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An efficient restoration method for Large network failure in wireless sensor network

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Abstract –As wireless sensor network (WSN) is frequently deployed in a hostile environment, nodes in the networks causes possibilities to large-scale failures, resultant in the network not working normally. In this case, an effectual restoration method is desirable to restore the faulty network timely. Most of existing restoration method is considering more about the number of deployed nodes or fault tolerance alone, but fail to take into account the fact that network coverage and topology quality which are also vital to a network. To address this issue, in this a new algorithms named Partial 4-Connectivity Restoration Algorithm (P4CRA), which restore a faulty WSN in different aspects. P3CRA constructs the dual-ring topology configuration to improve the fault tolerance of the network. P3CRA is suitable when the network value is considered first. Compared with other algorithms, the given algorithm ensure that the network has stronger fault-tolerant function, also larger coverage area and enhanced balanced load after the restoration.

Keywords: Wireless sensor network, restoration, deployed, topology, fault-tolerant

I INTRODUCTION

Wireless sensor networks (WSN), sometimes the wireless sensor and drive networks (WSN) airspace, such as temperature, sound, pressure, etc, physical or environmental conditions, monitoring and cooperation with the send-autonomous sensors in the distribution is a key location Network through their data. Even more modern networks enable the sensor to control the action, there are two navigation. The development of wireless sensor networks was motivated by the military applications such as battlefield surveillance; Today, most of such networks, such as industrial process monitoring and control, engine health monitoring, and many other industrial and consumer application Where every node from a certain one (or sometimes several) connected to hundreds or thousands of sensors, the - WSN "nodes" built.At the time of sending data through nodes sometimes causes failures..And there is a problem of restoring the nodes which is been affected

II. PREVIOUS WORK

In the previous work restoration cost, fault tolerance, network coverage and topology quality were considered . They search to use fewer nodes to establish a network with fault-tolerant function under the premise of multiple segments that are not capable to communicate with each other. Meanwhile, except for the restoration cost and fault tolerance, they consider the network coverage, the excellence of topology and others in this paper, so as to ensure that the network can not only has better fault tolerance, but that also has stronger robustness and higher coverage after the restoration.

Certainly, these performance are not considered fully in the existing work. The algorithms we propose in this paper are summarized as follows: Partial 3-Connectivity Restoration Algorithm (P3CRA) provides three vertex-disjoint paths between the every pair of segments and at least two vertex-disjoint paths between every pair of relay nodes. This algorithm is suitable while the fault tolerance, network coverage and topology quality are considered first

Drawbacks

1. Cost is considered first.

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2. Computation complexity is high

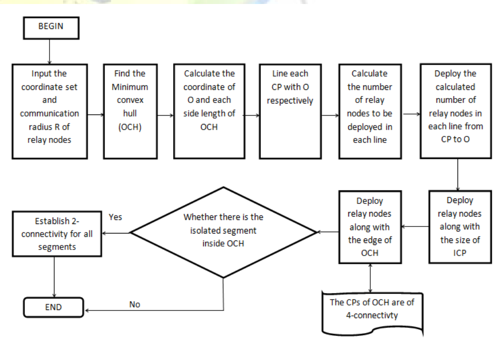
III . RELATED WORKS

In [1] Hao, B. Et all have suggested a fault-tolerant relay node placement problem for wireless sensor networks. The proposal have presented a polynomial time approximation algorithm to solve this problem and proved that its worst case performance ratio is bounded by O(D logn). Preliminary imitation results shows that solutions provided by our algorithm are close to optimal. And also the process of designing approximation algorithmswith better performance ratio

In[3] Lloyd, E.L et al suggested the problem of deploying a minimum number of relay nodes to get diverse levels of fault-tolerance which in the context of heterogeneous wireless sensor networks, where target nodes have various transmission radii. The various transmission radii of the target nodes initiate *asymmetric communication links* between neighboring nodes, resultant in one-way and two-way paths. The problem is additional complicated by the need to facilitate the desired fault tolerance levels among every pair of (target and/or relay) nodes, or every pair of target nodes. Specifically, the system develop $O(\sigma k2)$-approximation algorithms designed for one-way and two way Partial fault-tolerance relay node placement, and $O(\sigma k3)$-approximation algorithms designed for one-way and two-way full fault tolerance relay node placement. In[5] Sitanayah, L suggested that wireless sensor networks are robust failures require that the physical network topology will offer substitute routes to the sink. This requires sensor network deployment to be planned with an objective of ensuring a number of measure of robustness in the topology, so that when failures do occur that routing protocols can continue to offer reliable delivery. The process contribution is a solution that enables fault-tolerant WSN deployment preparation by judicious use of extra relay nodes. In this paper, we define the problem for increasing WSN reliability by deploying a number of extra relay nodes to ensure that each sensor node in the initial design has k node-disjoint paths to the sinks. The system propose GRASP-ARP, a centralised offline algorithm to be run during the initial topology design to solve this problem. The process also adapt a version of the closest approach from the literature for comparison

IV . PROPOSED WORK

In this the proposed method improved a Partial 4-Connectivity Restoration Algorithm (P4CRA). P4CRA is similar to F2CRA, but the network restored by P4CRA will have partial 4-connectivity structure. Partial 4-connectivity means that after the restoration, all the segments have 4-connectivity at least, and the deployed relay nodes have 2-connectivity at least. The network restored by P4CRA has larger coverage and better fault tolerance than that by F2CRA. However, P4CRA needs to deploy more nodes; therefore, P4CRA is suitable when the network quality is taken into consideration first. F2CRA is suitable when the cost is in consideration. P4CRA flow chart is shown in following Figure.



V.ALGORITHM

INPUT: R, S = {s1,s2, . . . ,sn} and {(x1, y1),(x2, y2), . . . ,(xn, yn)}. P is null.

