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Improved Coverage of Node Placement using Greedy Approach on Scent Marking of Territorial Predator

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Abstract—*WSN has an implementation problem of the placement, coverage, connectivity and energy of senor nodes (SNs) in the given area. Coverage make sure the observing region is covered by at least one SN while connectivity is required to make sure that each SN is straight associated to the sink node or not directly associated to the sink node via any other SNs. A SN placement technique that employs a novel biologically inspired optimization method that impersonates the behaviour of territorial predators in spotting their domains with their aroma perceived as Territorial Predator Scent Marking Algorithm (TPSMA). The chief objectives measured in this paper are to attain highest coverage and lowest energy consumption with certain connectivity. A simulation consider has been done to survey the assess of the proposed algorithm completed with the base technique. With the help of greedy algorithm coverage range, uniformity and area covered are improved in our proposed work. Maximum area is covered by using less number of sensor nodes in the WSN.*

Keywords—*Wireless Network, Node placemenet, TPSMA, Scent marking, Predator, Territory.*

I. INTRODUCTION

In computer network, there is more importance for wireless networks because the setup of wireless network is not difficult and not more expenditure. It has lots of approaches to spare the money and the bandwidth. In wireless network there is diverse type of network one of them is called as WSN. Numbers of sensors are available in the network and all are connected to each other through wireless link. All Sensors are performing the same function transmission of data and receiving of data. All sensors are working in cooperative manner and trying to balance the network by balancing the different environmental factors of the network.

For the most part sensor networks are utilized for the checking the physical conditions, for example, consistency of temperature, regardless of whether conditions, diverse technologies related sound. Sometimes it is used to measure pressure and to check environmental pollutions. WSN is gathering of various autonomous nodes and these nodes are battery powered nodes. At the point when source node sends a few data to sink node, it courses through various nodes. There is one sender and one receiver but many nodes are required for making the communication between sender and receiver which are acting as a router in networks. There are other wireless network which are more flexible and has a high active topology and elasticity which makes them more useful for wireless communication [1].

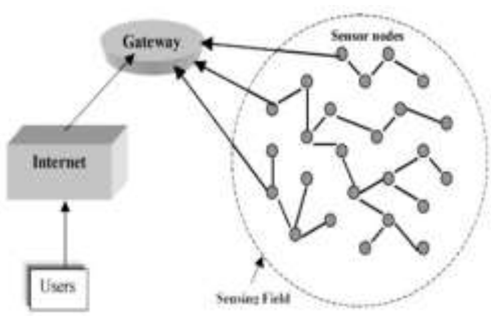

Fig. 1 WSN

II. PLACEMENT OF NODES

Moreover, sensor placement also affects the resource management in WSNs. Sensor networks frequently monitor specific focuses, e.g., monitoring intersections or animal settling locales, which oblige the node placement. In such cases, the placement issue is highly application-specific. Our survey is only of cases where the aim is to monitor an entire area, either continuous or on a discrete grid. According to the roles that the deployed nodes play, node placement can be classified into placement of ordinary nodes, and placement of relay nodes, respectively. The former focus on the deployment of normal sensors, while the latter places a special type of nodes which are responsible for forwarding packets [4].

III. CLASSIFICATION OF NODE PLACEMENT

At introduce the researches on the deployment of wireless sensor nodes for the most part gathered in the static and the dynamic deployment.

A. Static Deployment

The static sending picks the best location as indicated by the optimization strategy, and the area of the sensor nodes has no change in the lifetime of the WSN.

The strategy for the deterministic sending is firstly to do the surveyed area meshing and afterward carries on the system node deployment. In the investigation of the deterministic sensor node deployment in view of the objective scope, a deployment methodology of sensor nodes by utilizing the most extreme multi-overlapping domains of target focuses and the genetic algorithm, which lessens the network deployment cost and understands the optimal allocation of spaces resources in WSNs. A technique with target scope in view of grid scan.

It first partitions the territory into grids. At that point the best grid is set the following sensor. The strategy can utilize least nodes to accomplish the target coverage meet the required level of the entire scope and improve positions for node deployment. Hence, the situation of WSN nodes is acknowledged organized and effectively, and the proposed technique can accomplish better recognition likelihood and scope consistency contrasted and a few strategies. The creator additionally exhibits an arrangement technique for sensor nodes utilized as a part of identifying and measuring the progressions of worldly traffic patterns in large scale.

