International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2018 IJSRCSEIT | Volume 3 | Issue 1 | ISSN : 2456-3307

Coverage Hole Avoidance Using Fault Node Recovery in Mobile Sensor Network

A. Sri Chamundeswari*1, P. Kesavini2, P. Sachidhanandam3

*1PG Scholar , Department of Computer Science, Knowledge Institute of Technology, Kakapalayam, Salem, Tamil Nadu, India

2PG Scholar , Department of Computer Science, Knowledge Institute of Technology, Kakapalayam, Salem, Tamil Nadu, India

3Associate Professor, Department of Computer Science, Knowledge Institute of Technology, Kakapalayam, Salem, Tamil Nadu, India

ABSTRACT

Sensor nodes are prone to failure due to energy reduction and some other reasons in Distributed Sensor Networks (DSNs). The coverage and energy utilization control in mobile heterogeneous wireless sensor networks (WSNs) are analyzed. The term heterogeneous mean that sensors in the network have various sensing radius, which is an inherent property of many functional WSNs. Two sensor deployment schemes are considered uniform and Poisson schemes. The main focus of this work is directed towards distributed coordination algorithms for coverage in a mobile sensor network. The sensors are assumed to have non identical sensing ranges, and it is desired to move them in such a way that the total sensing coverage increases as much as possible. Towards the end, the field is partitioned using the multiplicatively weighted voronoi cells, and then different geometric methods are developed to find new locations for the sensors such that the coverage is improved. The proposed algorithms are iterative, and use the existing local information to place the sensors accurately, aimed to decrease the size of the coverage holes in the system. The scheme proposes a defective node recovery and replacement algorithm for WSN based on the grade diffusion algorithm combined with genetic algorithm. The Fault Node Recovery (FNR) algorithm requires replacing smaller number of sensor nodes and reuses the most routing paths, rising the WSN lifetime and reducing the replacement rate. The proposed algorithm increases the number of active nodes and reduces the rate of energy utilization.

Keywords : Wireless Sensor Networks(WSN),Coverage holes,The Fault Node Recovery (FNR) algorithm.

I. INTRODUCTION

Wireless sensor networks have received a great deal of attention in the past decade, and have found a broad range of applications in various areas. Examples of sensor network applications include biomedical engineering, security surveillance, target tracking and environmental monitoring, to name only a few. In particular, a mobile sensor network is comprised of a number of wireless nodes, where each node is capable of moving in different directions and communicating with a subset of sensors in order to achieve a global objective. Typical objectives in a mobile sensor network include monitoring of a moving target [7] and energy-efficient area coverage [8]. In practice, to achieve the desired goals cooperatively, it is often preferable to use a decentralized decision-making

Scheme for sensor deployment [9]. Furthermore, the deployment strategy needs to be independent of the initial location of the sensors; as such information is usually unavailable [10]. In addition, the cost-effective resource management techniques are required to prolong the network lifetime [11].Coverage hole can appear into existence due to poor instalment, or nodes whose power is weak. So they are formed by the power depletion, topology failure and by presence of obstacles.

The paper is organized in such a way that Chapter 2 discusses Review of Literature, Chapter 3 discusses problem statement, Chapter4 discusses proposed method and Chapter5 gives the conclusion.

II. METHODS AND MATERIAL

1. Review of Literature

X.Wang, et al(2013) [6], briefly describes the network achieve full coverage, regardless of the total number of sensors or the sensing radius of a single senor under random mobility patterns, which is a much easier and more general way to operate coverage control. Meanwhile, we can operate a tradeoff control between coverage performance and energy consumption by adjusting ESR.

S.Zhu and Z.Ding (2011)[11], describes the neighborhood collaboration based distributed cooperative localization of all sensors in a particular network with the so-called convex hull constraint. All nodes in such a network are either position known anchors or sensors to be localized, and every sensor is inside the convex hull of its neighbors.

M. Pourali and A. Mosleh (2013)[7], provides a Bayesian belief network (BBN) based sensor placement optimization methodology for power systems health monitoring. The approach uses the functional topology of the system, physical models of sensor information, and Bayesian inference techniques along with the constraints. It is to answer important questions such as how to infer the health of a system based on limited number of monitoring points at certain subsystems, how to infer the health of a subsystem based on knowledge of the health of the main system , and how to infer the health of a subsystem based on knowledge of the health of other subsystems (distributed propagation).

