The Bio-Inspired Technique for Mobility Generation in WSN

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Abstract- The wireless sensor networks is the decentralized type of network in which sensor nodes sense environmental conditions and pass that information to base station. Due to small size and far deployment of the sensor networks energy consumption is the major issues which need to get resolved. The LEACH protocol is the energy efficient protocol in which whole network will be divided into fixed size clusters. The cluster heads are selected in each cluster on the basis of distance and energy. In this research work, technique of mobile sink will be applied using ant colony optimization technique. The proposed scheme will directly reduce energy consumption of the network and increase network lifetime
Keywords- LEACH, Mobile Sink, ACO, Angle of Trajectory

I. INTRODUCTION

The decentralized types of networks which involve number mobile nodes within them are known as wireless sensor networks. There are many recent enhancements proposed within wireless sensor networks as per the applications in which they are deployed. Today, the WSNs have been deployed in almost all the fields [1]. It is very difficult to design the protocols being utilized within these networks. The energy present within these networks is very limited as the size of nodes is very small due to which they have smaller batteries. In order to improve the efficiency of WSNs, there is a need of high density nodes within these networks. There are many small nodes which are also known as the energy resource constraints within these networks. Wireless communication is provided within these networks. Many computational resources are presented within these networks which help in providing the processing of signal tasks. Due to the presence of large number of sensor nodes within the networks, the size of these networks is not fixed [2]. On the basis of the designing of network and the objective for which it is designed the deployment of sensor nodes in WSNs is done. Within the last few years, the applications such as military fields and other remote areas have been including the wireless networks within them. There is an increasing demand of these networks mainly due to environmental monitoring. Within one area, large numbers of sensor nodes are deployed such that the environmental conditions can be sensed. In order to ensure that the networks are in working state at all times, the battery of these nodes are powered. However, the security of networks which are deployed within unprotected environments is not ensured. To prevent such networks from unauthorized access there are many privacy measures applied [3]. There are numerous nodes present in the networks which have their individual batteries. It is impossible to charge such numerous batteries in these large networks. In order to provide energy consumption of the nodes in simple and efficient manner, numerous techniques are proposed and applied within the WSNs. Amongst these methods; the clustering technique is the one which has helped in providing efficient measures to save the energy of nodes. Routing is known as the method through which the paths are selected in order to send the traffic occurring due to presence of data within the networks [4]. One such routing protocol is the ad-hoc on demand distance vector (AODV) reactive type of routing protocol. There are numerous enhancements made as well within these protocols which are utilized in numerous applications on the basis of their advancements. Amongst the cluster heads and their members the routing occurs within these networks. Amongst the base station and cluster members, the indirect communication is provided. If in any case the base station is at far distance from the cluster head, multi-hop communication mechanism is used in order to provide communication amongst them. As per the distance, the packets are transferred from one cluster head to another [5]. On the basis of the cluster which has the shortest distance, the selection of cluster is done. Further, this information is transmitted to the base station which is further analyzed. There is a need to develop new designs in order to fulfill the increase of demand of huge wireless networks. There is a need to enhance the already proposed methods in order to ensure that the deployment of these networks in numerous applications can manage the increased number of nodes. Less amount of energy is to be consumed within these nodes as this is also a major factor which affects the type of network that is to be deployed. Almost all the networks involve handling few numbers of nodes and are not very scalable as well. In order to provide solutions to the various such issues, the multiple mobile base stations can be deployed within larger networks. In order to provide effective results, these base stations should be placed in the sensed areas [6]. There is a need of an efficient scheduling technique in order to balance the workload of hybrid WSNs. There is a need to extend the lifetime of network. The monitoring of holes within the network is also not possible. In such conditions, divide and conquer method is to be utilized.

II. LITERATURE REVIEW

Subramanian Ganesh, et al, (2013) proposed in this paper [7] with the help of Signal to Noise Ratio (SNR) the enhancement of ad hoc on demand distance vector routing. Efficient and Secure Routing Protocol for wireless Sensor networks using SNR based Dynamic Clustering (ESRPSDC) is the proposed theory used here. On the basis of the SNR value, the non-cluster head nodes combine with the cluster head nodes. When there is an inter-cluster routing process going on, the error recovery can be done. This is done to keep the network end-to-end error free. With the help of sink-base routing pattern analysis, the malicious nodes are separated from the other nodes. This helps in maintaining the security of the network.

