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# A Real Time Energy Efficiency Wireless Sensors Networks Coverage and Localization for Sustainable Applications

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## Abstarct

Generally, in an open air environment placing of the large sensor networks randomly can result a small coverage. Therefore for these sensor networks, coverage factor is playing as a significant role for the improvement of performance which reflecting the monitoring quality of a sensor array. The deployment of sensor nodes also plays an important role in Wireless sensor networks (WSN) because of the collective information preset at each sensor node. A review of placing and monitoring of sensor nodes in the wireless sensor networks is presented in this paper with the two algorithms which maximize the coverage area and optimize the localization of audio in wireless sensor networks. Firstly, a generalized harmony search algorithm is reviewed, which is a metaheuristic algorithm for solving optimization

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quandaries to amend the coverage of wireless sensor networks. Secondly, a Virtual Force Algorithm (VFA) is described as a coverage optimization algorithm for a wireless sensor network in the surveillance area.The simulation results for the both algorithms are illustrated that the Harmony search algorithm outperforms than existing algorithms, whereas VFA algorithm shows an improved optimization effect on uniformity and coverage rate the sensor nodes that optimize the network coverage of wireless sensors than other algorithms.

**Keywords:** Wireless sensor networks, maximum coverage area, Harmony Search Algorithm, Virtual Force algorithm,energy

## 1 Introduction

In the present day, application areas in which Wireless sensor networks (WSNs) are most commonly used are civilian applications which includes theforest monitoring, water resource monitoring, seismic observation, vehicle tracking, and building monitoring [1,2]and are initially designed for the military applications. The most significant performance measure of any WSN is the coverage rate.Achallenging question of interest for a WSN Technology is that in which way a minimum number of sensor nodesare used towards monitor the target area. Usually, Wireless sensor nodes are placing at the monitoring area randomly which leads to an uneven distribution of the sensor nodes that in turn results a small coverage rate for the monitored area. Improving the rate of coverage area with the adjustment of sensor node positions is therefore has a high importance in WSNat the monitored area.

There have been three tremendous advances in the field of Wireless Sensor Network (WSN) in the last few decenniums, especially in terms of coverage and connectivity. A WSN may typically remain either structured or unstructured in general. It is possible to describe an unstructured WSN as an amassment of sensor nodes which are arbitrarily distributed over the region. Due to this random distribution monitoring the network maintenance such as connection management and sensor node failure detection is a hectic process. Rather in a structured WSN, the sensor nodes are distributed in an organized manner where all the nodes form a connected network. Coverage is the process that ensures the guarantee of covering the entire region within the given sensor nodes. Connectivity deals with the establishment of connections between the deployed sensor nodes .Furthermore, coverage problem can be deal with two factors, area coverage or target coverage. Area coverage deals with monitoring the given entire environment whereas target coverage deals with specific region in the given area.

The deployment of device nodes aimed at the Wireless Sensor Network remains one of the most paramount considerations (WSN).Finding out the optimal positions (among the available positions) is the main goal of this is towards place the Sensor Nodes so that one or else more Wireless Sensor Network plan goals can be meet under the conditions of a particular application. This can be considered as a challenging task towards remain quite possibly the most intricate plan measures in the field of WSN. The WSNs are inherently restricted because of the various sensor device constraints that are available such as energy, processing and communication. This is the main reason for the design is so complex. Connectivity of Sensors between each other, lifetime and efficient coverage of network are the other performance metrics of the WSN on which the impact of the deployment process is improved.

## 2 Literature Survey

The node deployment problem of Wireless sensor network is frequently formulated as the optimization problems [6]. To address a solution for this problem of placing sensors, a significant number of optimization techniques are used. In a heterogeneous wireless sensor network a model for the associated target k-inclusion issue remains proposed by Cheng in [3].This paper provides the coverage and efficient energy in the heterogeneous network by the use of two algorithms specifically distributed Cognate algorithm for target k-coverage and centralized linked algorithm for target k-coverage. Their proposed model abbreviated the k-coverage of linked targets with fewer k-active sensor nodes. The numbers of active device nodes are reduced with their proposed model and every node is connected to sink node to forward data. In a wireless senor network coverage problem deals with deploying sensor nodes with maximum coverage area by scheduling and analyzing device nodes. Connectivity in wireless sensor network provides communication among sensor nodes through directly or indirectly to forward data to sink node.

Energy-efficient wireless sensor network coverage is proposed in[6]. In this, the subterranean insect province improvement calculation remains utilized as an alternative to the deployment of sensors for sensor activation schedule. It is additionally suggested that energy-efficient coverage in the wireless sensor network [5] is defined utilizing PSO in the artificial bee colony algorithm utilized by them aimed at the coverage quandary then optimum positions for the deployment of a given sensor node.They implement the heuristic algorithm for the network lifetime problem by scheduling the sensors activation which results in maximizing the network lifetime by means of the required coverage level. The connected coverage assurance of two methods is proposed by Adulyasas *in*[4] for scheduling the sensors with a virtual hexagon partition.

