HOLE DETECTION AND HEALING IN WIRELESS SENSOR NETWORK

Mohan Kumar C¹, Jessynirmal A G² and Patra P S K³
¹PG Scholar, Computer science and Engineering, Agni College of Technology, Chennai, India
²Asst.prof, Computer Science and Engineering, Agni College of Technology, Chennai, India
³HOD, Computer Science and Engineering, Agni College of Technology, Chennai, India

Abstract -- A wireless sensor network (WSN) is one of the fundamental services provided by the monitoring of a specific Region of Interest (RoI). WSNs due to holes in RoI exposure is unavoidable considering the fact that the inner nature, environmental factors, random Uses, and external attacks, is to ensure that revenue is covered completely and consistently Key. This paper seeks to issue mobile WSNs hole detection and healing. We are discussing the main drawbacks We ensure the security of mobile WSNs effective solutions will be critical for the identification of four main components: 1) determining the boundary of the Region of Interest, 2) detecting coverage holes and estimating their characteristics, 3) determining the best locations to relocate mobile nodes to repair holes, and 4) dispatching mobile nodes to the best target locations while minimizing the moving and messaging cost. We present two novel distributed algorithms for hole detection in a wireless sensor network (WSN) based on the fault on the region. The first which we refer to as the Distributed Hole Detection (DHD), this method relies on the Delaunay triangulation of the underlying communication graph of the WSN. The second one treats the hole healing with novel concept called the backpressure routing algorithm is a centralized method for directing traffic around a queuing network that achieves maximum network throughput.

Index Terms—Region of Interest; Hole Detection; DHD; backpressure routing algorithm

I. INTRODUCTION

A wireless sensor network (WSN) consists of small sensors With limited computational and communication Energy. By design, the sensors are very weak and vulnerable In various forms, such as the sudden shock defeat, their position (Air-dropping), or not depleted Energy resources. This should be an inherent weakness Network is considered a normal property. WSNs can disable many contradictions in their As a result of the formation of the desired functions for different mean, the kind of holes: Security holes, routing Holes, jamming holes, worm holes [1]. In this work we are bordered pores, ie, large holes are interested in Sensor nodes had shrunk. In this case, the content Holes, ie, the areas under the nozzle. Contact holes, ie, devoid of any of the areas in the corners, and will be referred to as the equivalent of holes the remainder of this paper. A WSN is one of the basic services monitoring in a specific area of interest (ROI), there the main duty of the environment and the lack of information Sink. Ensure that ROI Completely covered all the most important [2]. However, Holes in RoI exposure is unavoidable, due to the WSNs inner nature, uneven settling, Environmental Factors, and external attacks. Therefore, an event Discovered or reported in these holes and no Therefore, the main task of the network will not be completed. Thus, it becomes a self-supply of the primordial Technique to detect and recover holes.

This paper seeks to hole detection problem and healing. Most of the solutions used in global operations and then calculate the size of a large hole in one Heal the hole in the mobile sensors. While some of them already Localized solutions also require strong assumptions or that's unrealistic. Incompleteness of previous works Presented here will stimulate our research. We called for a comprehensive solution to the holes Diagnosis and Healing area is a very low risk (to heal) to avoid some of the deficiencies noted in previous works. The algorithm is a distributed and localized to heal two distinct stages. The first phase consists of three Additives; Hole Identity Innovation (HD) and boundary Detection. Unlike prior efforts, we propose a distributed and localized hole detection algorithm (DHD) acts as a Network Gabriel graph (GG) on. DHD is a Much less complex and deals with different forms of holes and the distribution and density of nodes, but the levels.

The first phase of hole healing the novel concept treats, hole healing area (HHA). It consists of two sub-tasks; Healing area and the edge of the hole in the determination of the node relocate. We are Commercial Local Healing propose a distributed virtual forces Healing approach in the area of the hole, which essentially forces to be effective. This allows not only for the local Healing the hole is located at a proper distance from the nodes will May be associated with the healing process.