Arslan Munir, et al, (2014) presented in this paper [8], that applications which involve complex in-network processing only need multi-core embedded sensor nodes. Architecture with heterogeneous hierarchical multi-core embedded wireless sensor networks (MCEWSNs) is put forth. This is considered along with the multi-core embedded sensor nodes which are used in the MCEWSNs. The performance of SMP and TMP is compared using the base of performance metrics. They involve the run time, cost, speed up, performance per watt, efficiency, etc. Where there is a requirement of the integer manipulation of the sensor data, there the TMA has caused exploitation of the data locality. They are more effective for the MCEWSN applications.

Velmani Ramasamy et al, (2013) presented in this paper [9], Velocity Energy-Efficient and Link-aware Cluster-tree (VELCT) scheme. This methodology has involved all the demands to be ensured in its technique. There is a construction of the Data Collection Tree (DCT) in this scheme. It is created on the basis of the cluster head location. There is no participation of the Data Collection Node in the DCT for sensing purposes. This scheme also minimizes the energy depletion. There is a reduction of the delay in the packet transferring. The traffic that is seen in the cluster head is minimized by much extent through this method. A simple tree structure is formed by this method which helps in reducing the traffic and thereby reduction in the amount of energy consumed. Ning Wang, et al, (2012) presented in this paper [10], a new method put forward for supplying power to the network. It involves laser power supply remotely. Maintaining uniformity the laser is spread by a spatial distributed light field. Using the phosphor element, the wavelength of the laser is converted into the most sensitive wavelength of the solar cell. Due to this, there is a capacity of powering more than one wireless sensor networks at a time. A system is designed which has an ultra-low power consumption. This method has proven to be a good source for power supply to the WSNs. This method has proven to be more useful where the energy field in not very strong. The results have been positive and the success rate is also high as compared to other methods used in these applications. Yang Xiao, et al, (2012) presented in this paper [11], that the WSNs underwater need to be studied with much proper concern as they are difficult to be handled. Various protocols are used for the multi-hops. Multi-hops are used when the nodes are far away from the sink. There is a use of the tight lower bounds for the concern of calculating minimum time between the samples. There are two folds involved. The first one comprises of MAC protocol which involves both, the signal channel as well as the half-duplex radius. The second one is assumed to be tight. The networks which involve more propagation delay use more of such methods than that which have lower propagation delays. The networks which have even high complexities can be further helped using bounds.

Chuan Zhu, et al, (2015) presented in this paper [12], a Tree Cluster-Based Data-Gathering Algorithm (TCBDGA). This is used for the WSNs and concern with the mobile sink. A tree-construction method is used for this. The tree constitutes of various tree nodes. Subrendezvous points (SRPs) are some special nodes that are elected. The bases of selections are the traffic load and the hops that are involved to the root nodes. Comparisons are made with other networks and the results show that the TCBDGA is able to balance the complete load of the network. Through this method the energy consumption is also reduced. The main problem that is the hotspot problem is completely depleted. This method also gets to increase the lifetime of the network.

III. RESEARCH METHODOLOGY

In this work, we proposed the equation that will calculate signal strength of and to judge that how many cluster heads are in the range of sink. The movement of sink will be decided using technique of bee colony optimization. In bee colony algorithm The ABC calculation accepts the presence of an arrangement of operations that may look like some elements of the bumble bee conduct. The "fitness value" alludes to the sustenance source quality that is unequivocally connected to the nourishment's area. The procedure impersonates the honey bee's quest for important sustenance sources yielding a similar to prepare for finding the ideal arrangement. The insignificant model for a bumble bee province comprises of three classes: utilized honey bees, passerby honey bees and scout honey bees. The utilized honey bees will be in charge of examining the sustenance sources and offering the data to select spectator honey bees. They, thus, will settle on a choice on picking nourishment sources by considering such data. The nourishment source having a higher quality will have a bigger opportunity to be chosen by spectator honey bees than those demonstrating a lower quality. A utilized honey bee, whose nourishment source is rejected as low quality by utilized and spectator honey bees, will change to a scout honey bee to haphazardly look for new sustenance sources. Along these lines, the abuse is driven by utilized and passerby honey bees while the investigation is kept up by scout honey bees. The usage points of interest of such honey bee like operations in the ABC calculation are depicted in the following sub-area.