Distinctive with the deterministic deployment, the random sending is typically utilized as a part of dangerous environment without stuff on duty, for example, forest surveillance earthquake observation and war zone. Large quantity of wireless sensor nodes are thrown in these zones, and after that self- organized out network framed. With the completion of various prior coverage of hot targets which required higher quality necessities, the algorithm could expand the scope rate all through the detection area. A system of WSN nodes haphazardly sending in view of Poisson dispersion. In this system, first settled the model of WSN node distribution, and after that discover the connection between the level of coverage area and the nodes density of target zone, ultimately locate the best scope of nodes density to get the optimal deployment.

B. Dynamic Deployment

The dynamic deployment may be upheld to the game plan of the robot. So as to make the sensor networks get the greatest execution, sensor nodes require consequently move to appropriate area, and afterward begin to work [3].

IV. NODE PLACEMENT BASED ON TPSMA

Territorial predator, for example, tigers and bears can be characterized as predators that reliably guard a particular region against animals from different species. The region is picked in view of certain factor, for example, food resources. Most territorial predators utilize aroma marking to show the limits of their territories which are likewise assuming a part in regional support and as data locales for different individuals from the population [4]. Aroma matching enables an inhabitant creature to recognize different occupants from interlopers by perceiving their scent, in this manner decreasing the requirement for territorial encounters [5].

A. Assumptions

- Sensor nodes are homogeneous static nodes and must not exceed the quantity of potential sensor node areas.
- Number of observed areas is equivalent to the quantity of potential sensor node locations.
- Monitoring territory is a 2-dimensional zone that is separated into a few checked areas.
- The center of each monitored location is considered as monitored point.

B. Sensing Model and Objective Function.

Binary Sensing Model (BSM) is adopted in this study. The covering region of sensor nodes is thought to be a roundabout territory with a span of Rs that speaks to the detecting range. The probability of node $S_j(x_{sj,}, y_{sj})$ detects an event occurs on i(xi , y_i) is [6]:

$$P_{cov}\left(S_{j,}i\right) = \int_0^1 \qquad \begin{matrix} d\left(S_{j,}i\right) \leq R_3 \\ otherwise \end{matrix} \qquad (1)$$

Where $d\left(S_{j,}i\right)$is the Euclidean distance between point i(xi , y_i) and S_j ($x_{sj,}$, y_{sj}).

i can be considered effectively covered if P_{cov}>C_{th} where C_{th} is the coverage threshold [7]. The objective function is determined by using the following equation which was presented in [7]:

Objective of Function, f(x) = Coverage Ratio = $\frac{N_{effective}}{N_{all}}$ (2)

Where$N_{effective}$ is the number of locations that are effectively covered and N_{all} is the total number of locations.

C. Pseudo code for TPSMA based sensor node placement

Number of monitored location, i=1, 2,……, S
Number of potential location for sensor node, j=1, 2,……, p
Step 1: check if there is a sensor node situated in all j………
Step 2: compute p_{cov} for all j and i
Compute coverage ratio f(x) for all respective j
Mark territory for sensor node in j that has the maximum coverage level to i

(Scent marking by predator on the territory that has highest food resource)
Repeat stage 2 until i=s
Stage 3: observed area will be checked by sensor nodes that are inside their stamped an area (sensor node identifies its monitored location by scent matching).

V. LITERATURE SURVEY

Rong Du et al. [2017] presented that the joint problem of optimal sensor node deployment and WET scheduling is investigated. Such an issue is defined as a whole number optimization whose arrangement is trying because of the twofold choice factors and non-direct limitations. To solve the issue, an approach in light of two stages is proposed. To begin with, the vital condition for which the WSN is eternal is set up. Based on this result, an algorithm to solve the node deployment problem is developed. Then, the optimal WET scheduling is given by a scheduling algorithm. The WSN is shown to be immortal from a networking point of view, given the optimal deployment and WET scheduling. Theoretical results demonstrate that the proposed algorithm accomplishes the optimal node deployment as far as the quantity of deployed nodes. In the simulation, it is shown that the proposed algorithm reduces significantly the number of nodes to deploy compared to a random-based approach. The results also suggest that, under such deployment, the optimal scheduling and WET can make WSNs immortal [8].