The main contribution of this work is the design and Rating localized distribution and detailed, heal The two-stage protocol, the ability to be able to assess the And a mobile WSN increase security in the area. The Paper makes the following specific contributions. First, The mechanism, called the distributed hole detection (DHD), is proposed to identify the boundary nodes And find the holes. We have conducted extensive simulations Check DHD. Second, we present virtual Forces of the hole healing mechanisms. Unlike existing Our algorithm is adequate unless the process relocates Nodes.
within a short time at low cost. Provides a cost-effective testing results show that heal and hole detection and a precise solution in Mobile WSNs.

II. RELATED WORK

A. Hole and Border Detection

Robert Ghrist and Abubakr Muhammad et al[4]. They introduce a new technique for detecting holes in coverage by means of homology. The impetus for these techniques is a conclusion of network communication graphs to two types of simplified complexes: the nerve complex and the Rips complex. The former gives information about the coverage intersection of individual sensor nodes, and then very difficult to compute. The later captures connectivity in terms of inter-node communication: it is easy to compute but does not in itself yield coverage data. We get coverage data by using the persistence of homology classes for Rips complexes. These homological are computable: we provide simulation results.

Kun-Ying Hsieh and Jang-Ping Sheu et al[6]. Coverage holes may exist in Wireless Sensor Networks (WSNs) due to presence of obstacles or invalid sensor nodes in the sensing field. The holes make the data routing failure when the nodes transmit their data back to the sink. In this paper, the distributed protocols are developed to identify the boundary nodes surrounding the holes of the sensing filed in WSNs without using any location information. untired results demonstrate that our algorithm can precisely and correctly identify the boundary nodes even in sparsely sensors deployed regions. As well, our algorithm can give better performance in terms of control packet overhead and simulation time as compared to previous work.

Yue Wang et al[10]. In this paper we study the problem of topology detection, in particular, identifying boundaries in a SN. Suppose a large number of sensor node are scattered in a geometric region, with the nearby nodes communicating with the each other directly. Our aim is to find the boundary nodes by using only connectivity information. We do not take for granted any knowledge of the node locations or inter-distances, nor do we put into effect that the communication graph follows the unit disk graph model. We propose a easy, the distributed algorithm that correctly detects nodes on the boundaries and connects them into meaningful boundary cycles. We get as a byproduct the medial axis of the sensor field, which has applications in creating practical coordinates for routing. We show by extensive simulation that the algorithm gives good results even for networks with the low density. We also the establish rigorously the correctness of the algorithm for continuous geometric domains.

Xu Li et al[21]. We consider sensor self-deployment problem, constructing FOCUSED coverage (F-coverage) around a Point of Interest (POI), with novel evaluation metric, coverage radius. We are proposed to deployed sensors in polygon layers over a locally computable equilateral triangle tessellation (TT) for optimal F-coverage configuration, and then introduce two types of deployment polygon, H-polygon, C-polygon. We propose two strictly localized solution algorithms, Greedy Advance (GA), and Greedy-Rotation-Greedy (GRG). The two algorithms drive sensors to move along the TT graph to surround POI. In GA, nodes greedily proceed as the close to POI as they can; in GRG, when there are greedy advance is blocked, nodes rotate around POI along with the locally computed C polygon to a vertex where greedy advance can resume. We establish that they both yield a connected network with maximized hole-free area coverage. The further examine their coverage radius property. Our study shows that GRG guarantee optimal or near optimal coverage radius. Through extensive simulation as well evaluate their performance on meeting time, and node collision.

Guiling Wang et al[20]. Adequate coverage is very important for sensor networks to fulfill the issued sensing tasks. In a lot of working environments, it is necessary to make use of mobile sensors, which can move to the exact places to provide the required coverage. In this paper, we study the difficulty of placing mobile sensors to get high coverage. Based on the Voronoi diagram, we are design two sets of distributed protocols for controlling the movement of sensors, one of the favoring communication and one of the favoring movements. In the each set of protocols, we use Voronoi diagrams to detect coverage holes and use one of three algorithms to calculate the target locations of sensors if holes exist. Simulation results show the efficiency of our protocols and give insight on choosing protocols and calculation algorithms under different application requirements and working conditions.

