho_i = x_{(i, d)} + sign(rand_D) \tag{7}$$

**Scout bee phase:**

The unemployed bees that choose their food sources randomly are called scouts. Employed bees whose solutions cannot be improved through a predetermined number of trials, specified by the number of users of the ABC algorithm and called “limit” or “abandonment criteria” herein become scouts and their solutions are abandoned. Then the converted scouts search for the new solutions, randomly. Cluster Head is selected based on the fitness value of the nodes and is replaced by the newly potential node as CH.

$$X_{(i, d)} = X_{(i, d)} Z_{cauchy}(0,1) \tag{8}$$

The scaling parameters set as 1 and Cauchy distribution function is set to 0, cauchy is given by

$$Z_{cauchy}(0,1) = \frac{1}{\prod (1 + fit(x_{(i)}))^2} \tag{9}$$

| Parameters        | value             |
|-------------------|-------------------|
| Nodes initialized | 39                |
| MAC-LAYER         | 802.11            |
| Routing protocol  | AODV              |
| Network size      | 1300 x 1000       |
| Comparing schemes | OGABC and IABCOCT |
| Initial Energy    | 1000 J            |

**Table 1 Configuration Parameters**

**Cluster Formation and self adapting update strategies:**

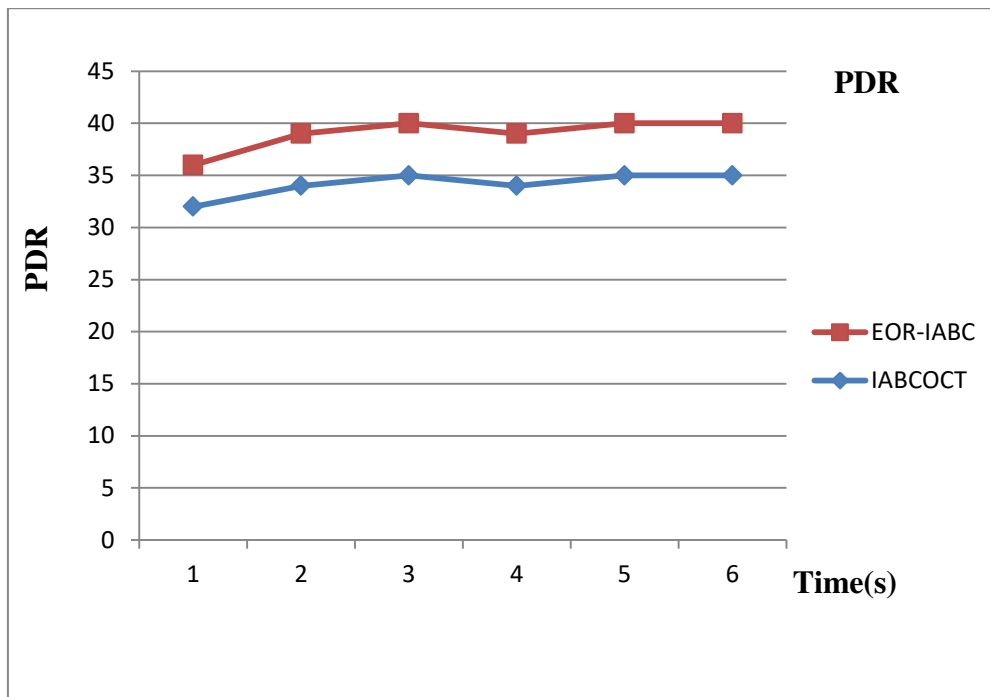
In this phase, cluster is formed after the cluster head selection which is near to the base station. Cluster formation by using AODV protocol, initially source node will send Route Request i.e.RREQ packet to its neighbors. Node “Y” and “Z” will check for route to destination node in the network. Node “Z” is the last node but the destination. It will send the RREQ packet to “X” stating “Route Not Found”. For cluster head selection nodes within the communication range receive the CH request message and then authenticated by CH, then form into cluster. At each round new cluster head is updated, successfully. Periodic and self adaptive update of CH selection is carried out in scout phase.