Punyasha Chatterjee et al. [2017] in this study, a normal case probabilistic analysis is done in light of ideal coordinating of irregular bipartite diagrams to build up a hypothetical lower bound on the quantity of nodes to be deployed. Analysis and simulation studies demonstrate that the proposed display comes about gigantic improvement in organize lifetime that fundamentally abrogates the cost due to over deployment. Thus, this system offers a excellent cost-effective and energy-efficient solution for node deployment and routing in extensive WSNs to work with delayed lifetime [9].

Wei Kuang Lai et al. [2017] This paper initially analyzes the corona model. In light of investigation comes about, we find that almost balanced energy utilization of WSNs can be accomplished with the extra help of orchestrating diverse starting conditions. We at that point propose the energy-balanced node deployment with an balanced energy (END-BE) calculation and energy-balanced node deployment with a most extreme life-time (END-MLT) plot, which decide the cluster density for every crown as indicated by the energy consumption of each CH. Simulation comes about demonstrate that energy consumption is almost balanced by actualizing END-BE, and the system lifetime is extraordinarily enhanced by adopting END-MLT [10].

H. Zainol Abidin et al. [2016] introduced that an intruder detection system in view of TPSMA. The exhibitions of the TPSMA IDS are assessed in light of coverage ratio and network likelihood through reenactment and hardware experimentation. The results demonstrate that the simulation and hardware experimental results are of comparable pattern with some normal contrasts because of different components [11].

A. Zrelli et al. [2016] displayed that the point of a wireless Structural Health Monitoring (SHM) framework is to screen and evaluate basic trustworthiness utilizing WSNs. Careful node placement in WSN can be an exceptionally successful optimization implies for accomplishing the coveted SHM. The paper additionally features the optimal deployment of sensor in SHM frameworks [12].

H. Zainol Abidin et al. [2014] displayed that a sensor node placement approach that uses another naturally motivated multi- objective optimization algorithm that imitates the conduct of a regional predator in denoting their regions with their smells known as multi-objective territorial predator scent marking algorithm (MOTPSMA). The algorithm utilizes the most extreme scope and minimum energy consumption target capacities with subject to full connectivity. A simulation study has been completed to look at the execution of the proposed algorithm with the multi-objective evolutionary algorithm with fuzzy predominance based decay and a number linear programming algorithm. Simulation results demonstrate that WSN sent utilizing the MOTPSMA sensor node placement algorithm outperforms the execution of the other two algorithms as far as scope [13].

N. M. Din et al. [2014] the MOTPSMA sent in this paper utilizes the base revealed region and minimum energy consumption as the target capacities subject to full network limitation. The execution of the WSN sent with MOTPSMA is then contrasted and another calculation known as Multi-objective Evolutionary Algorithm in view of Fuzzy Dominance (MOEA/DFD), Simulation results demonstrate that the WSN sent with the proposed sensor node placement algorithm gives a larger coverage ratio, full availability and lower energy consumption [14].

VI. PROPOSED WORK

This part involved the proposed scheme systematically beginning with a short explanation on the proposed scheme applied over the territorial predator behaviour in marking the region. In the proposed work, Greedy Approach is used for the uniformly distribution of the sensor nodes in the network.

Proposed Algorithm:

Step:1 Initialize network
Step:2 Establish the area of 100m * 100m
Step:3 Divide the area into 16 locations which is known as monitored locations
Step:4 Put access point in the middle of the monitored locations
Step:5 Place sensor nodes using uniform distribution using Greedy approach
Step:6 Calculate coverage area using the formula:

$$Coverage_p = \begin{cases} 1 & dist(sen_i, mon_p) \le R \\ 0 & otherwise \end{cases}$$

Where R is the radius, $dist(sen_i, mon_p)$ is Euclidean distance between sensor node and monitoring point

Step:7 For the evaluation of Euclidean distance

$$dist(sen_i, mon_p) = \sqrt{\left(x_{sen_i} - x_{mon_p}\right)^2 + \left(y_{sen_i} - y_{mon_p}\right)^2}$$

Step:8 Calculate the coverage ratio which is known as objective function f(x)

f(x) = Covered locations/Total locations

Step:9 Exit

VII. RESULT ANALYSIS

For the show of proposed approach, a numerical simulation has been completed with MATLAB. The simulation performed with several fixed sensor nodes arbitrarily organized in the observing region. Simulation results are evaluated with results formed by base work and proposed work.