The Particle Swarm Optimization (PSO) algorithm remains a well-kenned algorithm used towards solve optimization quandaries in WSN due towards its simplicity, high solution quality, expeditious convergence and negligible computational burden[7].For the positions to be found, the

PSO algorithm utilized in[8] Optimal for which sensors are situated for the top cover. The authors state that the data fidelity can be improved by the using this PSO on the sensor placement process. Kulkarni in[7] proposed the diagram of Voronoi and PSO and on a sensor placement process. Here, the PSO remains used towards find the position of devices which offers a best coverage and then the fitness of the solution is evaluated by using the Voronoi diagram. But aimed at high-speed real-time applications particularly when the optimization is towards remain performed frequently, the PSO may prohibit its used ue to its iterative nature. PSO can reduce its application to resource-rich based stations since a great size of memory is required for it [7]. Wang in [9] proposed a coverage problem in a heterogeneous network as a function of the coverage and capacity of the circumference. Legami in [10] proposed, a stochastic coverage for heterogeneous networks and from a lower coverage problem to the intersection problem. Due to the age, [11] solved a problem of scalability and performance problems for heterogeneous networks with a differential coverage algorithm [12-13].

## 3 Hormony Search Algorithm

### *3.1 Problem Definition*

Let us consider that there are $m$ sensor nodes $\{s_1, s_2, \cdots s_m\}$in the region $G$where $n$targets are available$T = \{T_1, T_2, \cdots T_n\}$. Each sensor node in the region$G$, has a communication range $C_r$for communication with other sensor nodes in the field and sensing range $S_r$for sensing the given target$t_i/I \in T$. If the aloofness amid device nodes $s_i$&$s_j$remains less than $S_r$then the nodes $s_i$and $s_j$are connected to each other where $i, j \in m$.The coverage matrix($Con\ M$)can be defined as[14-15]

$$Con\ M_i = \begin{cases} 1\ if\ t_i \le S_r(s_j) \in n, j \in m \\ 0 \qquad\qquad\qquad otherwise \end{cases} \text{------- (1)}$$

And the connection matrix can be defined as

$$Con\ M_i = \begin{cases} 1\ if\ d\left(s_{i,}(s_j)\right) \le C_r, i, j \in m \\ 0 \qquad\qquad\qquad otherwise \end{cases} \text{------ (2)}$$

### *3.2 Harmony Search*

Harmony Search (HS) remains a popular population-predicated metaheuristic algorithm used to solve quandaries with optimization. The harmony search algorithm remains utilized in this paper towards optimize the prosperous location of device nodes in order towards cover all the targets and preserve connectivity[16-17].Harmony search works under three different forms, (1) it follows the Harmony Memory (HM) which it stored based on best results, (2) a slight pitch adjustment, (3) randomization. Its parameters used for pitch adjustment and use of HM is based on $r_{pa}$and $r_{accept}$. The pitch adjusting Harmony can be defined as,

$$x_{new} = x_{old} + B_{range} x \varepsilon \text{-------- (3)}$$

Where $B_{range} \in [-1,1]$

### *3.3 Mapping $HS - m$Connected Coverage WSN*

Each variable in HS is considered as a potential deployment region of a sensor node $s_i \in \{0,1\}$ [18-19] The defined algorithm for solving $m$ Connected Coverage using HS is given in following algorithm frame work shown in figure (1).

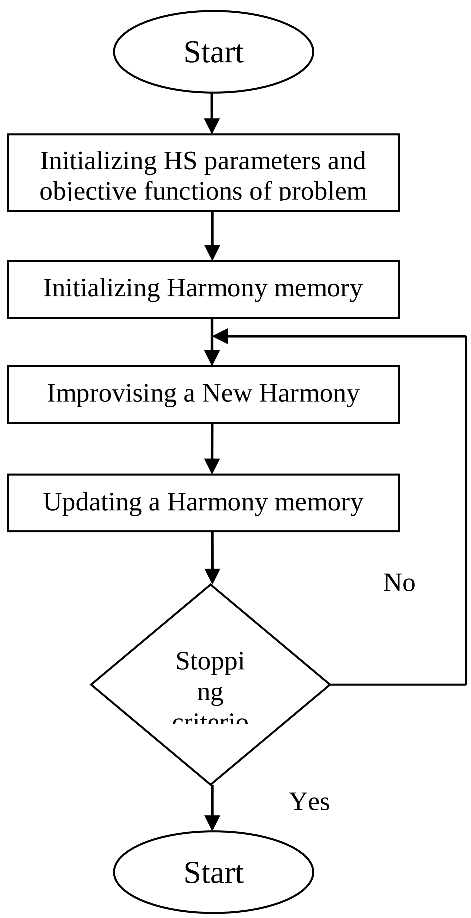


**Figure 1** Frame Work of Harmony Search Algorithm

### 3.4 Performance Measures

- **Computational Time:** It is defined as the time taken to complete the given number of iterations
- **No. of sensor nodes deployed:** It is defined as the ratio of the number of sensor nodes deployed to the available positions designated.
- **F value:** The ratio amid the number of positions available for plotting sensor nodes and the total number of sensor nodes deployed remains defined as a value of F.

$$F = \frac{K}{L} \text{ ----- (7)}$$

Here, L exhibits the total number of sensor nodes deployed, while K betokens the total number of positions available for the sensor nodes to be plotted.

