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Hybrid BPSO Genetic Algorithms Based Life Span Extension of Wireless IOT Devices

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Abstract

Information collection from unconditional geographical location was done by IOT devices. Hence life span of those devices plays an very important role. Increasing the hardware requirement for this will directly increase the cost of devices, hence logical solutions are proposed by different researcher for this issue. This paper has also resolved this issue by utilizing the hybrid genetic algorithm combination term as butterfly and particle swarm optimization. This hybrid algorithm gives an effective cluster selection method which reduce packet transfer cost in term of energy. Here paper has proposed a fitness function based on position of sensor node and energy value both so resultant clusters are better. Results are compared with existing algorithms on various size of region and number of nodes. Experiment shows that proposed BF-PSO based life span expansion is better on different evaluation parameters like number of rounds, total packet transfer.

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

I. INTRODUCTION

Among the present development in the field of sensors, a real-time application has gained huge interest amongst technocrats and researchers. To abolish the hurdles of the sensors, technologists, and researchers found a solution by putting up the real-time applications of Wireless sensor networks (WSN). The real-time sensors can instantly trace, sense, and send reaction to the end-user for further attending of the acquired information. Above all, the real-time application is anxious with the presentation of essential applications that need restricted hindrance latency. Real-time wireless communication is a growing application field of WSNs that includes a prospective fundamental study direction. Real-time applications competent to examine, respond immediately to customer input, or categorize an outer atmosphere. The outer environments are normally associated to the computer system via sensors, actuators, and input-output procedures. Wireless device networks that permit the network restricted delay assurance, that is vital for the end to end packet deliverance, are named as real-time WSN [1,2].

Wireless sensor network (WSN) is of the utmost significance in computer networking for the insightful area and in records set. WSN discovers its application in several areas, jointly with performance and information storage. Due to the rapid urbanization, the duration of the applications of WSN has been increasing immensely. WSN has numerous sensors that communicate through causation data from one gadget to a special sensor in a remarkably large space through packets. WSN is collectively developed in several fields like armed forces police examination [3], the fitness care business [4], and other industries [5]. The appearance of 3rd-millennium industries makes it fascinating to analyze WSN. The meticulous execution of WSN was launched in 1950 and also the USA military utilizes this machinery. The most

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important mature WSN was named as the “Sound Surveillance System” (SOSUS). It had been an adapted prospect of the risk of underwater submarines. Acoustic tools (a different type of sensors accustomed to verify the amplitude of the waves) are used for (SOSUS) and this equipment is furthermore being adept nowadays [6]. These days, in every phase of life, a sensor is engaged to sense sound, sight any realistic vibrations, test the water level, view the temperature intensity [7], in smart homes [8], in mobile phones, and most extensively, we be likely to utilize several sensibly sensors inside the organic formation [9].

The WSN involves nodes, and all through these nodes, sensors communicate with one another. Each node broadcast information to the sink node that is supplementary. In several analysis works, asymmetrical agglomeration protocols could lessen the cluster radius or large collection of CMs with heavier transmit website guests secure to the sink node. As an outcome, CHs near to the sink node trouble lighter local sites guests and still be additional strength to forward the pass on guests. The distances from the drop node or step counts are adapted to style clusters. In an exceptionally non-uniform dispersed population, the node density manipulates intra-cluster power utilization which necessitates to be thought of to bind the cluster volume.

This paper resolve issue in LEACH-C [15] algorithm work has to specify the threshold probability value of cluster head selection manually. This reduces work efficiency in dynamic network as searching good threshold value again and again is complex. In [16] authors have first divide region into equal size than regression of merging and splitting final clusters were obtained. This merging, splitting increase analysis time. Hence Objective of this solution are Dynamically adopt new nodes when movement of nodes occur. Network should not be limited to a very small region, it should be ready to work on large region as well. Execution time for the clustering algorithm should be less.