There are mainly four steps involved in the proposed technique. They are the initialization process, the construction process of node transition rule, the pheromone update process, and the termination criterion. Below is the process followed using these steps:

1. Initialization process: Within an image *i*, *m* numbers of artificial ants are placed randomly. For each pixel, 0.0001 is set as the initial pheromone value.

2. Construction process of node transition rule: A stochastic approach is utilized to select *k*th ant from the *m* artificial ants in the *n*th construction step. Within an image *i*, there is a continuous mobility of this ant from node (r, s) towards its neighboring node(i, j). The node transition rule is followed here and the equation generated is:

$$P^{\eta}_{(r,s),(i,j)} = \begin{cases} \dfrac{(\tau^{(n-1)}_{(i,j)})^{\alpha}(\eta_{(i,j)})^{\beta}}{\sum_{(i,j)\epsilon\Omega(r,s)}\left(\tau^{(n-1)}_{(i,j)}\right)^{\alpha}(\eta_{(i,j)})^{\beta}} & if\ (i,j)\epsilon\ \Omega(r,s) \\ 0 & Ot\square erwise, \end{cases} \quad \text{------ (1)}$$

Here, for node(i, j), $\tau^{(n-1)}_{(i,j)}$ and $\eta_{(i,j)}$ are the pheromone and heuristic information values respectively.

4. Calculation of threshold Value: - The threshold value is calculated in this phase to update pheromone value. The PSO algorithm is applied to calculate threshold value.

In order to threshold value within PSO algorithm, the pixel intensity and pixel number update steps play an important role. With the help of following equation, the pixel intensity of each particle in the swarm can be updated:

$$v_i(t+1) = wv_i(t) + c_1r_1[\hat{x}_i(t) - x_i(t)] + c_2r_2[g(t) - x_i(t)] \quad \text{------ (2)}$$

Here, *i* is used to represent the index of the particle. The velocity of particle *i* at time *t* is represented by $v_i(t)$. Further, the location of particle *i* at time *t* is represented by $x_i(t)$. There are some user-supplied coefficients which are represented here as *w*, c_1, and c_2. For each velocity update, some random values are regenerated which are represented by r_1 and r_2. For particle *i* at time *t*, the individual best candidate solution is represented by $\hat{x}_i(t)$. The swarm's global best candidate solution at time *t* is represented by $g(t)$. The position of each particle is updated after the intensity for each particle is computed. The new threshold is applied to the previous position of particle in order to update the position which is provided by:

$$x_i(t+1) = x_i(t) + v_i(t+1) \quad \text{------ (3)}$$

Until the stopping condition is satisfied, the process keeps repeating. The stopping conditions that can be placed include within them the number of iterations that are preset within the PSO algorithm, the number of iterations left since the last update of the global best candidate solution or the target fitness value that is predefined. The $x_i(t+1)$=t where "t" is the threshold value for the pheromone update

3. Pheromone update process: Following is the rule which is used to update the pheromone once all the *m* artificial ants are move within each of the construction process:

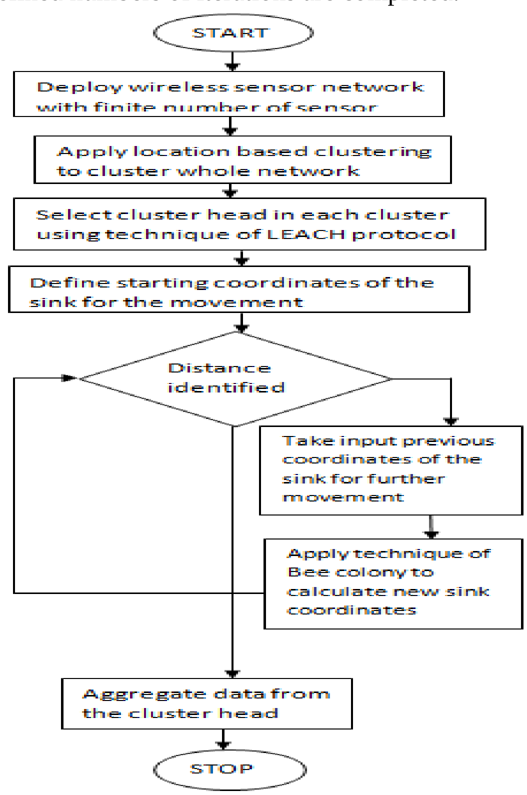
$$\tau_{(i,j)}(new) = (1-\rho)_{\tau_{(i,j)}}(old) + \sum_{k=1}^{m}\Delta\tau^{k}_{(i,j)} \quad \text{------ (4)}$$

