

Optimal Energy Efficient Connected Coverage Wireless Sensor Networks

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ABSTRACT

Coverage intends to guarantee that every one of the focuses in the zone to be observed or secured by the sensors. A few applications necessitate that each point in the territory is observed by just a single sensor while different applications may necessitate that each point is secured by at any rate k sensors to recognize adaptation to non-critical failure. In this manner, inclusion is one of the significant worries in WSN. The capacity to report the detected information to base station is called network. The sensor system stays associated with the goal that the data gathered by sensor hubs can be transmitted back to the base station. Availability depends primarily on the presence of connection. It is influenced by changes in system topology because of portability, the disappointment of sensor hubs and assaults, etc. Along these lines, Coverage alone in WSN isn't adequate. In this way, WSN must fulfill both Coverage and Connectivity required by applications at the same time. In this exploration we propose the calculation called Energy mindful Connectivity Algorithm which will give full inclusion and network to WSN.

Keywords : About four key words or phrases in alphabetical order, separated by commas.

1. INTRODUCTION

A Wireless Sensor Network (WSN) is a framework involving various remote sensors, moreover called center points, which take part in identifying a kind of physical or natural conditions, for instance, temperature, sound, vibrations, light, improvement, and so forth[12]. Movements in little scale electro-mechanical structures, propelled equipment, and remote correspondences have engaged the improvement of another period of sensor center points. These sensors are little in size and they give in a multi-hop path as a result of a short radio range. In addition, they are powered by a confined imperativeness source. This makes a couple of limitations on the applications and shows which are proposed for use in such frameworks. These sensor center points collaborate to outline an extemporaneous framework prepared for specifying framework activities to a data social occasion sink. Position of hubs in a WSN affects unequivocal system execution measurements, for example, vitality utilization, deferral and throughput. For an example, vitality utilization may get upgraded because of harmed correspondence joins when the separation between hubs ends up higher. Ideal hub position is an extremely requesting emergency that has been confirmed to be NP-hard for almost every one of the definitions of sensor abuse (Nokhanji,2015). To manage such trouble, various heuristics has been prescribed to find imperfect arrangements. Be that as it may, these improvement arrangements depend on the examination of fixed topologies (Nokhanji,2015) . Therefore, such plans can be ordered into two sorts specifically static situating and dynamic situating. Then again, different techniques have upheld dynamic change of area of hubs in light of the fact that the optimality of the first areas may wind up void amid the system task restrictive on the system state and an assortment of outside issues [11]. Since, the available system assets may vary in the end, for example, new hubs could interface with the system, or the vitality of the current hubs might be demolished.

2. RELATED WORK

Qi Liu,[3] have displayed a whole answer for the emergency for sensors that were conveyed by a Poisson point process. In precise, they offered an effective dispersed calculation to develop sensor boundaries on long strip zones of unpredictable shape with no requirement on running into each other. Their methodology is as per the following: they at first shown that in a rectangular region of width w and length l with $w = \Omega(\log l)$, in the event that the sensor thickness achieves a specific esteem, at that point there makes due, with high likelihood, different disjoint sensor obstructions over the whole length of the territory to such an extent that interlopers can't cross the region undetected. On the other hand, in the event that $w=O(\log l)$, at that point with high likelihood there is an intersection way revealed by a couple of sensor regardless of the sensor thickness. They at that point conceived, in view of the outcome, a productive circulated calculation to build various disjoint boundaries in an extensive sensor system to cover a long limit region of a