II. Related Work

In [10], the reporting issue is revealed as a topology management technique in WSNs. The designed reporting method is categorized into three types equally: area coverage protocols, barrier coverage protocols and sweep coverage protocols. Area coverage protocols are further categorized based on these types (that is. static, mobile or hybrid) of sensors reachable in the WSNs and in addition the coverage demands (1-coverage or k-coverage). Additionally, barrier coverage protocols are calculated for each developed and probabilistic intelligence model.

The writer of [11] proposed a rapid survey on k-coverage hurdles and protocols. The protocols were above each grouping, in two modules: k-coverage verification protocols and sleep scheduling protocols for k-coverage issues.

The analysis of the evolutionary algorithm (EA)-based sleep scheduling practices is given in [12]. The author highlights the major reason behind accepting EA in sleep scheduling practices. In accumulation, the assessments of sleep scheduling practices are classified, based on the EA they established, in four kinds: Swarm intelligence (ant colony optimization) (ACO), 2.particle swarm optimization (PSO), 3. Pulse-coupled biological oscillators (PBO)) protocols, 4.genetic algorithms (GA), differential evolution (DE), cellular automata, and protocols that utilizes substitute ranges of EAs.

TL-LEACH [13] utilizes the thought of two CHs named as primary and secondary CHs. The set of protocols revolves the local cluster BS randomly. Just similar to LEACH, CHs in first stage gathers information from member nodes, at the same time, the CHs in the second stage holds CHs of the primary stage as a member node. This stabilizes the network load, due to which the resultant network endurance will boost.

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In [14], novelists have anticipated two role methods for spread node utilization in an extremely diverse WSN identified as lifelong-oriented and hybrid consumption. The investigation offers a trade-off between life and possessions in giant-scale networks and reproduction shows advanced end results.

In [17] identify the cluster center head as the remaining energy and distance from the sink station. For this author of this paper has use fuzzy logic as this reduce the energy losses when packet transfer. Hence clustering increase the life span of the network. Fuccy C mean based clustering performance was also shown in [18] and it was obtained that FCM works better than LEACH.

III. Proposed Methodology

Assume Node in a Fix Region

As work focus on energy optimization of nodes, so a RxR region need to be developed for same. In this RxR region number of nodes were place which can dynamically change there position. Here a base station and sensor nodes organize in region as done in [19].Let transmission of packet having L number of bits for distance d from one node need E_T amount of energy, Eq. 1 shows calculation of E_R[20, 21, 22]. Estimation of energy losses for receiving L number of bits is shown in Eq. 2.

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

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

Where Eelec is energy need to covert analog to digital or digital to analog. Value of a and b constand depends on distance between the nodes. So for small distance than a threshold it will be less and for higher distance than threshold values are high.

Estimate Optimize Size of Cluster

Optimize size of wireless sensor network was obtained by Eq. 3. This equation of cluster center size estimation was depend on network area RxR, number of nodes N, other set of parameters are constants such as ε_{fs} which is free space consumption of amplifier power.

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

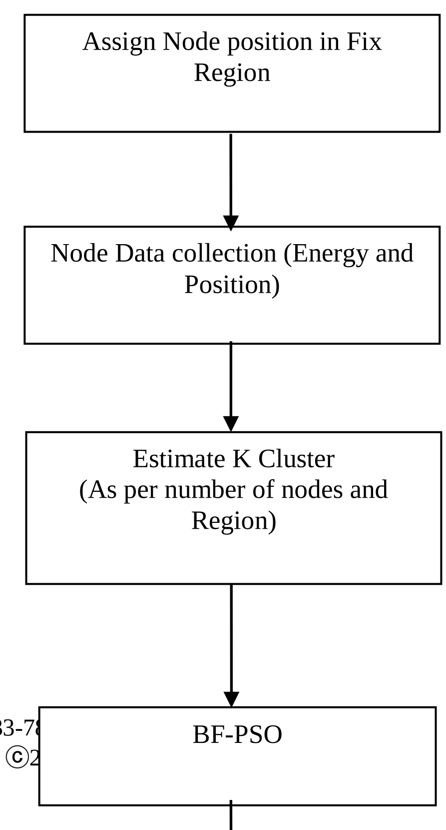

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Fig. 1 Block diagram of proposed work.