**IV. PERFORMANCE AND RESULT ANALYSIS**

**i. Packet Delivery Ratio vs Time**

Figure.2 shows the time vs packet delivery ratio, it is seen from the graph initially the nodes started to send packets in equal interval of time, as time increases packet delivery ratio also increases in Energy Optimized Routing improved Artificial Bee Colony Algorithm. AODV protocol optimize the best route for transmission. Comparing to IABCOCT in the proposed method PDR is high.



**Figure 2 Packet delivery ratio vs Time**

**ii. Number of Rounds vs Time:**

Figure 3 shows the Number of rounds taken for selecting Cluster Head, in the proposed method Cluster Head is selected based on the energy level of node and the distance between the source and base station. As time increases number of rounds also increases that increases the network lifetime.

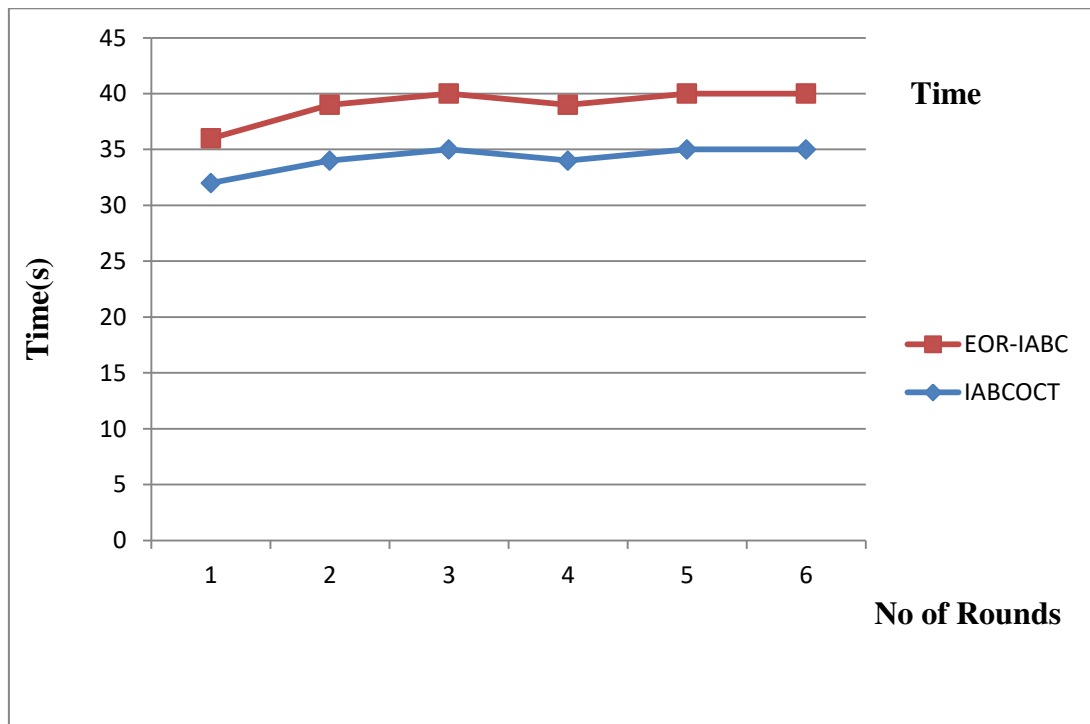


Figure 3 Number of rounds vs time

**iii. Energy vs packet:**

Figure 4 shows the energy consumed in the packet transmission. In ERO-iABC for the transmission of 5bytes it consumes 5(J),but in IABCOCT for transmission of 5bytes it consumes 14(J).As the number of packets increases the power consumption also increases in OABCOCT. In the proposed method, clustered nodes send data from source to destination using AODV protocol it send RREQ to establish route for data transmission, except the nodes in transmission are set in sleep mode. It increase the network lifetime .