sporadic shape. Their calculation assessed the region by isolating it into flat rectangular sections interleaved by vertical dainty strips. Each portion and vertical strip autonomously figures the obstructions in its own zone. Building "level" obstructions in each section associated by "vertical" boundaries in neighboring vertical strips, they had accomplished nonstop hindrance inclusion for the whole district. Their plan extensively decreased postponement, correspondence overhead, and calculation costs contrasted with brought together procedures. At last, they had actualized their calculation and complete various tests to demonstrate the viability of building hindrance inclusion. Chengfa Li, [6] are proposed the Distributed Optimum Coverage Algorithm (DOCA) which was depended upon to reinforce the structure lifetime by having the sensors sporadically figure their ability to adjust their holding up time. Definitely when the holding up time slips they will meander out to a working state. Remote Sensor Network for their quick strategy can be connected in living space searching for seeing fire and in a debacle for supporting rescue get-togethers. Center point restriction is a focal factor for various applications. Jauregui-Ortiz has proposed the Triangular Centroid Localization figuring (TCL). It relied on major trigonometric figures and it prohibits enchanting apparatus or synchronization time. In their reenactments abusing the got banner quality marker; TCL improved the exactness of Centroid Localization (CL) in 54% and Weighted Centroid Localization (WCL) in 64%; using the connection quality pointer it was improved to CL in 38% and WCL in 64.98%. Yanjun [10] considered the issue of topology progression to spare centrality in remote sensor systems. The proposed topology improvement structures create reduced topologies utilizing the Connected Dominating Set methodology in a dispersed, convincing, and clear system. The issue is extremely trying as the strategy must outfit a related structure with complete consolidation of the area of excitement utilizing the base number of focus focuses feasible. Further, the checks should be computationally unobtrusive and the customs enough clear comparatively as their message and figuring multifaceted nature, so they don't devour more centrality making the diminished topology than the significance that they should spare. Moreover, it is speaking to diminish or completely dispose of the need of limitation structures since they present extra expenses and significance use. For these conditions, they have shown the social occasion of A3 dispersed topology improvement figuring's, four clear estimations that fabricated decreased topologies with low computational and message multifaceted nature without the need of hindrance data. The figurings were looked lacking and thick systems versus immaculate theoretical cutoff focuses for related thought topologies and two passed on heuristics found in the making utilizing the sum out of powerful focus focuses and the degree of fuse as the standard execution estimations. The outcomes showed that there is no conspicuous victor, and rather, tradeoffs endure. In the event that consolidation isn't as genuine as significance (engineer lifetime), it is better than use A3Lite, as it requires less number of focuses and messages. [2] proposed an impact desire segment proposed to deal with this questionable issue, by manhandling transient spatial associations among material data. The major thought lies in that a sensor center can be executed mindfully when its material information can be grasped through two or three conjecture procedures, as Bayesian finding. They have gotten the possibility of entropy in information theory to measure the information powerlessness about the region of interest (RoI). They calculated the trouble as a base weight sub disconnected set spread issue, which is known to be NP hard. To address the issue, a beneficial brought together truncated ravenous computation (TGA) was proposed. They showed the execution affirmation of TGA to the extent the extent of complete weight accomplished by TGA to that by the perfect count. In context on the decentralization thought of WSNs, they had likewise shown a coursed variation of TGA, meant as DTGA, which acquired the similar game plan as TGA. The utilization issues, for instance, sort out system and correspondence cost were exhaustively exhibited. They had performed genuine data preliminaries and proliferations to reveal the advantage of DTGA over the present testing count and the effects of various parameters related with data associations on the framework lifetime.

3. PROPOSED WORK

Optimal Energy Efficient Connected Coverage (OE2C2) mechanism is proposed to address the issue of energy efficiency in connected coverage. It consists of four phases namely Construction of the Cover Set, Cover Set Optimization, Construction of Connected Cover Set, Connected Cover Set Optimization.

3.1. Construction of the Cover Set

The input to this phase consists of the set of available sensors V which is sorted in descending order of battery power and the set of target points. The goal is to compute a cover set C . It is observed that a solution to energy-efficient coverage problem explores all possible combinations of sensors to find the set of sensors which provides minimum coverage sum to all the target points with respect to the set and maximum utility sum to all the sensors in the set, simultaneously. A greedy heuristic which tries to achieve the same without exploring all possible combinations of sensors, is applied here to compute the cover set. During the process of computation, the heuristic tries to minimize the coverage of individual target points and maximize the utility of individual sensor nodes. At each stage, the heuristic chooses an uncovered target point which has a minimum coverage with respect to the set S and then chooses a sensor to cover the chosen target point such that the sensor provides maximum utility. Here the spanning tree can be constructed from the set of available sensors according to the following steps.

- Step 1: Let $v \in V$ be the largest degree node. Include v to the empty Spanning Tree T .
- Step 2: For all nodes adjacent to v , choose a node w that has maximum neighbor nodes. Add edge (v,w) to T . If two or more nodes like $w_1, w_2, \dots, w_n$ have equal maximum neighbor nodes, add edge $(v,w_1), (v,w_2), \dots, (v,w_n)$, to T .
- Step 3: Repeat the above steps until all the nodes in the network are present in the tree T .
- Step 4: After constructing the partial spanning tree T , remove all the leaf nodes present in the tree. Now, the tree is called a spanning tree.
- After constructing the spanning tree, the cover set has to be computed according to the following steps.
- Step 5: Initialize the cover set $C = \text{Null}$.
- Step 6: Classify the nodes in the tree based on the hierarchy level of the spanning tree.
- Step 7: From the upper level to the lower level of the tree $l_0, l_1, \dots, l_n$ add elements to C , until all elements at the various levels are added to the C .

Activating sensors with high utility also favors data aggregation at the source, since data corresponding to multiple events in the network gets combined in one transmitted message. In addition, this reduces network traffic when similar events occur at multiple target points. Since only one active sensor covers all the target points, it leads to only one message being generated in response to multiple events in the network.

3.2.Cover Set Optimization

- Step 8: While there is at least one element in the cover set C { Let w be the element with maximum level that has minimum degree. Remove the element w from the set and delete that node from the tree, since the node not be turned on for coverage condition to be satisfied. }

To optimize the cover set, it is observed that what is more related to the size of cover set is the coverage requirement. According to the proposed algorithm, Step 8 removes nodes in the cover set because they does not satisfy the coverage condition.