Here, the pheromone evaporation rate is denoted by ρ. The limitless deposition of the pheromone trails are avoided with the help of ρ. It also helps in restraining the ants from selecting similar routes which can cause stagnation of the algorithm. By the *k*th ant, the pheromone that is deposited at node(i, j) which is denoted by $\Delta\tau^{k}_{(i,j)}$. It is denoted as

$$\Delta\tau^{k}_{(i,j)} = \begin{cases} \eta_{(i,j)} & if\ node\ (i,j) is\ visited\ by\ t\square e\ kt\square\ ant\ and\ \eta_{(i,j)} \geq t, \\ 0 & ot\square erwise, \end{cases} \quad \text{------ (5)}$$

Here, t is the threshold value which is calculated with the PSO value to update pheromone. During the mobility of ants in the following edges, the pheromone is deposited with the help of heuristic information value above *t* by the ants with the help of these parameters.

4. Termination criterion: The algorithm can be stopped after the predefined numbers of iterations are completed.



Algorithim

1. INPUT#1:$D_{distance}$

2. INPUT#2:CHs // Number of Cluster Heads

3. INPUT#3:N // Number of Nodes

4. INPUT#4 : Pheromone τ_{ij} :

5. Output: Selection of cluster Head

Begin

For i=1 to NN

If (d_i<d_{i+1}) Then

Best Distance D_i

Else

Best Distance D_{i+1}

End

For i=1 to NN

If (Energy<$Energy_{i+1}$) Then

Best Energy E_i

Else

Best Energy E_{i+1}

End

For i=1:NN

If (Best Energy(i)<Best Energy(i+1) && Best Distance (i)<Best Distance(i+1)

Return Cluster Head= I

Else

Return Cluster Head=I+1;

End

End

for all Cluster Heads i: Construct Solution (i)

for all Cluster Heads i:Sink Location update(i)

for all Cluster heads: Cluster head Change Location

τ_{ij}=(1-p)(τ_{i-j})

Construct Solution(i)j

For all Cluster heads in the solution :

Increase the Sink coordinates according to quality

τ_{ij}=1/Length of the path stored

End

IV. EXPERIMENTAL RESULTS

The proposed scheme has been implemented in NS2 by considering simulation parameters defined in table 1

Parameter	Values
No of nodes	26
Queue type	Priority queue
Queue size	50
Antenna type	Omi-directional
No of Sinks	1
Area	800*800 meters

Table 1: Simulation Parameters

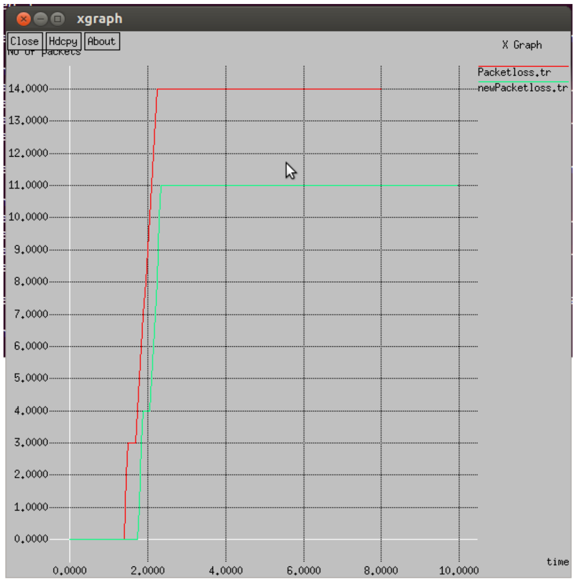


Fig.1: Packet loss Graph

As shown in figure 5.6, the packet loss of the proposed and existing scenario is compared. Due to sink base station packet loss is more and when multiple sinks are deployed in the network packet loss is reduced at steady rate in the network.