Data Collection of Nodes: Node positon in the network area plays an important role. While available energy in each node sustain the network so both type of information from node were utilize for further analysis.Selection of node in form of cluster center depends on position energy value.This paper increase life of WSN by applying BPSO algorithm where fitness value of this algorithm were estimate by energy and position of node.

Generate Population

Cluster center node selection is an NP hard problem in case of WSN. So paper has use BPSO hybrid algorithm which is combination of Particle Swarm optimization with Butterfly Genetic algorithm. So population generation was done in this step for BPSO algorithm, where each chromosome is a combination set of network node. So size of chromosome depends on number of cluster K, while population have any number of chromosome. So random selection of node in the chromosome was done by Gaussian function shown in Eq. 4.

Gp = Random(K, m)----Eq. 4

Where m is number of chromomse in the population.

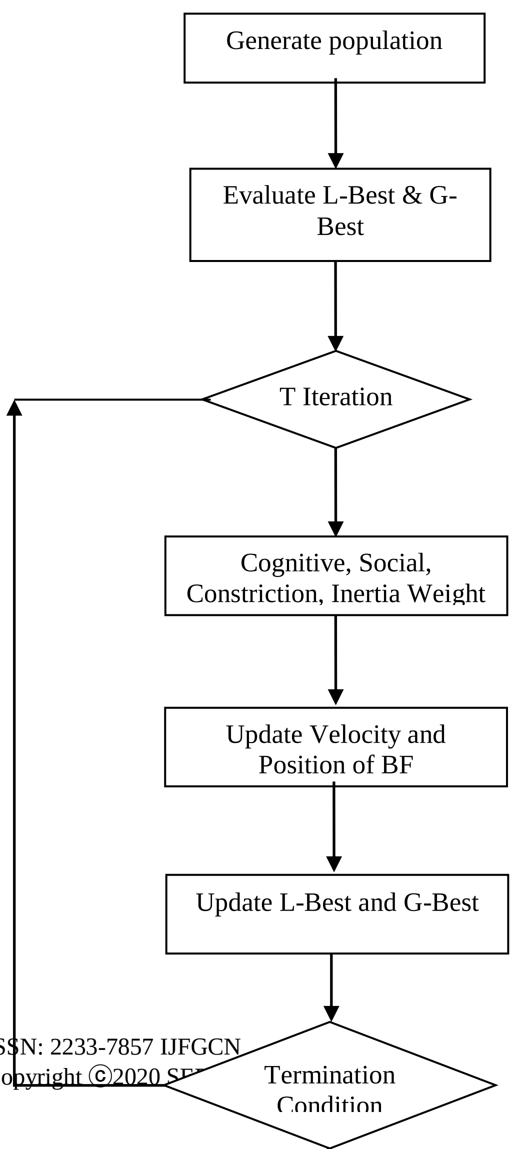

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Fig. 2 Block diagram of BF-PSO algorithm.

Local and Global Best

Estimation of chromosome fitness value depends on energy losses done when a packet transfer from all set of node to base station. So as per chromosome cluster center energy losses value depends where minimum energy consumption chromosome act as best solution. Following algorithm find fitness value of chromosome:

Input: Gp,

Output: Fv // fv Fitness Value

1. Loop I:m
2. Loop 1:k
3. $C_h \leftarrow G_p[m,k]$
4. Loop 1:N
5. $E[k,N]=$ RandxE_T(L, Distand(C_h, N)) // Rand value 0-1
6. EndLoop
7. EndLoop
8. $F_v[m] \leftarrow$ Sum(Min(E))
9. EndLoop
10. Lbest$\leftarrow$Min(F_v)

Out of all iterations minimum local best value act as global best. This Lbest and Gbest is for PSO algorithm, for first iteration both values are same [21].