3.3 Construction of Connected Cover set

The input to this phase consists of the cover set C computed in the coverage optimization phase and the network connectivity graph. The goal is to compute connected cover set B such that the set C is included in the set B . The optimized cover is checked for connectivity. If the set C is already an active set, the set B is set equal to the set C . Otherwise, relay nodes are added to the set C to form the connected set B . Density based relay node placement approach is considered while adding relay sensors for connectivity.

1.2 Connected cover set Optimization

The input to this phase is an active set B (computed in the construction of connected cover set phase above), which ensures connected coverage in the network. The goal is to remove maximum number of redundant sensors from the set B so as to form a minimal active set. The heuristic developed here is based on the following intuition. A sensor $s \in B$ with a higher degree (measure of connectivity) in B is less likely to be redundant. Even when such a sensor is redundant, preferring sensors with a lower degree than s for removal, would possibly lead to more number of sensors being removed from the set B . Initially all the sensors $s \in B$ are unmarked.

- Step 1: Choose the unmarked sensor $s \in B$ with the lowest degree in B .

- Step 2: Check to see if the set $B - \{s\}$ is an active set i.e. it ensures connected coverage in the network.

- Step 3: If true, modify the set B as $B = B - \{s\}$, else mark the sensor s .

- Step 4: Repeat steps 1 to 3 till all the sensors $s \in B$ are marked.

The active set thus obtained is sufficient to provide connected coverage to the network for one round. Once the four phases of a particular iteration are over, the set of available sensors is modified as $V = V - B$ and the algorithm proceeds to the next iteration. Iterations are repeated till no more active set can be found. The active sets computed are now activated in successive rounds.

4.SIMULATION AND RESULTS

NS2 has been used for performance evaluation of the proposed scheme. A stationary network with sensor nodes and target points located randomly in a 500m×500m area is considered for simulation. Parameters used for simulation are cited in Table 1.

Table 1: Parameter setting for simulation

Parameter	value
Number of sensor nodes	100:600
Number of targets	25:100
Simulation time	500:3000s
Initial energy of each node	2 joules
Energy for covering one target	1 joule
Sensing Range	40:50 m
Communication Range	80m
Size of data packet	4096 bits

The performance ofOE2C2 was studied with respect to network lifetime, coverage with respect to number of nodes and simulation time, number of covers with respect to number of nodes, average node energy consumption and tracking error.

Table 2: Comparision of various coverage schemes

Parameters	CCH-MCDS	E-MCDS	IP-CDS	OE ² C ² (Proposed)
Total cost of the CDS for network of size 500 nodes (J)	165	143	113	90
Average risk for a network of size 500 nodes (%)	32	29.4	26.8	22
CDS Size for a network of size 500 nodes	75	67	53	43
Link interference for a network of size 500 nodes	25	23	21	20

Coverage for a network of size 500 nodes	91	94	95	100
Percentage of dominant nodes during 200 rounds	72	70	60	50
CDS Size for a network of size 100 nodes during 30m	30	25	18	10

The attainability of the proposed plan is assessed through execution investigation and reproduction results. The outcomes demonstrate that proposed plan outflanks very much contrasted with the current plans as far as expands the inclusion as for number of hubs, limits the normal hazard, decreases the size of the CDS and connection impedance and builds the level of overwhelming nodes concerning number of rounds. Subsequently the proposed methodology keeps up availability with the assistance ruling set based methodology in contrast with different algorithms.

5. CONCLUSION

Energy Efficient Connected Coverage mechanism which consists of four phases namely construction of the cover set, cover set optimization, construction of connected cover set and connected cover set optimization. In the first phase, a spanning tree is constructed from the set of available sensors. After the construction of the spanning tree, the cover set is to be computed. The input to the second phase is the cover set. The output of this phase is the optimized cover set. This optimized cover set may have nodes which need not be turned on for coverage condition to be satisfied. These nodes will be eliminated at this phase. In the third phase, the optimized cover set is checked for connectivity. If the cover set is already an active set, the cover set is set equal to the active set. Otherwise, relay nodes are added to the cover set to form the connected cover set. Here a density based relay node placement approach is considered while adding relay sensors for connectivity. In the final phase of connected cover set optimization, a connected cover set is given as input and produces the minimal connected cover set. This phase ensures connected coverage in the network. Here the maximum number of redundant sensors is removed based on a heuristic from the connected cover set so as to form a minimal active set.

The achievability of the proposed scheme is evaluated through performance analysis and simulation results. The results show that proposed scheme outperforms well compared to the existing schemes in terms of maximizes the coverage with respect to number of nodes & simulation time, maximizes the network lifetime, increases the cover size with respect to number of nodes, minimizes the average node energy consumption and reduces the tracking error compared to other related schemes. Hence the proposed approach achieves energy efficient connected coverage in comparison to other schemes.

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