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Energy Efficient Wireless Sensor Node Clustering Using Butterfly-PSO

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Abstract- Remote Sensor Networks are utilized in variety of region since they can be appropriate for different situations. It can work autonomously in the state of hazard places where a human's nebulous vision is spirit or hard. This paper introduces cluster center selection genetic algorithm using Butterfly and PSO (Particle Swarm Optimization). Selection of nectar by butterfly algorithm with particle swarm optimization improves the cleverness of butterfly-PSO for cluster node set identification. Hence final cluster node obtained from the algorithm increase packet count as well. Experiment was done on different dimensional area with various number of nodes. Result shows that proposed has effectively analyze data and improve evaluation parameters values as compare to previous other approaches.

Index Terms- Cloud Computing, Load balancing, Machine Learning, Soft Computing, Virtual machines.

I. INTRODUCTION

The significance of Wireless Sensor Networks is observing and gathering information from the earth. A WSN ordinarily comprises of sensor nodes as well as sink(s) that can move inside the system. These sensor nodes are dissipated in the sensor field and it can gather the nearby ecological data, process them into helpful information bundles, and send the parcels to the sink node by multi-jump appeared in fig. 1. The sink node transmits the parcels to head through web or GPRS. A large portion of these sensor nodes having constrained battery life, restricted transmission control, low memory and restricted preparing capacities [1].

With the emotional advancement of hard-product innovation, the CPU and glimmer memory are ending up extremely littler, all the more dominant and less expensive. Subsequently, the memory and handling capacities of sensor nodes won't be the most essential issue for the utilization of WSNs. Not with standing, the battery innovation has neglected to get an achievement yet. Clearly, the vitality volume of sensor nodes will be the key bottlenecks for the advancement of WSNs in an exceptionally prolonged stretch of time. So the examination going on enhance strategies for enhancing vitality productivity of WSNs for the most part include the vitality proficient steering calculations and grouping calculations. In this way, WSNs require powerful instruments to use and resolve the restricted assets [2].

Clustering is a standout amongst the best procedures [1, 3] for bringing down energy utilization. In a bunched Wireless Sensor Network, sensor nodes are gathered into a specific number of groups, every one of which comprising of a group head (CH) and some non-bunch head nodes (non-CHs). CH gathers data from all the group nodes and after that advances to different CHs or base station (BS), while non-CHs nodes are in charge of detecting condition and transmitting data to the relating CH [3]. The looks into have been led for accomplishing high energy effectiveness in grouped calculation WSNs [1-6].

The rest of this paper will be: Section 2 discusses various approaches applied by different authors in WSN node clustering for improving energy efficiency of the network. While third section discuss proposed technique. In Section 4 the Clustering Parameters are explained and comparison of results was done with existing methodology [10]. Finally the conclusion and future work was detailed.

II.RELATED WORK

In [5] researcher proposed algorithm that base station can be situated at focal point of the algorithm and system is working in two dimensions. System group development is finished in the1standin second dimension the determination of circulated bunch heads is performed. For the choice of CH parameters utilized are node situating and the energy of remaining. In [6], researcher proposed another IDS system utilizing cross breed inconsistency recognition, by utilizing an information mining algorithm, the algorithm utilized is K-implies Clustering. For location the interruption.

The K-implies algorithm of the Clustering assembles the examples of interruptions consequently over prepared information. Coordinating the exercises of the system against these examples of recognition the interruptions are identified. The researcher assessed the methodology over a remote sensor arrange dataset that was made by OpNet modeler, that contained different characteristics, for example, traffic got traffic sent a start to finish delay, the point of the introduced EAFCA is to give a skillful decision procedure of the CH concerning all the imperative favorable circumstances that helped alongside a straightforward hand-off model between group.

From the outcome that was taken from HNA and FND methodologies demonstrated that the sensor organize life span and consequently guaranteed the heap all through dissemination the system working. In [7] (Hbrid bunching energy mindful steering convention) H-CERP has been proposed to shape the effectiveness of the groups with lesser head check of the group than the ideal estimations and utilizing the correspondence of multi hop with passages nodes for correspondence alongside the base station.

This cutting edge procedure gives the frameworks more preferences that the inclusion of the sensors and system lifetime are much essential at no extra expenses. In [8], scientists give a energy proficient Clustering strategy, in view of fake honey bee settlement algorithm and factional math. MFABC try to augment the system energy and life time of nodes by half breed ideally choosing group head. This algorithm created to control the union rate of Artificial Bee Colony with the recently structured wellness work which considered three targets like, energy utilization, remove ventured out and deferrals to limit the general goal. The execution for bunch head determination of MFABC is contrasted and three conventions; LEACH, PSO and ABC-based steering as indicated by energy and life time. The reenactment results appeared, FABC is amplifies the energy and life time of nodes as contrasted and existing conventions.

