Energy Conservation In Wsn Using Hyper Sphere Sensor Optimisation

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Abstract:- ***Due to minimum energy consumption and compact size, the Wireless Sensor Network (WSN) is widely used in almost all areas of research. In WSN, optimum coverage and lifetime of nodes are major challenges. In this paper, a Hyper Sphere Sensor Optimization is proposed to estimate the neighbourhood distance for placing the sensor nods in an optimal way over an effective location. Levy fight in flower pollination utilized for optimal energy location with hyper sphere localization. In first phase based on hyper sphere is used to location identification of sensor nodes. Based on neighbour hood distance energy consumption of sensor network nodes are reduced. The results show that the proposed method is effective than other methods in terms of reducing the reduced energy consumption.***

Keywords: Wireless Sensor Network, Neighbourhood Distance, Levy Flight, Flower Pollination, Ant Colony

I. INTRODUCTION

Wireless network sensor systems are classified as ad hoc networks, with low-cost sensor devices with connected wireless links and low energy conservation. Limited resource constraints and a compact sensor node are also a benefit of the wireless sensor network [1]. The wireless sensor network is similar to the ad-hoc mobile network (MANET) on an autonomous, multi-hop and distribution basis, however, it has no fixed infrastructure. Compared to the WSN and MANET networks, a significant difference in cost and bandwidth decreases, higher power constraints and redundancies [2]. For a regular monitoring process, the industrial deployment sensor network is used. In order to ensure confidential communication, reliability, efficiency and security at all levels of network infrastructure, information is exchanged continually at the end of the process [3].

Wireless media, with unintended nodes, has a overhear transmission for legitimate and private information removal [4] for eavesdroppers within communication fields. In order to ensure safe communication within a network of wireless sensor, encryption techniques are incorporated into the hierarchy of communication protocols for confidentiality [5] [14]-[17].

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For significant performance in the cluster-based WSN of wireless sensors communication, significant benefits are developed below:

1. For redundancies or incomplete data, data aggregated or collected in a cluster head. The energy used to transmit a bit of data enables the aggregation of a high volume of information. For example, when aggregate data is transferred, energy consumption is decreased than when redundant data is sent.
2. Routing can be done easily in these networks. The required routing information is therefore less than that only the CHs keep the local path of other CHs established. This feature improves the scalability of the network considerably.
3. Only between the sensor nodes and their CHs is the communication link. The bandwidth of communication is therefore retained and redundant data is also not exchanged.

Maximization of the network wireless sensor throughput for efficient wireless sensor network performance with minimum energy consumption.

In this paper, a Hyper Sphere Sensor Optimization is proposed to estimate the neighbourhood distance for placing the sensor nods in an optimal way over an effective location. Levy fight in flower pollination utilized for optimal energy location with hyper sphere localization. In first phase based on hyper sphere is used to location identification of sensor nodes. Based on neighbour hood distance energy consumption of sensor network nodes are reduced. The results show that the proposed method is effective than other methods in terms of reducing the reduced energy consumption.

Paper is organized as follows: In section 1 provides general description about WSN and meta-heuristic algorithm. In section 2 related works are presented for throughput maximization and energy consumption. In section 3 describes the hyper sphere condition. Section 4 presented about simulation results and in section 5 described the conclusion of this research.

II. RELATED WORKS

In [6], the researcher adopted effective resource allocation algorithm for cognitive OFDM schemes where transmission energy limitations are transfor med to a standardized capability. In [7], developed a scheme for allocation of optimal power by use of Genetic Algorithm (GA) specifically CRN MIMO system. In [8], examined the stationarity properties for evaluation and analysis of GFDM system characteristics in comparison with OFDM system.

For achieving GFDM system transmit diversity [9] adopted Widely Linear Estimation (WLE) for minimizing ISI effect over channel with multipath characteristics through utilization of space-time coding (STC)-GFDM to exhibit significant performance in terms of SER and symbol error rate. For achieving efficient strategy of power allocation PS algorithm is adopted for maximizing throughput in SUs system for maximize power and interference reduction for GFDM cognitive system is evaluated in [10].

For GFDM system various implementation algorithm are implemented for minimizing complexity with respect to state of the Art (SoTA) is investigated in several researcher in [11].