OUTPUT: A set of relay nodes P.

Step 1. Find OCH.

(1) Adopt the Graham scan algorithm used to find OCH in S. Suppose that CPs set of OCH is ts1,s2, . . . ,smu Ă S and their corresponding coordinate is tpx1, y1q, px2, y2q, . . . , pxm, ymqu. The remaining segments set inside OCH is tsm`1,sm`2, . . . ,snu.

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(2) Calculate the coordinate px0, y0q of O. x0 “ 1 m řm i“1 xi y0 “ 1 m řm i“1 yi

(3) Calculate each side length of the OCH. for i “ 1 to m do j “ i ` 1 if i “ m then j “ 1 end if sidei “ b` xi ´ xj ˘2 ` ` yi ´ yj ˘2 end for Then the set of the side lengths of OCH is tside1,side2, . . . ,sidemu.

Step 2. Find ICH.

(1) Line each CP with O, respectively, and calculate the length of each line: for i = 1 to m do

li “ b pxi ´ x0q 2 ` pyi ´ y0q 2
Then the set of these lines is {l1, l2, . . . , lmu}

(2) Calculate the angle between two adjacent lines:
for i “ 1 to m do j “ i ` 1 if i “ m then j “ 1 end if θi “ arccos ˜ 1 2 i ` 1 2 i`1 ´ side2 i 2 ˆ li ˆ li`1 ¸ Calculate the number of relay nodes to be deployed in each line: x 1 i “ x0 ˘ R ˆ |x0 ´ xi| 2 ˆ li ˆ sinθi 2 , y 1 i “ y0 ˘ R ˆ |y0 ´ yi| 2 ˆ li ˆ sinθi 2 n 1 i “ — — — – b` xi ´ x 1 i ˘2 ` ` yi ´ y 1 i ˘2 R ffi ffi ffi fl Start with a CP of OCH si , and deploy relay nodes towards O with one relay node every distance R, then get the corresponding deployment position of n 1 i nodes. Add these nodes into the set of P and set the last node pi , the coordinate px 2 i , y 2 i q. end for Then the CPs set of ICH is tp1, p2, . . . , pmu.

(1) Line each CP with O, respectively, and calculate the length of each line given:
for i = 1 to m do

$$l_i = \sqrt{(x_i - x_0)^2 + (y_i - y_0)^2}$$

Then the set of these lines is { l1, l2, . . . , lm}

(2) Calculate the angle between two adjacent lines:

for $i = 1$ to m **do**
$j = i + 1$
if $i = m$ **then**
$j = 1$
end if

$$\theta_i = \arccos\left(\frac{l_i^2 + l_{i+1}^2 - side_i^2}{2 \times l_i \times l_{i+1}}\right)$$

Calculate the number of relay nodes to be deployed in each line:

$$x_i' = x_0 \pm \frac{R \times |x_0 - x_i|}{2 \times l_i \times \sin\frac{\theta_i}{2}},$$

$$y_i' = y_0 \pm \frac{R \times |y_0 - y_i|}{2 \times l_i \times \sin\frac{\theta_i}{2}}$$

$$n_i' = \left\lfloor \frac{\sqrt{(x_i - x_i')^2 + (y_i - y_i')^2}}{R} \right\rfloor$$

Start with a CP of OCH si , and deploy relay nodes towards O with one relay node every distance R, then get the corresponding deployment position of n_i' nodes. Add these nodes into the set of P and set the last node pi , the coordinate (x “$_i$, y”$_i$).
end for
Then the CPs set of ICH is tp1, p2, . . . , pmu

(3) Deploy the nodes along with the edge of ICH. for i “ 1 to m do if i “ m then j “ 1 end if Deploy

Step 3. Establish 3-connectivity for the segments on OCH.

for i “ 1 to m do

Deploy relay nodes between si and si+1 . (if i =m, then i + 1 = 1)

end for

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Step 4. Establish 4-connectivity for the isolated segments on the plane.

for k = m + 1 to n do

Find the nearest three nodes u 1 , v 1 and w 1 for sk . (u 1 , v 1 , w 1are not on the same line) Deploy nodes uniformly in sk and u 1 , sk and v 1 , sk and w 1 .

end for

The first two steps shown are consistent in F2CRA algorithm and P4CRA algorithm, but in Step 3, P4CRA algorithm which is directly deploys nodes along the edge of OCH. At that time, all CPs (segments) on OCH form 3-connectivity. In Step 4, all segments on the plane eventually form 4-connectivity. Like F2CRA algorithm, the time complexity of P4CRA algorithm is also O pnlognq. To précis, the network topology repaired by F2CRA algorithm has 2-connectivity. As it needs fewer nodes, this algorithm is suitable when the given cost is considered first. Compared with F2CRA algorithm, P4CRA algorithm which needs to deploy more nodes in the process. Due to the stronger fault tolerance, larger coverage and extra balanced load, P4CRA algorithm is applicable when the performance of network is considered first.

VI.EXPERIMENTAL RESULTS

F2CRA algorithm	10.27 sec
P4CRA algorithm	5.1 sec

VII .CONCLUSION

Due to the deployment environment, WSN is prone to large-scale failure; therefore, the effective algorithm is desired for timely recovery so that the network can run normally and stably. In this paper, the processes propose two fault restoration algorithms, respectively for solving the WSN fault restoration problem from different points. Existing work is suitable when cost is considered first; and P4CRA is suitable when the performances of the network are considered first. While Compared with other algorithms, these two algorithms ensure that the network has the stronger fault-tolerant function, larger coverage region and extra balanced load after the restoration. In future work, the process plan to consider additional factors of deployment environment in our algorithms, such as obstacles and rough terrain, so that the proposed algorithms can be added in line with the actual situation.

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