III.PROPOSED METHODOLOGY

Here explanation of proposed work Butterfly-PSO (Genetic Algorithm Based Cluster Head Selection) is done by two method first is by block diagram so it act as graphical representation of whole work while in second explanation of each step is done in word form.

So reading this part make clear understanding of whole work in detail. In this work a approach is adopt for finding the best set of cluster center by using genetic algorithm. Here whole work is depend on the random condition of the available energy present in different nodes In this work energy obtained from the nodes act as important feature for the cluster selection. Butterfly-PSO algorithm finds the best set of power resources for particular set of demands.

1.Develop Region and Assign Node position

Develop an MxM region place N number of nodes present in the region. In order to assume the initial stage of the network some energy need to be set for each node in the network. While calculation of energy losses for transmitting and receiving a bit from distance d is depend on eq. 1 and 2.

$$E_{Tx}(L,d) = E_{elec} \times L + a \times L \times d^{b} \text{----------Eq. 1}$$

$$E_{Rx}(L,d) = E_{elec} \times L \text{----------Eq. 2}$$

In above equation E_{elec} the energy consumption per bit, L represents the data size in bits while d is the distance I unit between source and destination. As per the d value constant a and b are assume this can be understand as if d is less than a d_0 reference distance than a and b will be a_{fs} and 2. Otherwise, they will be $a_{amp}$and 4. Now value of $a_{fs}$and $a_{amp}$are the amplifier cost of the nodes. So to send packet longer than reference distance higher energy need to spend.

2. Estimate K Cluster

As per [10] optimal size of cluster in a wireless network where N nodes are moving with a area of MxM is depends on eq. 3.

$$K_{opt} = \sqrt{\frac{N \times \varepsilon_{fs} \times M^2}{2\pi(2E_{elec} + E_A)}} \text{----Eq 3}$$

Where ε_{fs} is amplifier power consumption of the free-space, E_A is energy consumption required for nodes to fuse *k*-length data.

3. Data Analysis- Here input data contain two information first is nodes position while second is available energy in each node.