Saurabh Ganeriwal et al[23]. Actuation ability introduces a fundamentally new design dimension in wireless ad-hoc sensor networks, allowing network to the adaptively reconfigure and repair itself in response to unpredictable run-time dynamics. One of the key system resources in these systems is energy and several uncontrollable factors lead to situations where a certain segment of the network becomes energy constrained before the remaining network. The presentation gets limited due to the constrained sections. We argue that in this state of affairs, instead of rendering the complete network useless, the remaining energy resources should be reorganized to form a new functional topology in the network. The present methods for the network to be aware of its own integrity and use actuation to improve presentation when needed. This capability of the system is referred to as “self-aware actuation”. In this paper, we consider a network where nodes (or a subset of the nodes) have traction ability. The network uses the mobility to repair the coverage loss in the area being monitored by it. We are completely distributed

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energy aware algorithm (referred to as Co-Fi) for coordinated coverage fidelity maintenance in sensor networks. Our preliminary analysis shows that Co-Fi can significantly help improve the usable lifetime of these networks.

III. PROPOSED WORK

In our proposed system hole detection and healing are based on two distinct phases like hole identification, hole discovery and border detection. Distributed and localized hole detection and healing algorithm deals with holes of various forms and sizes despite the nodes distribution and density. Second phase consists of hole healing area determination and node relocation. Distribute virtual force based local healing allows a local healing where only the nodes located at appropriate distance from the hole will be involved.

A. Distributed Hole Detection (DHD)

Our DHD algorithm allows us to find out holes, to compute their characteristics and to discover the network boundary. In a HEAL performs a local healing where only the nodes located at an appropriate distance the hole will be involved in the healing process. We define an attractive force that actions from the hole center and attracts the nodes towards the hole center. At the equal time, a repulsive force is defined among nodes to reduce the overlying among them. These forces will be effective in a limited area, which we call the Hole Healing Area. The proposed algorithms consist of hole detection and hole healing steps. We first discuss how to detect the hole and heal a single hole and then we show how to deal with several holes.

HHA allows a local healing where only the nodes located at an appropriate distance from the hole will be involved in the healing process. The HHA constitutes the basic idea of our algorithm. The determination of this range will determine the number of nodes that must be relocated to ensure a local repair of the hole. After the ID of the hole by the DHD algorithm, the Hole Manager (HM) node calculates the center and the size of the hole. We approximate the hole by a circle whose radius is the longest distance between two hole boundary nodes. Therefore, to determine the Hole Healing Area, we need to determine the radius of the circle that defines the HHA (fig 1). S0 node move A via to B point to used DHD algorithm

In our algorithm we propose collaborative mechanisms to detect and heal holes. In our hole detection mechanism deals with holes of a variety of forms and sizes. We try to attentive a limited number of nodes surrounding the hole, only those nodes have the task of relocated and repairing the hole. Our DHD algorithm allows us to discover holes, to calculate their characteristics and to discover the network boundary. HEAL performs a local healing where only the nodes located at an appropriate distance from the hole will be involved in the healing process. We define attractive force that acts from the hole center and attracts the nodes towards the hole center.

The main contribution of this work is the design and evaluation of HEAL, a distributed, localized and comprehensive the two-phase protocol, that can efficiently estimate and enhance the area coverage in a mobile WSNs. In this paper makes the following specific contributions. i), a collaborative mechanism, called Distributed and Hole Detection (DHD), is proposed to identify the boundary nodes and discover holes. We have conducted extensive simulations to validate DHD. ii), we present a virtual forces-based hole healing algorithm. Not like existing algorithms, our algorithm relocates only the adequate nodes within the shortest times with the lowest cost. The experimental results show that HEAL provides a cost-effective and an accurate solution for hole detection and healing in mobile WSNs. HEAL is based on a localized healing process that: (i) minimizes the WSNs’ resources consumption; (ii) accelerates the healing process; and (iii) preserves as much as possible the initial WSN topology. The number of nodes solicit in the healing process depends on the holes’ characteristics. In addition, only the nodes positioned at an appropriate distance from the hole will be involved in the healing process.
The DHD algorithm creates a routing table using the GD algorithm and replaces sensor nodes using the genetic algorithm when the number of sensor nodes that are not functioning exceeds the threshold. The DHD algorithm creates the grade value, routing table, Neighbor nodes, and load value for each sensor node using the grade diffusion algorithm.