Iteration Steps As BPSO include butterfly basic operation such as sensitivity Eq. 7, congnitive decision Eq. 8 and social decision Eq. 9. At the same PSO feature of velocity and position were update in each iteration as shown in eq. 10, 11. To merge both algorithm intertia weight value and constriction vale were calculate by Eq. 6, 9. used.

Sensitivity of Butterfly

$$S = e^{-(M_r - C_r)/M_r}\text{----Eq. 5}$$

where C_r is iteration count value, while $M_r$is total number of iteration allow for findin the best solution through the BPSO genetic algorithm.

Intertia Weight

$$W = y + \frac{(M_r - C_r)}{M_r}\text{-----Eq. 6}$$

Cognitive and Social parameters

$C_p = y * \left(\frac{C_r}{M_r} + x\right)$----Eq. 7

$S_p = x * \left(\frac{C_r}{M_r}\right)$----Eq. 8

Where x, y are constant

Constriction FactorC_{eq}

$$C_{eq} = 1 - (C_p + S_p) - \sqrt{(C_p + S_p)^2 - 4(C_p + S_p)}\text{----Eq. 9}$$

Update velocity V and position X of each probable solution

$V_{i+1} = C_{eq} * (W * V_i + S \quad * (1 - P) * r * C_1 * (L_{best} - C_r) + P * r' * C_2 * (G_{best} - C_r)$----10

$$X = r*P*V_{i+1}\text{----11}$$

Where r is random constant having value between 0-1.

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Finally as per PSO algorithm velocity value were update as per intertia weight and constriction factor, once velocity getupdate than position feature of the chromosome were also update by Eq.
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.

Crossover
Modification in the population was done by crossover operation where as per velocity value rows of the chromosome update by local best chromosome and as per position value column cluster center value were shuffle. Modification of chromosome were accept if child chromosome is better as compared to parent.

Update Global Best
At the end of each iteration global best value were compared with current local best value. So when local best value chromosome value is better as compared to global best solution means if chromosome energy value is less than global best value were update.

Cluster Based Routing
So routing of the packets in WSN was done by final global best chromosome. Each non cluster chromosome pass there sensed packet to selected cluster center node, further cluster center pas received data to another cluster center or base station.

IV. Experiment And Result

Results
Comparison of BF-PSO was done with existing algorithm LEACH and UCATD taken from [15], [16]. Comparison parameters are number of packet transfer in life of a devices till last survival node. Total number of rounds, first discharge node round count and execution time of the cluster head selection.

Table 1 First Node Discharge round count based comparison of different approaches.

Nodes	Region size	UCATD	E-LEACH	BF-PSO
100	**100**	5345	5371	12039
150	**100**	6964	7709	13566
100	**200**	689	654	1187
150	**200**	355	641	822

Table 1 shows that proposed Butterfly and Particle Swarm Optimization Based algorithm works better as compared to E-LEACH and UCATD approaches, as first node discharge rounds of BF-PSO is highest in each rounds. Hence use of hybrid genetic algorithm for clustering of sensor nodes reduce energy losses.

Table 2Total packet transfer to sink based comparison of different approaches.

Sensor Nodes	Region size	UCATD	E-LEACH	BF-PSO
100	**100**	622158	591989	1317206
150	**100**	1131978	1188832	2137849

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100	**200**	102380	86834	196052
150	**200**	127394	151937	210934

Table 2 shows that proposed Butterfly and Particle Swarm Optimization Based algorithm works better as compared to E-LEACH and UCATD approaches, as number of total packet of BF-PSO is highest in each region. Hence use of hybrid genetic algorithm for clustering of sensor nodes reduce energy losses. It was shown in table 2 that packet delivery in small region is high as compared to large region of 200x200. This was due to increase in distance, so energy requirement also increases.