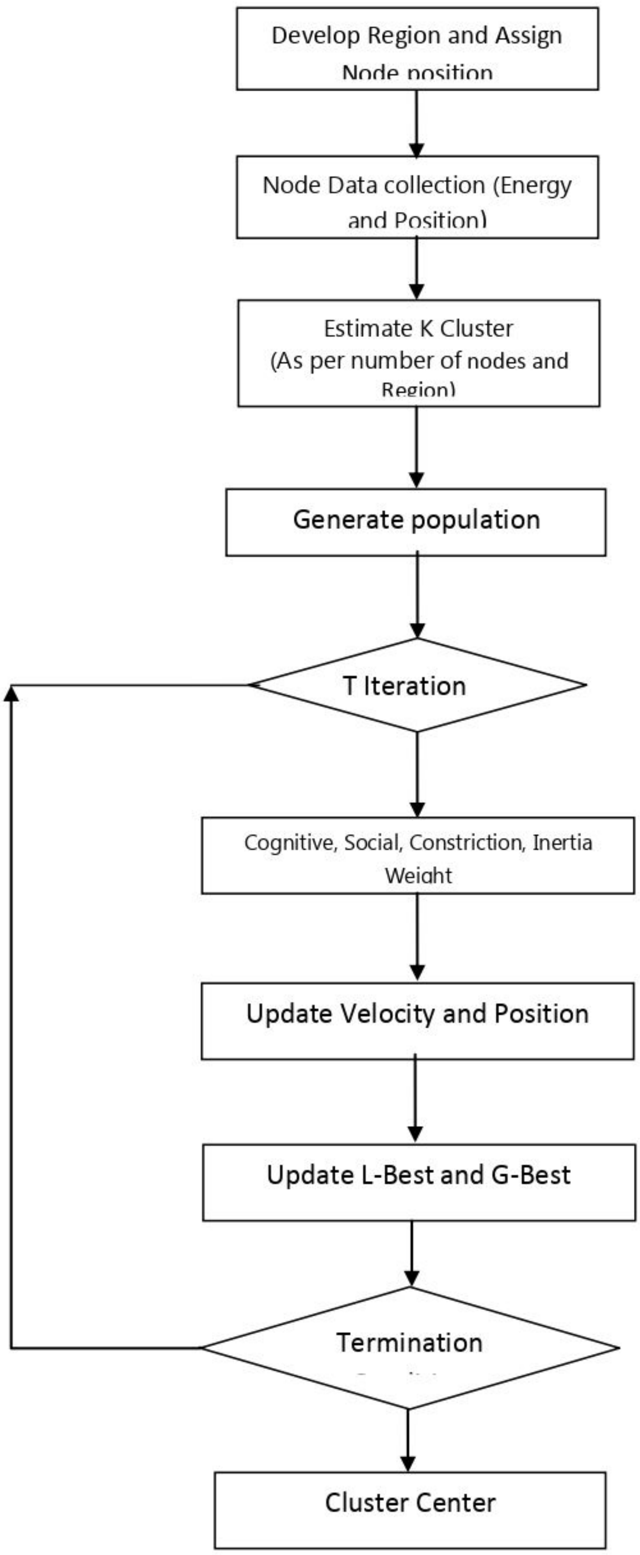

Fig. 1 Block diagram of butterfly-PSO.

Here on the basis of both parameter selection of cluster center and cluster size is done by using Butterfly-PSO genetic algorithm. In this model Butterfly-PSO was used for clustering the wireless nodes. In this work genetic algorithm BUTTERFLY-PSO is use because this takes two phase learning. Main motive of this model is to reduce the dataset size and increase the clustering accuracy.

4. Fitness Function in BUTTERFLY-PSO- The first part is the normalized energy consumption. The energy consumption for non-CHs is defined as

$$E_{non\text{-}CH}= \sum_{i=1}\sum_{j=1} (E_{Tx}(L, d(CH_i, N_j)) \text{ x } Xij \text{ -----eq. 4}$$

In above eq. 4 CH_i is cluster head and N_j is J^{th} non cluster node from N set of node for which cluster need to identify. D is again a distance between CH_i and N_j node. Here X_{ij} is a constant value which may be 0 to 1. The energy consumption for CHs is defined by eq. 5 as

$$E_{CH}= \sum_{i=1}(Lx|Cij|x(E_{DA}+E_{Rx})+E_{Tx}(L, d(CH_i, BS)) \text{-----Eq. 5}$$

where jCij is the number of members belonging to the ith CH, and E_{DA} is the energy consumption for data collection.

$$D = E_{CH} + Enon\text{-}_{CH} \text{-----Eq. 6}$$

So the matrix D of eq. 6 contain all the values of the centriod distance from the nodes present in one cluster then find the minimum distance which will evaluate specify best possible solution.

5. Generate Population- Here assume some possible solution set that are the combination of the random cluster head. This was developed by the random function shown in eq. 1. This can be understand as let the number of cluster be K and number of initial population is P, then one of the possible solution is Cc $=\{N_1, N_5, N_7.....N_m\}$ this can be assume as the solution set. While P = [Cc1, Cc2,......Ccn] is an population obtain randomly by eq. 7 while only those node participant who have energy greater than T_E (Threshold of Energy), where m is number of cluster center and n is number of chromosomes.

$$P \leftarrow Rand(m, n) \text{----Eq. 7}$$

6.Evaluate L-Best and G-Best- This step find best chromosome form the population and fitness value of this best solution act as Local best and Global best value. Here it was obtained by evaluating the fitness value of each probable solution in the population. After this iteration of the algorithm starts where L-Best and G-Best update regularly.

7. Iteration Steps - This involve calculation of Sensitivity of Butterfly by eq. 8 than cognitive values with constriction factor and inertia weight were evaluate by eq. 9, 10. Here velocity and position of the butterfly also get updates which are parameters of PSO. So as per position matrix crossover is done to update population.

8. Sensitivity of Butterfly

$$S = e^{-(M_r - C_r)/M_r}\text{----Eq. 8}$$

Where S is sensitivity of r^{th} iteration where M_r is maximum number of iteration takes place and Cr is current iteration of this B-PSO algorithm.

9.Cognitive and Social parameters

$$C_1 = y * \left(\frac{C_r}{M_r} + x\right)$$

$$C_2 = x * \left(\frac{C_r}{M_r}\right)$$

Where x, y are constant.

