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# COVERAGE AND CONNECTIVITY IN WIRELESS SENSOR NETWORKS

Engineering


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## ABSTRACT

Addressing the coverage problem is not a complete set of tasks for solving data aggregation in Wireless Sensor Networks (WSN). Since the collected information of each sensor node to reach the base station the deployment of sensors plays a critical role in WSN. This paper addresses connected coverage problem which covers all the given targets and provide a complete connectivity between the sensors for effective data aggregation of data to the base station. A widespread Cluster-based Energy Efficient Search Algorithm for resolving optimization problems is imposed in this sensor deployment concept. The results of the suggested algorithm have been related to other existing techniques and the outcomes show that the proposed algorithm outperforms existing algorithms.



## KEYWORDS

WSN, Cluster-based Energy Efficient Search, m connected coverage, active sensor node (ASN), region of interest (ROI)I.


## INTRODUCTION

WSNs are attracted the important consideration from industry & community of research in the last some years. The primary purpose for the latest rapid improvement & research deliberations of WSNs will be their possible application in an extensive range of contexts containing health care, army applications, observing of environment, surveillance frameworks, & public security [1], [2]. These provisions need the numerous deployment sensors to cover a provided ROI in the field of network. While, sensor nodes might work separately, they might also work cooperatively to observe physical factors of the environment. The sensor nodes might sense the environment, connect with neighboring nodes, and in numerous circumstances, execute essential computations on the information continuously gathered [3] [4].

These features create WSNs a phenomenal decision for numerous presentations [2] running over environments, which risky to the existence of humans. The issue of coverage will be the main issue in WSNs as it has an immediate influence on the lifetime of network & energy consumption of sensors [5]. The issue of coverage might commonly denote how to observe the field of network viably. There are a few approaches to categorize the issues of coverage in WSNs. The issues of coverage might be categorized as stated by the network field monitor frequency, under either sweep coverage issues or continuous coverage issues. The continuous coverage issues might be categorized as stated by the ROI for observing under 3 kinds, they are point coverage, area coverage, & barrier coverage. Furthermore, coverage protocols might be categorized according to the framework method of the network. There are 4 features under the framework method: sensor mobility methods, sensor sensing methods, sensor deployment methods, & sensor location awareness. The sensing methods have comprehensively categorized, rely on sensing capability, under two kinds: Probabilistic sensing methods & deterministic sensing methods. The sensing methods might also be categorized, rely on sensing range direction into either omnidirectional sensing or directional sensing methods. The coverage protocols might also be categorized rely on whereas coverage optimization occurs, that is under either "coverage aware deployment protocols", whereas coverage optimization occurs before the stage of deployment, or sleep scheduling protocols, while coverage optimization occurs after stage of deployment. The protocols of sleep schedule might be categorized rely on network topology, under either sleep scheduling or cluster-based sleep scheduling protocols for flat networks.

## II. Literature Survey

Cheng et al., [6], proposed a model for connected target k-coverage difficult in heterogeneous WSNs. They used two algorithms namely distributed connected target k-coverage algorithm & centralized connected target k-coverage algorithm to provide energy-efficient and coverage of heterogeneous network. Their proposed model minimized connected target k-coverage with least k-active sensor nodes. Their proposed model reduced the number of ASNs and every node can connect to the sink node to forward data.

The coverage issue in WSN deals with deploying sensor nodes with a maximum coverage area by scheduling and analyzing sensor nodes. Connectivity in WSN provides communication among sensor nodes directly or indirectly to forward data to the sink node. Wang et al., [7] proposed coverage issues in heterogeneous networks based on coverage and reachability. Lazos et al., [8] proposed stochastic coverage for heterogeneous networks and they framed minimum coverage issues as intersection issues. Due et al., [9] solved an issue for scalability and performance issues for heterogeneous network using differential coverage algorithm.

Zorbas et al., [10] suggested an efficient algorithm to maintain discrete active sensor nodes to cover all the available targets and provide connectivity among the network. They suggested an algorithm to schedule sensor nodes to increase the lifetime of network connectivity. The author proposed an optimized connected coverage heuristic algorithm to preserve the connectivity of network with maximum network lifetime. Scheduling in sensor network coverage includes area coverage and target coverage. This author solved target coverage issues in wireless sensor networks with an optimized connected coverage algorithm.

Cardi et al., [11] proposed linear programming and greedy based techniques to solve the coverage problem in sensor networks. In their proposed work, the sensor nodes cover more than one coverage set and thus it raises the number of coverages set in the network.

Greedy based target coverage algorithm was proposed [12] to maximize the number of sensor coverage sets by maintaining and managing poorly target nodes. Based on cost function the authors proposed heuristic methodology to manage poorly connected targets and improve the lifetime of the network.