## 4 The Virtual Force Algorithm (VFA)

In general, the Virtual Force Algorithm (VFA) is an algorithm that avails mobile robots in unknown environments towards evade obstacles. This VFA is utilized to maximise the coverage and disperse sensor nodes in the wireless sensor networks facilely. With this VFA, every sensor node in the network remains treated as a charged particle. The repulsive and attractive patterns used to represent the forces between two sensor nodes.The force is represented as repulsive pattern if the distance between any of two nodes is closed as much as smaller than threshold$D_{th}$and this pattern can intendfor separating them. While,the force is represented as attractive pattern if the aloofness amid any of two nodes remains larger than threshold $D_{th}$and this pattern can intendto draw them closely. In a region, let us consider a set of device nodes $S = \{s_1, s_2, s_3 \cdots s_l\}$, then $s_i(x_i, y_i)$remainsthe aloofness$d_{i,j}$amid the two device nodes$i$ $and$ $j$&$s_j(x_j, y_j)$ is given by,

$$d_{i,j} = d(s_i, s_j) = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

Then, the power of the $s_j$sensor node on the $s_i$sensor node is,

$$\vec{F}_{ij} = \begin{cases} \omega_\alpha (d_{i,j} - D_{th}), \alpha_{ij} d_{i,j} > D_{th} \\ 0 \;\; d_{i,j} = D_{th} \\ \omega_\gamma / d_{i,j}, \alpha_{i,j} + \pi \;\; d_{i,j} < D_{th} \end{cases} \text{ --- (4)}$$

Where, $\omega_\alpha$ and $\omega_\gamma$indicates the virtual force coefficients and$\omega_\gamma \gg \omega_\alpha$. The threshold $D_{th}$ represents threshold vale for the generatedgravitation and repulsive forcewhich has a $\sqrt{3}R_s$ value. The line angle between the sensor nodes $i$ $and$ $j$ is$\propto_{ij}$with respect to the y-axis. The sensor node$i$ is closertowards the sensor node$j$when it remains considered as $d_{i,j} < D_{th}$ at which the force is in a repulsive pattern while the sensor node$i$ have a distance to the sensor node$j$when it remains considered by way of$d_{i,j} > D_{th}$ at which the force is in an attractive pattern.The resulting force in the horizontal direction of the sensor node I remains $\underset{F\ i}{\rightarrow}$ the resulting force $\underset{F\ ix}{\rightarrow}$, the resultant force in the vertical direction is $\underset{F\ iy}{\rightarrow}$, then the node positionremains updated throughthe following Equations (5) and (6).

$$x(k+1) = x(k) + \frac{\vec{F}_{ix}}{\vec{F}_i} \times Maxstep \times e^{-1/\vec{F}_i} \text{--- (5)}$$

$$y(k+1) = y(k) + \frac{\vec{F}_{iy}}{\vec{F}_i} \times Maxstep \times e^{-1/\vec{F}_i} \text{--- (6)}$$

Here,$x(k)$indicates the horizontal coordinateof sensor node $s_i$ at time $k$and $y(k)$indicatesthe vertical coordinate of same sensor node $s_i$ at time $k$. MaxStep exhibits the step size to be transferred by the wireless sensor node.

## 5 Conclusion

A review on maximizing techniques of wireless sensor networks coverage and localization is given in this paper. The virtual face algorithm for the node realization and the metaheuristic harmony search algorithm to solve the m connected coverage network in the WSN network are reviewed. The higher coverage rate, short distance of average sensor node displacement and the main objective of the design is ensured. The results of the simulation show that the coverage rate, uniformity and elimination of the mean moving up of the VFA algorithm for the wireless sensor network remain all together in a way that remains better than those of CPSO, CS & LGWO, then the VFLGWO calculation has a vigorous capacity to adjust to the environment. The result of the HS algorithm has been compared by other evolutionary GA & PSO algorithms and the results show, that the HS algorithm surpasses existing algorithms.

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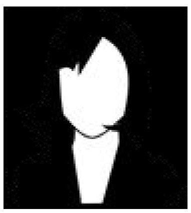
## Biographies



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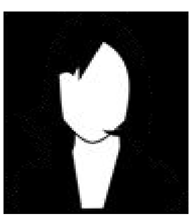

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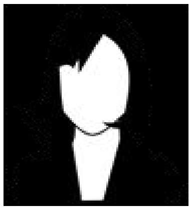

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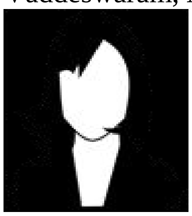

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