Table 2 Number of Rounds based comparison of different approaches.

Nodes	Region size	UCATD	E-LEACH	BF-PSO
100	**100**	16294	16005	20640
150	**100**	19629	17507	21991
100	**200**	3708	2439	6172
150	**200**	4217	3235	5355

Table 3 shows that proposed Butterfly and Particle Swarm Optimization Based algorithm works better as compared to E-LEACH and UCATD approaches, as number of rounds of BF-PSO is highest in each region. Hence use of hybrid genetic algorithm for clustering of sensor nodes reduce energy losses. It was shown in table 3 that rounds in small region is high as compared to large region of 200x200. This was due to increase in distance, so energy requirement also increases.

Table 3 Execution time based comparison of different approaches for cluster head selection.

Sensor Nodes	Region size	UCATD	E-LEACH	BF-PSO
100	**100**	0.3144	3.6872	0.2175
150	**100**	0.2184	5.4883	0.3054
100	**200**	0.4379	3.7805	0.2297
150	**200**	0.3538	5.7925	0.3197

Table 2 shows that proposed Butterfly and Particle Swarm Optimization Based algorithm works better as compared to E-LEACH and UCATD approaches, as time required for the BF-PSO based cluster center selection is lowest. Hence use of hybrid genetic algorithm for clustering of sensor nodes reduce energy losses.

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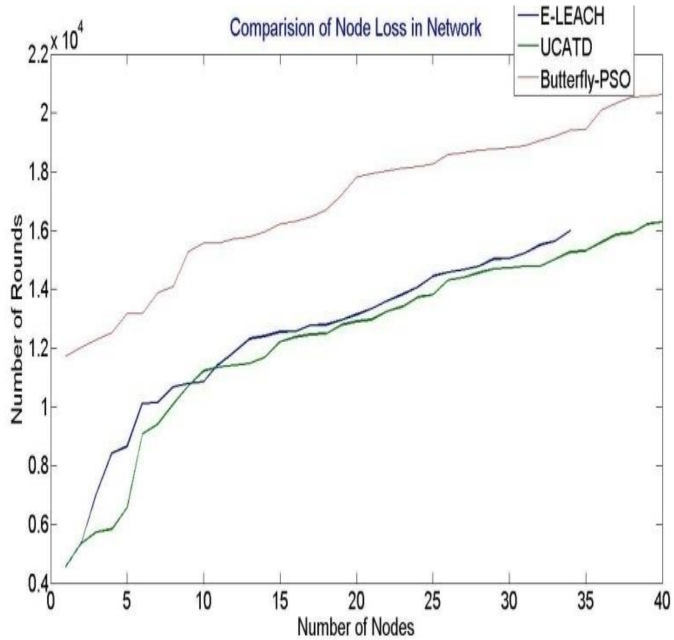

Fig. 3100 nodes and 100x100m region node loss comparison.

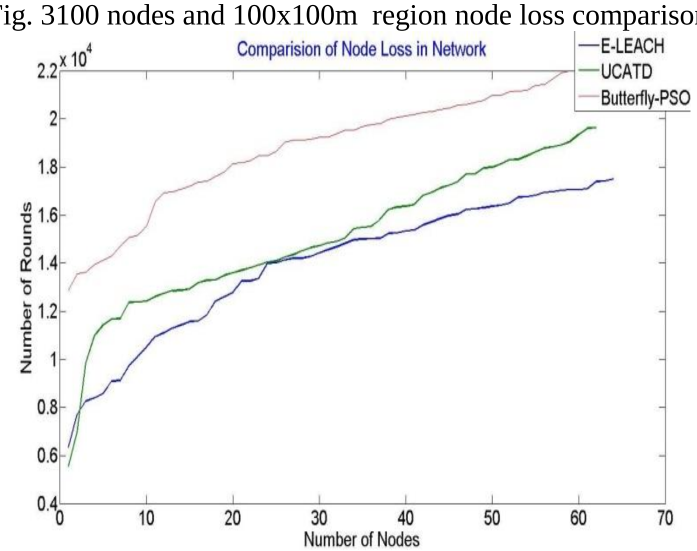

Fig. 4150 nodes and 100x100m region node loss comparison.