Table 1: Simulation Parameters

Parameters	Value
Number of sensor nodes	9 to 12
Monitoring Area	100m x 100m
Sensing Range, R	20m
Uncertainty in sensor detection	10m
Coverage threshold	0.900
Alpha1	1
Alpha2	0
Beta1	1
Beta2	0.5

1. *Sensor Nodes Positions:*

Figures 2, 3 and 4 demonstrate different number of SNs with their positions. The location of monitored regions is shown by red stars which is the access points whereas the SNs are specify by the blue stars. Coverage of each SN is shown by the blue circles. Figure 2 shows WSN installed with 10 SNs where it is noticeably shown that 4 locations are not enclosed by any SNs. while, Figure 3 shows WSN installed with 11 SNs where it is noticeably shown that 3 locations are not enclosed by any SNs. With 12 SNs, all locations are completely covered as demonstrated in Figure 4 because all locations are equipped with a SN.

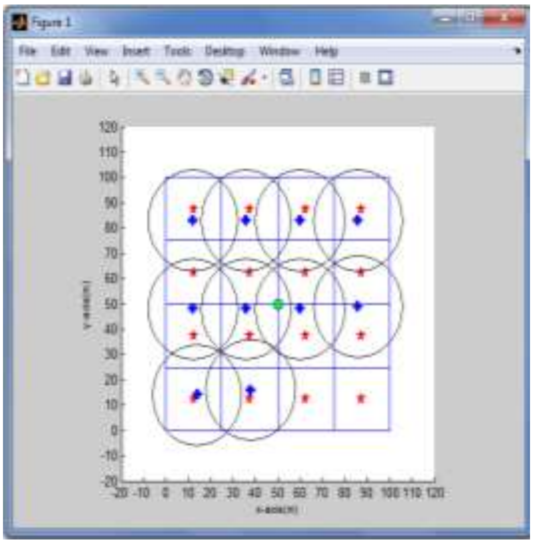

Fig. 2. Sensor Nodes (10)

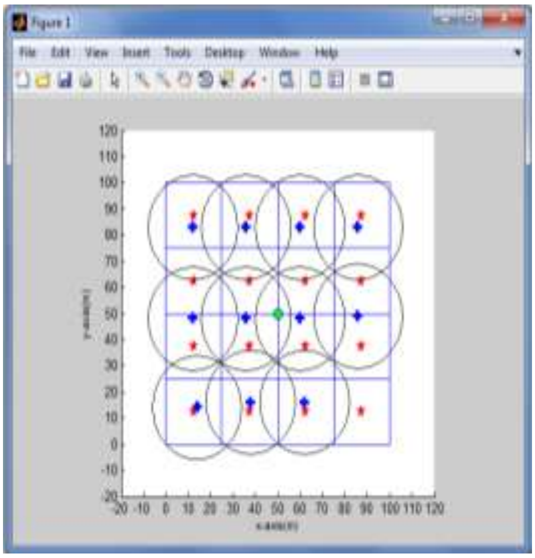

Fig.3. Sensor Nodes (11)

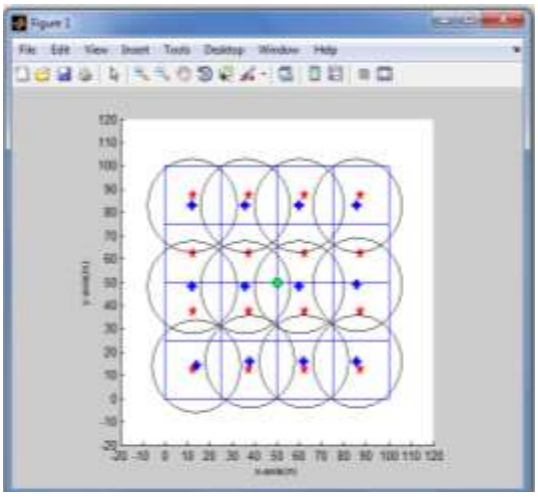

Fig.4. Sensor Nodes (12)

2. Coverage Ratio:

Figure 5 demonstrates the coverage ratio of WSN for different numbers of SNs. With the increase in number of SNs, the coverage ratio of WSN will also increase.