## III. Implementation

The WSN design will be impacted by numerous elements like scalability, costs of production, network topology, initial energy, sensing environment, & consumption of power of sensor nodes. Subsequently WSN designing will be a much challenging assignment when scope along with a lifetime of network will be deliberated. There

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presents a trade-off among a lifetime of network & coverage due to whether we deliberate full scope then a lifetime of the network becomes lessened & whether we try to enhance the lifetime of a network then coverage becomes decreased. The identified surroundings might make in the type for whole organization area, particular focuses in the across a specific area, or deployment area whereas there will be few probabilities of a breach. Given these over conditions, coverage is sorted under 3 sorts.

1) Target Coverage
2) Area Coverage
3) Barrier Coverage

Target Coverage: In this situation, targets have depicted as a group of distinct points in the provided field of interest & every target should be enclosed by at least one ASN. This kind of coverage will be commonly utilized in applications of the army.

Area Coverage: It mentions to detect the whole region. This signifies, each single point in the provided field of interest should be below the sensing range of at least one ASN. Preferably, the amount of ASNs is least even whether the amount of deployed sensor nodes is very high.

Barrier Coverage: It denotes to detecting the movement of the mobile item, which enter into the border of a provided field of interest across the field of the sensor. The intrusion detection will be a significant barrier coverage application.

Figure 1.1: Information flow in WSN

In any WSN, the sensor node comprises of 4 simple modules, as exposed in Figure 1.2, they are transceiver unit, sensing unit, power unit, & processing unit. They are also having extra application reliant modules like a power generator, location discovery framework, and mobilization.

Figure 1.2: The WSN modules

Though various techniques & protocols are suggested for traditional wireless ad-hoc networks such as MANET, they have not well appropriate for WSNs due to the subsequent variations among ad hoc networks & WSNs like

MANET

1) Many WSNs in distinctive WSN have very greater than nodes in the basic Adhoc network.
1) Sensor nodes are compactly deployed & the cost of node failure will be very high because of inadequate initial energy at deployment time.
2) The WSN topology deviations very often for particular applications.
3) Sensor nodes mostly utilize a broadcast communication, while most ad-hoc networks have utilizing point-to-point communications.
4) WSNs are inadequate in computation, energy, and storage memory.
5) Nonappearance of global & unique identification (ID's) due to the large number of nodes & large amounts of overhead taking portion in WSN subsequent in incapability to preserve database of sensor nodes.

To deal with the issue, a hybrid grouping to recover the service of QoS is suggested in this examination article. To expand a searching method, a Genetic algorithm is suggested & to enhance the best quality in packet transmission, cooperative caching will be suggested & this method demonstrates worthier than initial versions of reactive protocols.

Step 1: The distinct confines are set for the Shortest Path route.

Step 2: Casual values are produced among confines.

Step 3: The values of produced routes have put into the function of the object

Step 4: The fitness evaluation will be completed for the numerous routes fmax (n, 1) = max (fx (n, 1)) fmin(n,1) = min(fx(n,1) for i=1:z ft(i,1) = (fmax(n,1) - fmin(n,1)) - fx(n,1); end ftb = mean (ft); for i=1:z rl (i, 1) = ft (i, 1)/ftb; end

Step 5: The best fit will be estimated rely on above formula.

Step 6: Assortment based on roulette wheel thought will be completed, the values offering the best fit being provided a high percentage on wheel region so that values giving a best fit have high probability of generating an offspring.

Step 7: Crossover will executed on strings utilizing midpoint crossover.

Crossover offers integration of extra features in off springs formed.

Step 8: Mutation will be completed whether consecutive iteration values have the similar.

Step 9: The novel routes, which satisfy the minimization object, & associated factors have plotted. Where: fx be the fitness value; ft=normalized fx

**Input:** Number of sensor nodes *m*, Number of Targets *m*, objective function *f*()
Begin
Initialize Population size (*PopSize*), Maximum Iterations (*MaxIT*)
Initialize the Harmony Memory (HM) with random memery values
Initialize $r_{pa} r_{pa}$ and $r_{accept}$
*while*($t \leq MaxIT$)*do*
*for* each $i \in Popsize$
*for* each $j \in |S|$
*if*($rand < r_{accept}$)*then*
Choose *j* from HM
*elseif*(*r* and $< r_{pa}$) *then*
Adjust *j* using Eq. (3)
*else*
Generate a random variable for *j*
*endif*
*end for*
*if*$\left(f\left(x_i^{new} < f\,(x_i^{old}\right)\right)$ *then*

$$x_i^{t+1} \leftarrow x_i^{new}$$

*endif*
*end while*
***End***

**Output:** Potential Positions to place the sensor nodes from

## IV. CONCLUSION

In this paper, the Cluster based EnergyEfficient Search Algorithm is used for solving m connected coverage WSN network. In Introduction section a detailed explanation regarding the problem is given and the given problem is defined.

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