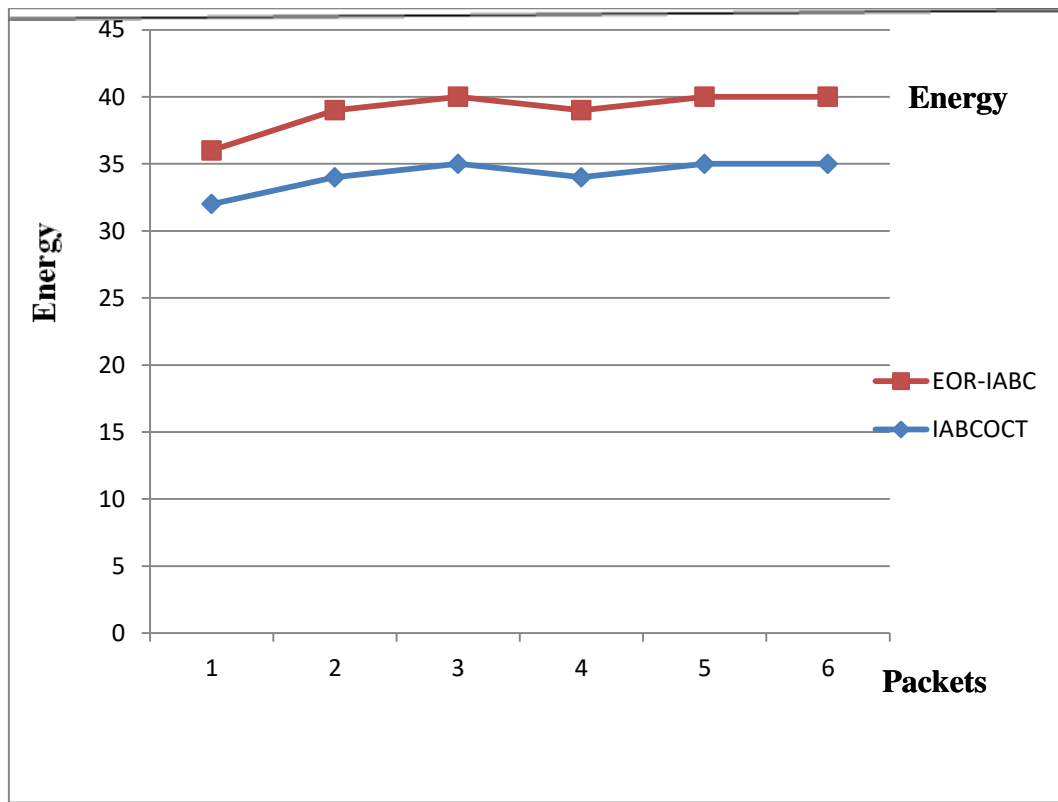


Figure 4 Energy vs packets

## V. CONCLUSION

To increase the network lifetime and battery life of the sensor nodes, EOR-iABC with AODV protocol using ring topology, energy consumption of node is decreased by set the node in sleep node which are not in data transmission route. The ring topology helps to extend the lifetime of network. As the number of round increases in minimum time helps to increase the transmission time and increase the lifetime of battery. Cluster Head is selected based on the Grenade Explosion Method and Cauchy Operator for the long range selection of nodes, fitness value is calculated at each round so there is a probability of selection of cluster head of all the nodes. Comparing to IABCOCT in proposed system energy consumption of node after transmission is reduced and network lifetime is increased.