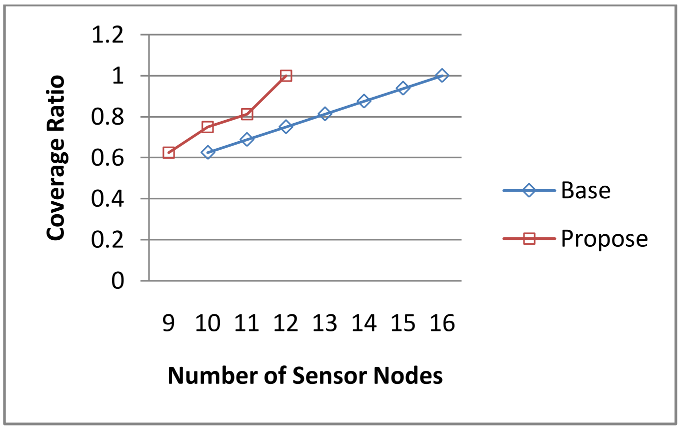

Fig. 5. Coverage Ratio vs. No. of Sensor Nodes

3. Network Uniformity:

The system lifetime is mainly calculated by Uniformity where WSN life span can be known as the shortest life span of all SNs. This is due to the fact that uniformly distributed sensor nodes spend energy more uniformly through the network. Additionally, fewer nodes are essential to cover the monitored area if the SNs are evenly distributed. The mean separations for all nodes to their neighboring nodes in a consistently distributed network are around equivalent, and henceforth the normal energy utilization per correspondence and in addition the normal lifetime of every node is approximately comparable. In this manner, finish energy use at each node and longer system lifetime of the network are expected.

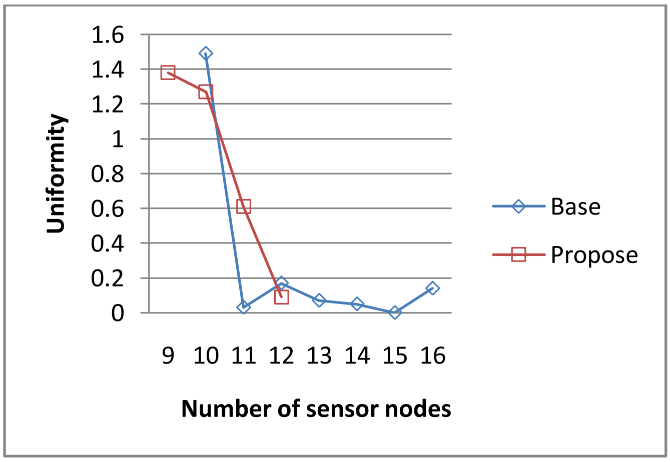

Fig.6. Uniformity vs. No. of Sensor Nodes

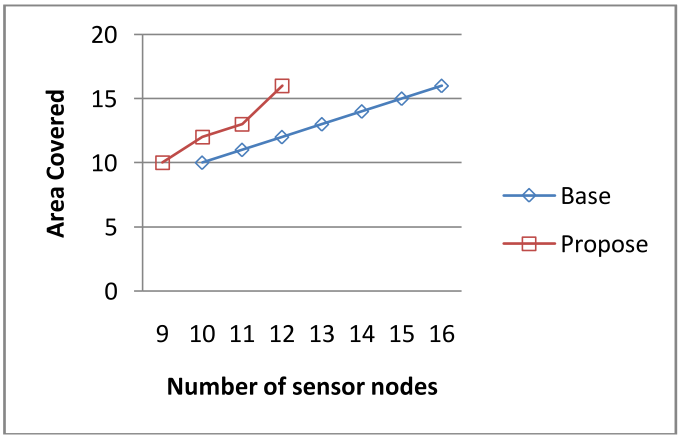

Fig.7. Area Covered vs. No. of Sensor Nodes

Conclusion

A SN placement method based on TPSMA has been planned in order to make sure that the WSN coverage is enhanced. The network model obtainable in this paper is an area that consists of numerous equivalent widths monitored places. A biological inspired algorithm known as TPSMA has been developed in the paper to optimize the SN deterministic assignment in a WSN. Two TPSMA approaches are presented in this paper known as TPSMA with greatest coverage and TPSMA with lowest energy consumption. Based on the simulation results acquired, it can be concluded that WSN installed with greatest coverage TPSMA SNs placement system is a cost efficient system that suggest considerably superior coverage ratio, full connectivity and lesser energy usage.

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