Time	CODES Algorithm	E-CODES Algorithm
2 seconds	14 packets	11 packets
4 seconds	16 packets	12 packets
8 seconds	38 packets	14 packets

Table 2: Packetloss Comparison

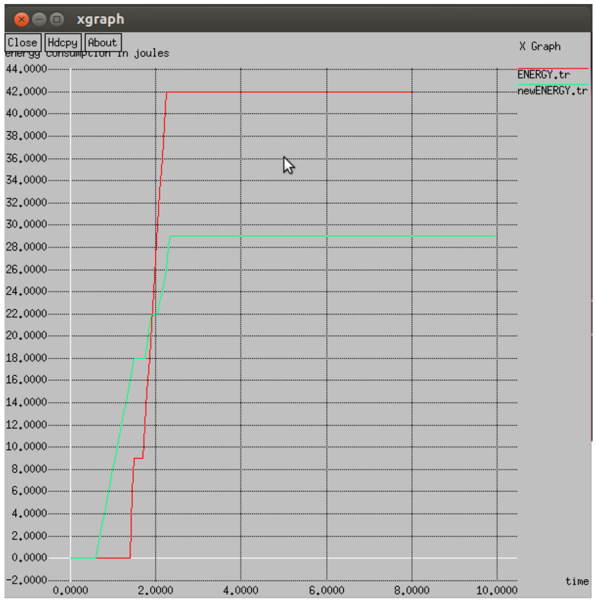


Fig.2: Energy Comparison

As shown in figure 5.7, the existing and proposed scenario is compared in terms of energy consumption. In the energy graph it is shown that in the proposed scenario is less due to multiple sink deployment in the network.

Time	CODES Algorithm	E-CODES Algorithm
2 seconds	30 joules	28 joules
4 seconds	32 joules	29 joules
8 seconds	75 joules	34 joules

Table 1: Energy Consumption

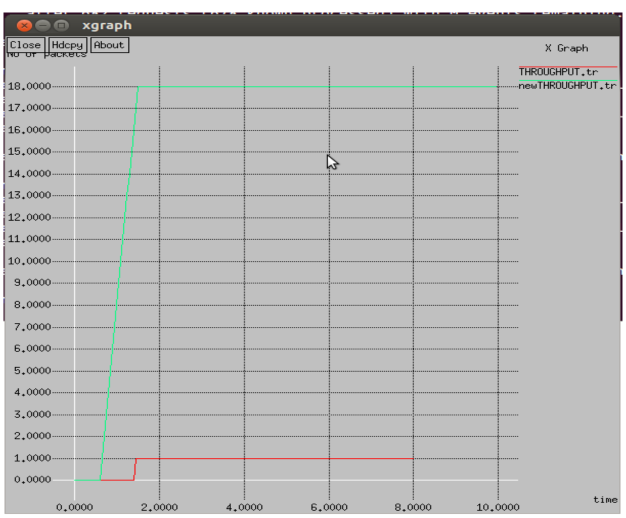


Fig.3: Throughput comparison

As shown in figure 5.8, the network throughput of the proposed and existing scenario is compared and it is been analyzed that network throughput is increased at steady rate due to multiple sink deployment in the network.

Time	CODES Algorithm	E-CODES Algorithm
2 seconds	3 packets	14 packets
4 seconds	6 packets	16 packets
8 seconds	15 packets	18 packets

V. CONCLUSION

In this work, it has been concluded that wireless sensor networks is the decentralized type of network in which sensor nodes sense environmental conditions and pass information to base station. The LEACH protocol is the energy efficient protocol which reduce energy consumption of the network. In this research work, technique of ACO and Angle of trajectory will be applied will generate sink mobility. The proposed scheme is implemented in NS2 and it has been analyzed that network performance increased at steady rate.

VI. REFERENCES

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