10.Constriction Factor C_{eq}

$$\alpha = C_1 + C_2$$

$$C_{eq} = 1 - \alpha - \sqrt{\alpha^2 - 4\alpha}\text{----Eq. 9}$$

11.Inertia Weight W

$$W = y + \frac{(M_r - C_r)}{M_r}\text{-----Eq. 10}$$

12.Update velocity V and position X of each probable solution

$$V_{i+1} = C_{eq} * (W * V_i + S \quad * (1 - p) * R * C_1 * (L_{best} - C_r) + p * R' * C_2 * (G_{best} - C_r)$$

$$p = \frac{L_{best}}{(L_{best} + G_{best})}$$

$$X = R*P*V_{i+1}$$

In above equation V is velocity, X is position while R and R' are random number whose values ranchangege between 0-1. p is probability of nectar for the butterfly selection. So as per X and V values crossover operation were performed.

13. Crossover- In this work population P is updated as per X column wise and V values update P row wise. Change in column help to assign new position for the cluster center in same probable solution. While changes in row value as per L_{best} solution increase the chance of generation of better fitness probable. Solution.

14. Update G-Best- After each iteration values of G-Best get optimize if new probable solution fitness function values are better than previous G-Best values. Hence if two iteration shows same values than iteration will break.

15. Final Solution- In this work after sufficient number of iteration best possible cluster centers are obtained and assign nodes to those clusters. Here each cluster is represent by its cluster center.

IV.EXPERIMENT AND RESULT

In order to conduct experiment and measure evaluation results MATLAB 2012a version software is use. This section of paper show experimental setup and results. The tests were performed on a 2.27 GHz Intel Core i3 machine, equipped with 4 GB of RAM, and running under Windows 7 Professional. Three benchmarks are used to evaluate the performance of the clustering algorithm with different objective function. The first benchmark is 70 sensor nodes in a 100m x100m region, the second benchmark is 100 sensor nodes in a 100m x 100m region. While third has 150 nodes and 150x150m region.

1. Evaluation Parameters

1.1Number of Rounds: One cycle of sending packet from non cluster center node to Base station is considered as Round. Here numbers of round are count for each comparing methods.

1.2Packet Transfer: This is the number of packet transfer done in the WSN while all the node get discharge, so wireless arrangement having maximum number of packet transfer is good solution.

2. Results

Results of the butterfly-PSO are compare with the existing method in [11].

Table 1 Comparison of number of rounds between proposed and UCATD.

Nodes	Area	UCATD	Butterfly-PSO
70	100x100	18859	19045
100	100x100	19706	21117
150	150x150	9590	11007

Above table 1shows that number of rounds value of Butterfly-PSO was high as compared to UCATD [10]. It has been observed that Butterfly-PSO centroid selection method is efficient as compare to the previous. Here iteration in both work increase the this evaluation parameter value but selection different set of features for clustering make high number of rounds value of Butterfly-PSO.

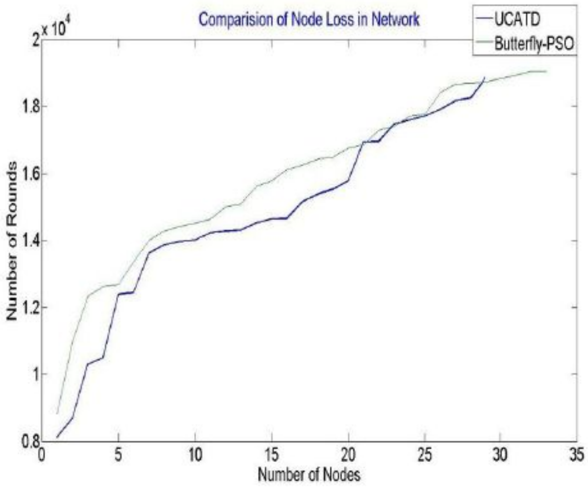

Fig. 2 Number of rounds comparison against 70 nodes decay for 100x100m area.

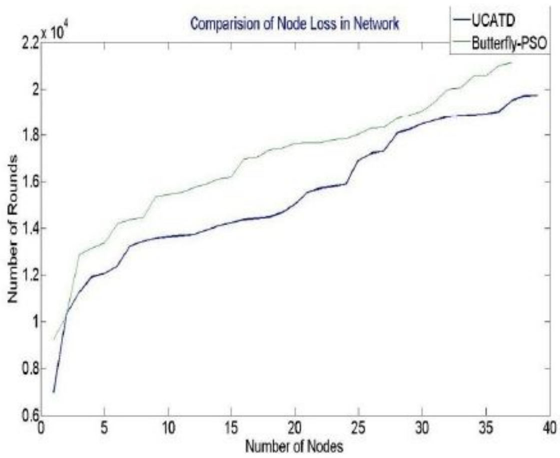

Fig. 3 Number of rounds comparison against 100 nodes decay for 100x100m area.