H.Mahboubi et al (2013)[5] suggested that each sensor detects coverage holes within its MW Voronoi region, and then moves in a proper direction to reduce their size. Since the coverage priority of the field is not uniform, the target location of each sensor is determined based on the weights of the vertices or the points inside the corresponding MW-Voronoi region. Hence, when the sensing radii of different sensors are not the same, the conventional voronoi diagram is not as useful for effective sensor deployment in the network.

K.Moezzi, et al (2014)[1] described a new coverage model called surface coverage and two important problems are studied: 1) expected coverage ratio with stochastic deployment and 2) optimal deployment strategy with planned deployment. In distributed control laws are presented to achieve a convex equipartition configuration in mobile sensor networks. Distributed control laws are provided for the disk-covering and sphere-packing problems using non smooth gradient flows. An algorithm is proposed for environmental boundary tracking with mobile agents, where the boundary is optimally approximated with a polygon.

K.Sayratian-Pour, et al (2014)[6], developed that to move each sensor iteratively in such a way that its sensing coverage is increased. Once a new location for a sensor is computed, the corresponding local coverage area of the sensor (in the previously constructed MW-Voronoi region) is compared to the preceding local coverage area. If the new local coverage area would be larger than the preceding one, the sensor moves to the new location; otherwise, it remains in its current position. A pre-specified threshold is used to stop the algorithm when no sensor's local coverage area increases by this amount.

S.Yoon, et al (2011)[10], described that stationary wireless sensor networks (WSNs) fail to scale when the area to be monitored is unbounded and the physical phenomenon to be monitored may migrate through a large region. However, a major challenge here is to maximize the sensing coverage in an unknown, noisy, and dynamically changing environment with nodes having limited sensing range and energy, and moving under distributed control. To address these challenges, propose a new distributed algorithm, Causataxis, which enables the MSN to relocate toward the interesting regions and adjust its shape and position as the sensing environment changes.

A.Galllaisl, et al (2008)[4], proposed several localized sensor area coverage protocols for heterogeneous sensors, each with arbitrary sensing and transmission radii. The approach has a very small communication overhead since prior knowledge about neighbor existence is not required. Each node selects a unsystematic time out and listens to messages sent by other nodes before the time out expires. Sensor nodes whose sensing area is not fully covered the deadline expires decide to remain active for the considered round and transmit an activity message announcing it. There are four variants in this approach, depending on whether or not withdrawal and retreat messages are transmitted. Covered nodes decide to sleep, with or without transmitting a withdrawal message to inform neighbors about the status. After hearing from more neighbors, dynamic sensors may observe that they became covered and may decide to alter their original decision and transmit a retreat message.

C.H.Caicedo-Nez. (2011)[2] described how a set of mobile agents can best monitor a convex region and at the same time localizes events such as biochemical threats that appear in the region. As the agents move towards an event to localize it, the coverage of the region deteriorates; on the other hand, if an agent does not help in localizing an event, it will take longer for other agents to localize it. The algorithm is shown to be stable and scalable, and is shown to converge to an optimal equilibrium position. The proposed parameterization of the task allocation problem depends on the number of agents in the network algorithm based on consensus protocols for estimating this number.

H.Mahboubi, et al(2017)[8] described a new concept called distributed coordination algorithms for coverage in a mobile sensor network. The multiplicatively weighted Voronoi (MW-Voronoi) diagram is utilized to find the coverage holes of the network for the case where the sensing ranges of different sensors are not the same. Since the coverage priority of the field is not uniform, the target location of each sensor is determined based on the weights of the vertices or the points inside the corresponding MW-Voronoi region.

2. Problem Statement

Errors may be due to a range of factors including hardware failure, software bugs, user error, and linkage difficulties. Data delivery in sensor networks is inherently faulty and unpredictable links may fail when permanently (or) temporarily blocked by an external object (or) environmental condition. The MW-Voronoi diagram is used in this work to develop sensor deployment algorithms. Every sensor has a circular sensing area whose size is not the same for all sensors. Consider each sensor as a weighted node whose weight is equal to its sensing radius, and draw the MW-Voronoi diagram. It is a straightforward results that if a sensor cannot detect a phenomenon in its region, there is no other sensor that can detect it either. This implies that to find the coverage holes in the sensing field, it would sufficient to compare the MW- Voronoi region of every node with its local coverage area.