III. PROBLEM FORMULATION

The energy function potential factor *E(X),* defines the overlap infeasibility occurred, this is stated as:

$$E(X)=\sum_{k=1}^{n}\frac{1}{2}\left(O_{vk}^{2}+O_{hk}^{2}\right)+\sum_{i=1}^{n-1}\sum_{j=i+1}^{n}\frac{1}{2}O_{ij}^{2} \quad (1)$$

The overlap in the network is denoted as *O;*the overlap exists between *k* circles and square vertical side is denoted as O_{vk}:

$$O_{vk}=Max\left\{\left|x_k\right|+r_k-\frac{L}{2},0\right\} \quad (2)$$

Similarly, O_{hk} denoted k circle overlap and square horizontal side.

$$O_{hk}=Max\left\{\left|y_k\right|+r_k-\frac{L}{2},0\right\} \quad (3)$$

O_{ij} is circle *i* and *j* overlap distance

$$O_{ij}=Max\left\{r_i+r_j-\sqrt{\left(x_i-x_j\right)^2+\left(y_i-y_j\right)^2},0\right\} \quad (4)$$

The limit are at the range of $L\geq 2r_n$, even vertical side containers is not overlapped with respect to sides in horizontal direction respectively. The network ingredient key is denoted as L_{CLB} with evaluation function $\langle L_{CLB}, E(X)\rangle$. The feasible solution for objective with *L* length for circle and evaluation function intuitively is defined as *L*.

IV. SYSTEM MODEL

Consider the aggregator distance form central unit as D>0 which lies among the employed relay nodes with strategy of decoding and forwarding. Also it is assumed that deployment of relay nodes are in straight line using aggregator and distance between central unit system is defined as d > 0 among any two nodes are similar. The equation h = D/d stated the hopping count in the network. It is assumed that communication is affected between nodes those are scattered and central unit of the system. Even it is assumed that signal received for jamming in receiver node are independent and provides link in multi-hop manner, and throughput is network is stated as T and its its corresponding link for multi-hop is defined as [12]:

$$T=\frac{\log(1+\beta)}{h}\left(P_{suc}\right)^{h} \quad (5)$$

Where, successfully decoded message at the receiver with probability function of P_{suc} and β > 0 successful reception of SIR minimal requirement. Also, it is assumed that coding involved in point-to-point Gaussian codes and decoding rule for interference-as-noise [13], efficiency of spectrum is log(1 + β), frequency is measured in bits/s/Hz and links of single-hop is denoted as SIR > β.

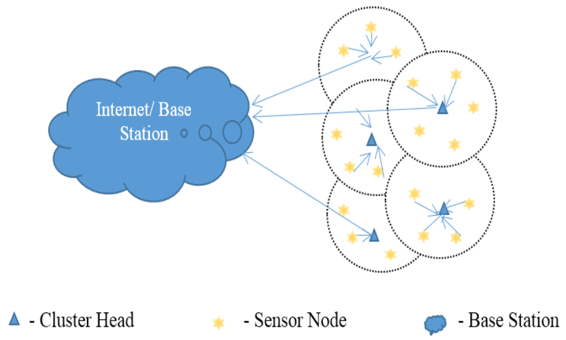

Figure 1. Sensor Network Components

V. CLUSTER HEAD (CH) FORMATION WITH HAC-FP

This section evaluated the clustering of level-based approach. Based on the function of CHs energy aware threshold. It is stated that nodes with higher energy level have the higher probability to become CHs. Through the generation of random value every node in the network try to become a CH. In case node with minimal random value rather than evaluated Threshold (T(i)) it becomes CH. If random value is less than evaluated threshold value than it will not become threshold. The T(i) of the network is evaluated mathematically using:

$$T(i)=\frac{P_{opt}}{1-p_{opt}\left(r.\bmod\left(\frac{1}{P_{opt}}\right)\right)}*\frac{E_i(r)}{E_{avg}(r)} \quad (6)$$

Every node the network is evaluated using $E_i(r)>0$. In this, r is represented as WSN lifetime of network for current round, the current energy of system is $E_i(r)$ for node I. E_{avg} represented average energy remaining in the system is stated as follows:

$$E_{avg}=\frac{\sum E_i(r)}{N}$$

for each and every node I, in this node total number is denoted as N.

1.1. Network Energy Model

This research randomly deploys the "N" sensor nodes in WSN of the network field. Every nodes in the network are stationary including sink node in which each and every node has its own identification number. Every node in the network monitor the environment and communicate with the every node using data transmission with sink node. Whenever communication is established among the nodes few energy is spared with respect to distance (D) with sink node. In this all links for communication are symmetric.