**-Calculation of bandwidth (bth)**
- User has to set some value between 0 to 1
- \( N_{\text{original}} \) (number of sensor node)
- \( N_{\text{now}} \) (number of functional sensor)
- If \((N_{\text{original}}/N_{\text{now}}) < \text{set value}\) 
  - \( T_i \) value 1 means Bandwidth greater than 0
  - Else
    - Bandwidth less than 0

**B. Hole detection**

Each stuck node is associated with only one hole in each direction it is stuck in. As the TENT rule detects all the directions where the nodes are stuck [11], the DHD algorithm will still work with the presence of many holes. However, a stuck node bi can be on the boundaries of multiple holes. In this case, bi initiates a HD packet in each direction it is stuck in (at most three). The second or the third HD packet could be considered as redundant and thus removed. To avoid this behavior, redundant HD packets detection is based on the direction of the HD packet in addition to the Hole-ID. At each hop, the direction of a HD packet is defined by the previous node that forwards this packet. This allows the detection of multiple adjacent holes. The following algorithm (1) hole detection describes about the procedure to prevent redundancy in the discovery process is carried out with a basic idea to eliminate redundant HD packets as quick as possible. The criterion for judging whether a HD packet is redundant is as follows: at each node, if a HD packet arrives and discovers that the packet has a Hole-ID greater than a Hole-ID performed by a packet already passed, the packet will be considered redundant and it will be deleted.

**Algorithm: Hole detection**

\[
\text{Input G(V, E, VLF : V} \rightarrow (x, y)) \begin{align*}
1: & \text{for all } v \in V \text{ do} \\
2: & \text{if } v.\text{hasConesGreaterThan}(\pi/3) \text{ then} \\
3: & \text{if } v.\text{acquireTwoHopNeighborLocks()} \text{ then} \\
4: & \text{for all } C \in v.\text{getEmptyIConesGreaterThan}(\pi/3) \text{ do} \\
5: & \text{C.markHole()} \\
6: & \text{end for} \\
7: & v.\text{releaseTwoHopNeighborLocks()} \\
8: & \text{end if} \\
9: & \text{end if} \\
10: & \text{end for} \\
\end{align*}
\]

**C. Backpressure Routing Algorithm**

We presented the design and implementation of backpressure architecture for wireless sensor networks. Fig. 3 Our design leverages a centralized controller for obtaining the throughput optimal scheduling. In the contrast to previous work, we integrated backpressure scheduling with a TDMA MAC protocol to allow precise timing in transmissions. In addition, we introduced a novel interference estimation technique and an efficient speculative backpressure scheduler.

**IV. SIMULATION**

In our future work, apart from the topics discussed, also intend to evaluate XPRESS in larger networks. We consider our work opens up interesting avenues in wireless network system design, performance that optimal centralized routing and scheduling are feasible for small- to medium-sized wireless sensor networks. For larger networks, we believe that the design primitives of the XPRESS cross-layer protocol stack can lead to new distributed.
In this section, we evaluate the performance of both DHD and backpressure algorithms in a range of different scenarios. The simulations are performed on NS2 Simulator. From the simulation, it is clear that the runtime remains almost the same or rather it decreases with increasing number of holes for a network with fixed number of nodes. Reduce the algorithm runtime can be explained by the fact that the number of boundary nodes is likely to increase when the number of holes increases.

The following figures show the pattern formation of data mining techniques used in this project.

V. CONCLUSION

This paper has proposed and implemented a lightweight and comprehensive two-phase protocol; make sure heal employing a mobile WSN coverage area. The protocol uses a distributed DHD to find the holes in the network. The computation complexity of DHD is $O(v^2)$, where $v$ is the average number of 1-hop neighbors. Compared with the existing schemes the DHD algorithm is the very low level problems and deals with holes of various forms and sizes despite the nodes distribution and density. By the exploiting virtual forces conception, our approach relocates only the adequate nodes within the shortest time and at the lowest cost.

Through performance evaluation, we used different criteria to heal, to check and it detects the number or amount of movement in different situations, but the less holes showed that heals. On healing the evaluation results and provides a cost-effective and accurate solution for mobile WSNs hole detection and healing.

With the help of back pressure will identify whether the node is available near by the particular node. If multi node fails the node cannot data send via. So solve this kind of problem to used back pressure algorithm.

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