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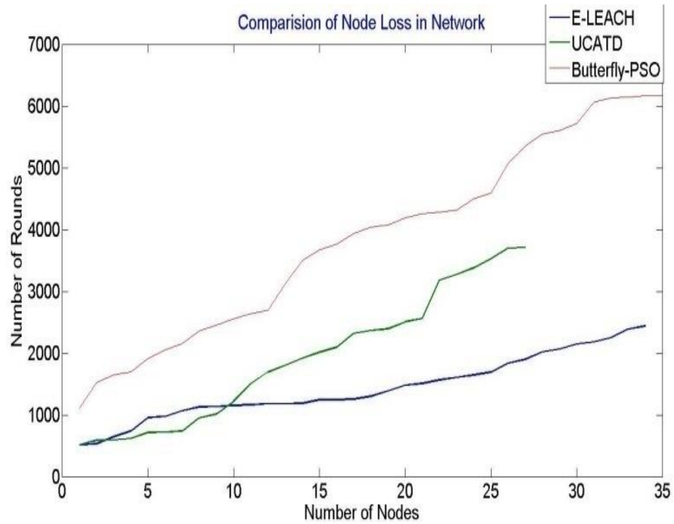

Fig. 5100 nodes and 200x200m region node loss comparison.

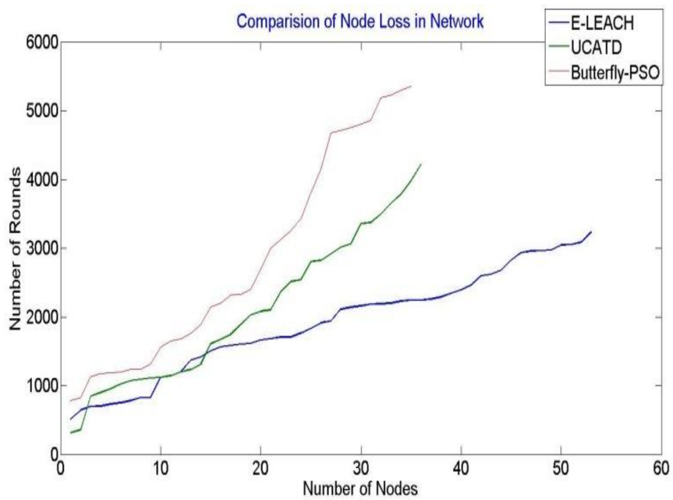

Fig. 6150 nodes and 200x200m region node loss comparison.

Fig. 3, 4, 5 and 6 shows proposed Butterfly and Particle Swarm Optimization Based algorithm works better as compared to E-LEACH and UCATD approaches, as number of rounds of BF-PSO is highest in each region. Hence use of hybrid genetic algorithm for clustering of sensor nodes reduce energy losses. It was shown in table 2 that packet delivery in small region is high as compared to large region of 200x200. This was due to increase in distance, so energy requirement also increases.

V. Conclusion

Wireless Sensor Network routing protocol work need to be improved for increasing the life span of sensing nodes. Dynamic adoption of different situation were achieved by genetic algorithm due random function. So this paper proposed a hybrid algorithm where two genetic algorithm were used for clustering of nodes in routing of packet from sensing IOT device to base station. Cognitive and social decision of butterfly improve the efficiency of work in population updation. Various size of region with number of nodes were developed for conducting the experiment in the work. Results were compared with UCATD existing algorithm and proposed work has improved value of life span by 23.5%. Packet transfer percentage value was also improved by 19.03%. In future one can adopt the neural network for learning the behavior of cluster nodes and alarm for new updation.

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