1.2. Energy model

Whenever deployed nodes in the network send or receives information based on the energy utilized with consideration of propagation model for two channels in free space for direct transmission or single-hopping and fading channel with multipath fading for multihop packet transmission in the network (D^2 power loss). Her, mathematical model involved in energy consumption is stated as follows:

$$E_n T_{rx}(L,D) = \begin{cases} LE_{n(elec)} + L\varepsilon_{fres} D^2, D < D_0 \\ E_{n(elec)} + L\varepsilon_{m_{pat}} D^4, D \geq D_0 \end{cases} \quad (7)$$

In the above equation (7) data packet size is defined as L; energy loss in free space is ε_{fres}, multipath energy loss is defined as $\varepsilon_{m_{pat}}$. Threshold distance is denoted as D_0 with consideration of states ε_{fres} or $\varepsilon_{m_{pat}}$. In this D_0 is calculated as:

$$D_0 = \sqrt{\frac{\varepsilon_{fres}}{\varepsilon_{m_{pat}}}} \quad (8)$$

1.3. Neighborhood Estimation

For solution *S* neighborhood of system is evaluated for obtaining solution through transformation with performance of predefined moves in the system. This solution of system is defined as *S* with consideration of neighbor. Based on the consideration of defined moves, the different nodes of neighborhood can be constructed. Effective search improvement is obtained through consideration of search, variable involved in Descent Neighborhood and local searches involved in neighborhood of Tabu Search. With respect to neighborhood selection iteration is performed for one solution. Based on the consideration of proposed system in WSN neighborhood classification is performed in two different categories such as the basic neighborhood (*BN*) and the candidate supplementary neighborhoods (*SNs*). The efficient neighborhood of the system is denoted as basic neighborhood calculation. The supplementary system for neighborhood is sorted based on the descending with consideration of efficiencies.

1.4. Node Deployment based on HAN-FP

In the mesh network, issues related to node deployment is relies on identification of optimal solution to withstand connectivity and coverage exists between them. The optimal solution involved in sensor deployment is focused on minimizing number of sensor for efficient connectivity establishment and network coverage. Through application of ant colony optimization nodes in the network are deployed for increasing coverage and connectivity in the network, it can be approximate optimal solution in network. Other drawbacks related to network are requirement of higher parameters and complex network environment setting. In order to overcome those limitations several optimization and controlling techniques are developed for improving performance of ant colony algorithm. Even though ant colony algorithm subjected to certain limitations such as unstability and minimal convergence rate to overcome this limitations CA-ACA techniques are developed with utilization of culture algorithm for to accelerate speed of searching in ant colony optimization with improving the ant colony algorithm stability. The basic concept behind CA-ACA approach is application of two-layer culture algorithm evolution strategy and application of enhanced ant colony optimization for space of population using evolutionary process. The developed ant system focused on identification of constraints solution and solution for output to derive optimal solution. The space of population is evolved spontaneously while in other hand, accept of space belief for individual space population in the process of evolutionary and influence on the population space and promotes the population space of ant to derive optimal solution. In figure 2 provided the general framework for deployment of nodes in network using CA-ACA algorithm. The process of evolutionary mechanism not only focused on reducing the sensor node count alone for achieving stable wireless sensor network but also focused on improving effectiveness of the network system. Further the proposed approach enhances the efficiency and stability of network using ant colony algorithm. In this paper, adopted a technique called CA-ACA algorithm for solving issue related to node deployment in grid network system. Individuals of ant is obtained through consideration of network spanning by means of adopting algorithm. Using ant colony optimization deployment of sensor count is evaluated with respect to equality of the WSN. Here deployed sensor fitness values are evaluated based on the consideration of individuals of ant. The main aim of developed CA-ACA algorithm is provision of guaranteed coverage and connectivity in WSN. Here, each value of ant is evaluated with derivation of minimal fitness function in an network.

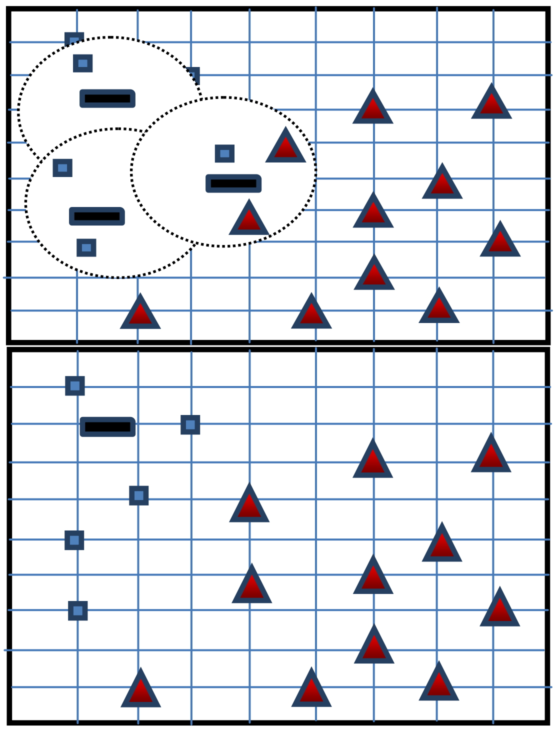

Figure 2. Hyper Sphere Sensor Optimization

Ant colony algorithm each and every individuals of ant releases pheromone on the way it travelled. Even though, this pheromone evaporate with respect to lapse of time and causes changes in environment. For node i, j updating formula for pheromone is defined as:

$$\tau_{ij} = \rho\tau_{ij} + \Delta\tau_{ij}^{k} \quad (9)$$

Where, existing pheromone evaporation coefficient is denoted as ρ, and for moving path simulated path for evaporation process occur naturally is defined as (1-ρ). With respect to iteration by means of process of natural evaporation pheromone evaporation is performed at grid points and minimizes effectiveness of network at ant located in bad points. Here, coefficient of evaporation with respect to evolution or natural selection in this τ_{ij}^{k} involved in increasing ant passing pheromone with grid points and value is evaluated with respect to following formula (10):

$$\Delta\tau_{ij}^{k} = \frac{Q}{SensorUsed} \quad (10)$$

In ant colony optimization algorithm process of implementation is inevitable for higher pheromone accumulation at certain specific location. In this, mechanism of positive incentive pheromone of ant is accumulated for faster coverage and deriving suboptimal solution for network. In order to minimize pheromone accumulation in unlimited manner certain pheromone concentration with limiting condition is derived which generally restricts the ability of attractiveness for ant concentration pheromone level with pointing of ants and lower concentration of ant pheromone concentration and guarantees pheromone one not to be small for ants. The following update pheromone limits are defined as follows:

$$\tau_{ij} = \begin{cases} \tau_{MAX}, pher > pher_{MAX} \\ \tau_{ij}, pher_{MIN} < pher < pher_{MAX} \\ \tau_{MIN}, pher < pher_{MIN} \end{cases} \quad (11)$$

where concentration of grid points with pheromone is defined as τ_{ij}; minimum and maximum value of pheromone at grid points is represented as $pher_{MIN}$ and $pher_{MAX}$ respectively.

VI. EXPERIMENTAL ANALYSIS & RESULTS

In this section presented about the experimental setting for proposed system. The parameters considered for designing WSN are presented in table 1 as follows:

Table.1. Designed network parameters

Parameter	Value
Area (x, y)	100, 100
Distance of Base station (x, y)	50, 50 or 50, 150
Number of deployed nodes (n)	100
Probability (p)	0.1
Initial Energy in an network	0.1
Energy level of transmitted	$50*10^{-9}$
Energy level of receiver	$50*10^{-9}$
Free space value with amplifier	$10*10^{-13}$
Multipath range with amplifier	$0.0013*10^{-13}$
Effectiveness of data aggregation	$5*10^{-9}$
Maximization of network lifetime	2500
Size of data packet	4000

Lifetime of network is defined as time taken by the node first and lastly dies in an network. In table 2 presented about proposed technique performance evaluation. Comparative analysis of proposed protocol with existing technique illustrated that lifetime of network is significantly improved compared with other techniques.

Network residual energy is stated as when last node in the network dies. Residual energy of network improved significantly when compared with conventional protocols and proposed technique effectively maximizes the energy level of the network.

The effectiveness of proposed approach is comparatively examined with other meta-heuristics techniques, The conventional meta-heuristics algorithm considered are artificial bee colony and genetic algorithm. Comparative analysis of results illustrated that performance of proposed technique significantly effective than meta-heuristics approac.

Table.2. Energy Evaluation

Nodes	Genetic algorithm	Artificial bee colony	Proposed
100	0.456 ± 0.1976	0.4864± 0.245	0.559 ± 0.1496
150	0.2845 ± 0.227	0.2645± 0.1575	0.3756 ± 0.2575
200	0.40123 ± 0.2455	0.42454 ± 0.14325	0.4342 ± 0.1465
250	0.38458 ± 0.208958	0.37454 ± 0.13655	0.4153 ± 0.175
300	0.26758 ± 0.2886	0.2445 ± 0.1856	0.2983 ± 0.14553
350	0.3285 ± 0.21665	0.3375 ± 0.14555	0.34755 ± 0.184
400	0.4488 ± 0.2386	0.45898 ± 0.16452	0.4775 ± 0.15554

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It is observed that proposed technique significantly improves the deployment of nodes in the network with improves residual energy in the system. Nodes in the network are deployed randomly with observed few fluctuation in the system. In table 3 comparison of proposed and existing technique is presented and it is observed that efficiency of system improved significantly at the rate of 2.8% in comparison with existing techniques.

VII. CONCLUSION

In this paper, a Hyper Sphere Sensor Optimization is proposed to estimate the neighbourhood distance for placing the sensor nods in an optimal way over an effective location. Levy fight in flower pollination utilized for optimal energy location with hyper sphere localization. In first phase based on hyper sphere is used to location identification of sensor nodes. Based on neighbour hood distance energy consumption of sensor network nodes are reduced. The results show that the proposed method is effective than other methods in terms of reducing the reduced energy consumption.

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