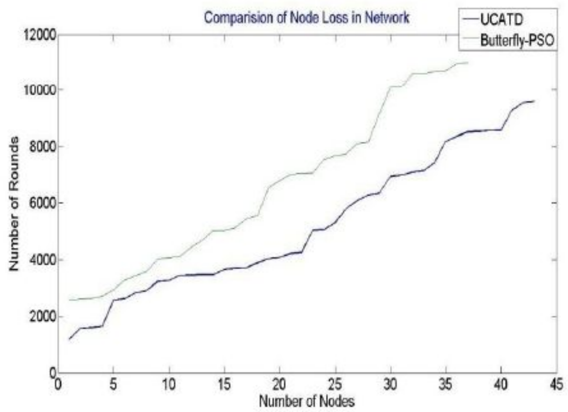

Fig. 4 Number of rounds comparison against 150 nodes decay for 150x150m area.

Above Fig. 2 3 and 4 shows that Node Discharge Round value of Butterfly-PSO was high as compared to UCATD [11]. It has been observed that Butterfly-PSO centroid selection method is efficient as compare to the previous. Here iteration in both work increase this evaluation parameter value but selection different set of features for clustering increase Node Discharge Round value of Butterfly-PSO.

Table 3 Comparison of total Packet Transfer for proposed and UCATD.

Nodes	Area	UCATD	Butterfly-PSO
70	100x100	691842	723102
100	100x100	873915	1085483
150	150x150	373222	560018

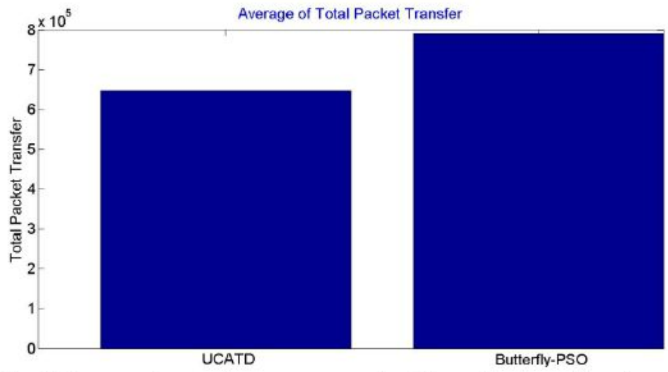

Fig. 5Comparison of average packet transfer for all set of region and nodes.

Above table 3 and fig. 5 shows that total packet transfer value of butterfly-PSO was high as compared to UCATD [10]. It has been observed that butterfly-PSO centroid selection method is efficient as compare to the previous. Here iteration in both work increase this evaluation parameter value but selection different set of features for clustering increase total packet transfer value of butterfly-PSO.

Table 4 Comparison of First Node Discharge Round for proposed and UCATD.

Nodes	Area	UCATD	Butterfly-PSO
70	100x100	8679	10975
100	100x100	10199	10280
150	150x150	1572	2610

Above table shows that First Node Discharge Round value of butterfly-PSO was high as compared to UCATD [10]. It has been observed that butterfly-PSO centroid selection method is efficient as compare to the previous.

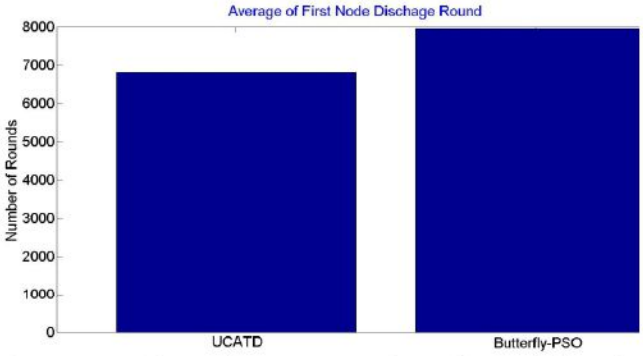

Fig. 5Comparison of average number of rounds for all set of region and nodes.

V.CONCLUSION

Wireless sensor networks are considered one of the best sources for monitoring remote fields and critical conditions which are out of range from human's perception. Here these calculation are dynamic and prepared to work continuously in unconditional circumstance without any earlier preparation. Here genetic algorithm based clustering was done. Use of this hybrid algorithm has increase the node packet routing efficiency by selecting correct set of fix cluster centers. Result shows that packet transfer rate was highly increase as compared to UCATD approach. In future a perfect algorithm is desired which can analyze data of the WSN device and increase routing in safer way against different attacks.

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