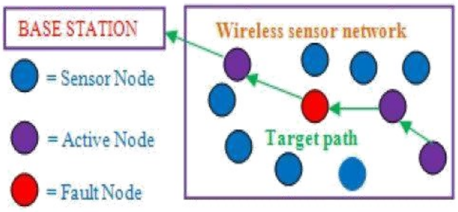

Figure 1. Faults Occurred in WSN Network

3. Proposed Methodology

The sensor nodes have less battery supplies and less energy, It also result in replacement of sensor node and replacement cost and using same routing path when few nodes are not working. Fault node recovery algorithm is the grouping of genetic and grade diffusion algorithm. This algorithm replace non-working node and reuse the routing path reduce the replacement cost and increase the life time. Suggests an algorithm to examine for and replace smaller amount of sensor nodes and to reuse the most routing paths. One scheme, the genetic algorithm (GA). The fault node recovery (FNR) algorithm based on the Grade Diffusion (GD) algorithm combined with the GA. The FNR algorithm creates a routing table using the GD algorithm and replaces sensor nodes that are not functioning. This algorithm not only reuses the most routing paths to increase the WSN lifetime but also reduces the replacement cost.

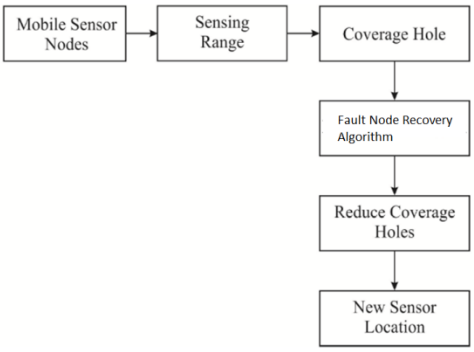

Figure 2. Proposed system Architecture

The grade diffusion algorithm is used to route paths for data transmit and communication in wireless sensor networks, reducing both power consumption and processing time to build the routing table and instantaneously avoiding the generation of circle routes. Moreover, to ensure the safety and reliability of data transmission, grade diffusion algorithm provides backup routes to avoid wasted power and processing time when rebuilding the routing table in case part of sensor nodes are missing. In the proposed algorithm, the number of nonfunctioning sensor operation and the parameter both is calculated. The algorithm creates the grade value, routing table, a set of neighbor nodes, and payload value for each sensor node, using grade diffusion algorithm. The sensor nodes the event data to the destination node according to the gd algorithm when events appear. Then, Bth is larger than zero, the algorithm will be invoked and replace nonfunctioning sensor nodes by functional nodes selected by the wireless sensor network can continue to work as long as the operators are prepared to interchange sensors. Grade is the sensor nodes grade value. The variable Ni original is the number of sensor nodes with the grade value i. the variable Ni now is the number of sensor nodes still functioning at the current time with grade value i. The parameter β is set by the user and must have value between and 1. If the of sensor nodes that function for each grade is fewer than β, Ti will turn into 1, and Bth will be greater than zero. Then, the algorithm will calculate the sensor nodes. Algorithm goal is to replace limited sensor nodes that are not working and have low battery power and repeatedly using the routing path. The above approach will ultimately increase the life time and deduce the cost of node replacement.

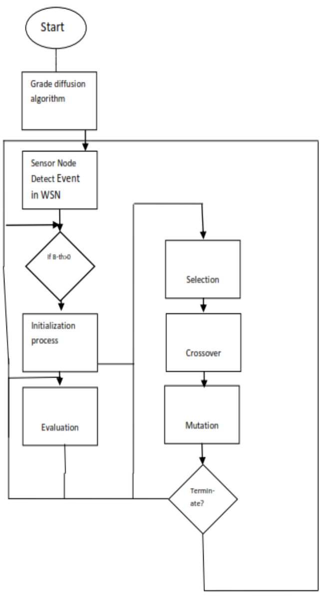

Figure 3. Flow chart of Fault Node Algorithm

Replacing using the genetic algorithm. The parameters are encoded in binary string and serve as the chromosomes for the genetic algorithm. The elements i.e., the genes, in the binary strings are adjusted to minimize or maximize the fitness value. The fitness function generates its fitness value, which is composed of multiple variables to be optimized by the genetic algorithm. At each iteration of the genetic algorithm, a predetermined number of individuals will produce fitness values associated with the chromosomes. Sensor network routing consists of the directed diffusion algorithm and grade diffusion algorithm. Grade diffusion and ACO and is proposed to solve the power consumption and transmission routing problems in wireless sensor networks. Moreover, to ensure the safety and reliability of data transmission, our algorithm provides backup routes to avoid wasted power and processing time when rebuilding the routing table in case part of sensor nodes are missing.