## REFERENCES

1. Khaoula Ziamen, Mohamed- El-Amine Brahmia, Laurent Moalic Abdelhafid Abouaissa, Lhassane Idoumghar, A Survey of Artificial Intelligence based WSN deployment techniques and related objectives modelling, IEEE Access 2022, 3217200.
2. Punith Bekal, Pramod Kumar, Pallavi R Mane, Ghanshyam Prabhu, "A Comprehensive review of Energy Efficient Routing Protocols for Query driven WSN", F1000 research 2023, 12:644.
3. Santosh V. Purkar, R.S. Deshpande, "Energy Efficient Clustering Protocol to Enhance performance of Heterogeneous WSN", Hindawi Journal of computer networks and communication 2018, 2078627.
4. Sawsan Alshattnawi, Lubna Afifi, Amani M. Shatnawi, Malek M. Barhoush, "Utilizing Genetic Genetic and Artificial Bee Colony Algorithm to extend the WSN lifetime", CISJ, 2022, 21.1.2514.
5. Sabreen Fawzi, Maytham Alabbas, "Optimal k-means clustering using Artificial Bee Colony with variable food sources length", IJECE, 2022, 5443.
6. Xingsi Xue, Ramalingam Shanmugam, Sathesh Kumar Palanisamy, Osamah Ibrahim Khalaf, Dhanasekaran Selvaraj, Ghaida Muttashar AbdulShahib, "A Hybrid Cross Layer with Harrish-Hawak-Optimization based Efficient Routing for Wireless Sensor Networks", Symmetry 2023, 15020438.



7. Walid Osamy,Ahmed M.Khedr,Ahmed Salim,Amal Ibrahim Alali,Ahmed A.El-Sawy,"Recent studies utilizing Artificial Intelligence Techniques for solving data collection,aggregation and dissemination challenges in Wireless Sensor Networks",Electronics 2022,11030313.
8. Trupti Mayee Behra,Umesh Chandra Samal,et.al"Energy Efficient Routing protocols for Wireless Sensor Networks:Architectures,Strategies,and Performance",Electronics, 2022.
9. Dr.I.Jeena Jacob,Dr.P.Eppy Darney,"Artificial Bee Colony Optimization Algorithm for Enhancing Routing in Wireless Networks",vol. 03/No.01,2021.
10. J.Sengathir,A.Rajesh,Gaurav Dhiman,S.Vimal,C.A.Yogaraja&Wattana Virisitavat,"A novel Cluster head selection using Hybrid Artificial Bee Colony and Fire fly Algorithm for Network lifetime and stability in WSNS",Connection science vol 34,386-408,2022.
11. B.JeyaPriya,D.Arulanantham,P.Anitha,A.Arthi,"An Energy-Efficient Ant Routing for the Internet of Things Sensor Networks",IJRASET,vol 9,2021
- 12.Mirza Samiulla Beg,Akilesh A.Waoo,"Modified Artificial Bee Colony Algorithm using Dynamic Technique,"IJIRT,Vol 2349-6002,2021.
- 13.Subrendu Guha Neogi,"Congestion Aware Routing Protocol for 6TiSCH Wireless Sensor Networks",ETJRI ,2581-8678 ,2020.
- 14.Balwant Kumar,Dr.Dharmendra Kumar,"A Review on Artificial Bee Colony ",International Algorithm Journal of Engineering and Technology,175-186,2013.
- 15.Poorana Senthilkumar.S ,Subramani.B,"Enhanced Objective Function ETX Metric in Routing Protocol for Low power and Lossy Networks(RPL)",IJCNA,Vol 9,2022.
16. Lakshmeesha,Dr.Shiva Murthy.G,"Dynamic Cluster Head Selection Mechanism for Wireless Sensor Networks",IJECS,Vol 5,2319-7242,2016.
17. Mirza Samiulla Beg,Dr.Akilesh A. Waoo,"A study in Wireless Sensor Network(WSN) using Artificial Bee Colony Algorithms with Dynamic Technique",IRJET,Vol 7,235-0072,2020.
18. Chirag Ganguli,ShiShir Kumar Shandilya,Aivan Izonin,"Design and implementation of Adaptive network stabilization based on Artificial Bees Colony Optimization for nature inspired cyber security",Journal of king and Saud university -Science 35 (2023)102713.



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