The use of Grade Diffusion algorithm is to calculate the grade value, load value for every sensor node. During wireless sensor operation we can calculate the no. of nonfunctioning sensor node and the parameter used for calculating is Sth. According to Grade Diffusion algorithm when event appear the sensor node move the data to the sink node. If Sth is obtain higher than zero then algorithm start at work and replace not working node by working nodes which will be selected by the genetic algorithm. The wireless sensor network will work as far as the operation wishes to replace sensor node Genetic algorithm consists of five steps: initialization, evaluation, selection, crossover and mutation.

III. CONCLUSION

Efficient sensor coordination algorithms are developed in this work to increase sensing coverage in a network of mobile sensors with non-identical sensing ranges. In WSN sensor nodes have limited energy resources in addition to routing it is important to research the optimization of sensor node replacement cost and reusing the most routing paths when some of sensor nodes are non – functional. Here the proposed FNR algorithm which takes less time to send the packets to sink node. Hence the energy and power consumption is less and number of non-functional nodes is less and functional nodes are more. Using the FNR algorithm can result in more reused routing paths and fewer replacements of nodes. By using FNR algorithm, the lifetime of the network will be improved when they reached low battery conditions.

IV. REFERENCES

[1]. Aghdam.A.G, Mahboubi.H, Moezzi.K, and Sayraan-Pour.K., 2014 "Distributed deployment algorithms for efficient coverage in a network of mobile sensors with non-identical sensing capabilities," IEEE Transactions on Vehicular Technology, 63(8), 3998-4016.

[2]. Caicedo-Nez .C.H and Zefran.M., 2011 "Distributed task assignment in mobile sensor networks" IEEE Transactions on Automatic Control, 56(10), 2485.2489.

[3]. Fang.S, Xu.L.D, Zhu.Y, Ahati.J, H. Pei., 2014 "An integrated system for regional environmental monitoring and management based on internet of things," IEEE Transactions on Industrial Informatics, 10(2),1596–1605.

[4]. Gallais.A, Carle.J, Simplot-Ryl.D, and Stojmenovi.I., 2008 "Localized sensor area coverage with low communication overhead," IEEE Transactions on Mobile Computing, 7(5), 661–672.

[5]. Habibi.J, Mahboubi.H, Aghdam.A.G, and Sayrafian-Pour.K., 2013"Distributed deployment strategies for improved coverage in a network of mobile sensors with prioritized sensing field," IEEE Transactions on Industrial Informatics,9(1), 451-461.

[6]. Han.S, Wang.X, and Wu.Y., 2013 "Coverage and energy consumption control in mobile heterogeneous wireless sensor networks," IEEE

Transactions on Automatic Control, 58(4), 975–98.
[7]. Marbukh.V, Mahboubi.H, Moezzi.K, Aghdam.A.G, Sayrafian-Pour.K.,2014 "Distributed deployment algorithms for improved coverage in a network of wireless mobile sensors" IEEE Transactions on Industrial Informatics, 10(1),163-174.
[8]. Mahboubi.H, Marbukh.V, Moezzi.K, Aghdam.A.G, Sayrafian-Pour.K.,2017 "Distributed sensor coordination algorithms for efficient coverage in a network of heterogenous mobile sensors" IEEE Transactions on Automatic Controls, 62(11),5954-5961.
[9]. Pourali.M and Mosleh.A., 2013 "A functional sensor placement optimization method for power systems health monitoring," IEEE Transactions on Industry Applications, 49(4), 1711–1719.
[10]. Saha.D and Das.N.,2016 "Self-organized node placement for area coverage in pervasive computing networks," in Proceedings of 3rd International Conference on Advanced Computing, Networking and Informatics, ser. Smart Innovation, Systems and Technologies. Springer, 43,365–376.
[11]. Wang.G, Cao.G, and Porta.T.F.L.,2006 "Movement-assisted sensor deployment," IEEE Transactions on Mobile Computing, 5(6),640–652.
[12]. Yoon.S, Soysal.O, Demirbas.M, and Qiao.C., 2011 "Coordinated locomotion and monitoring using autonomous mobile sensor nodes", IEEE Transactions on Parallel and Distributed Systems, 22(10), 1742-1756.
[13]. Zou.Z, Bao.Y, Li.H, Spencer.B.F, and Ou.J., 2015 "Embedding compressive sensing-based data loss recovery algorithm into wireless smart sensors for structural health monitoring," IEEE Sensors Journal, 15(2),797–808.
[14]. Zhu.S and Ding.Z., 2011 "Distributed cooperative localization of wireless sensor networks with convex hull constraint," IEEE Transactions on Wireless Communications, 10(7), 2150–2161.