Reconnection of Wireless Sensor Network Partitions on Multi-Agent Platform

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ABSTRACT

In wireless sensor networks, repairing partitions is of high priority. Various methods have been proposed for detecting partitions in the networks. One approach for reconnecting a partitioned network is to repair partitions using mobile nodes. For reconnecting the partitions approaches like transmission range adjustment and message ferry methods have been proposed but these are based on the degree of connectivity with neighbors. In the proposed method, we consider a partition detection system where the base station knows the position of the sensor nodes and the base station communicates with the nodes at regular intervals. The failure of the base station to communicate with a group of sensor nodes located together is the proof that some partitions have occurred. There could be two or more partitions occurring at a time and so multiple mobile nodes are to be employed. The aim of the algorithm is to coordinate among the mobile nodes and the partitioned network and to reconnect the partition. Here the safety of nodes, security of the network and scalability are considered.

KEYWORDS

Cut Detection, Mobile Nodes, Re-Connection, Wireless Sensor Networks

INTRODUCTION

Wireless Sensor Networks are becoming increasingly important for monitoring in remote or hazardous environments, including pollution monitoring, chemical process sensing, disaster response, and battlefield monitoring (Gharghan, 2017). As these environments are uncontrolled and may be instable, the network may suffer damage, from hazards, direct attack or accidental damage from wildlife and weather. They may also degrade because of depletion of energy or any other hardware failure. In such cases the data generated will be missed or the nodes may fail to collect the environment data (Luo, 2016). When few nodes get fail at different regions of the network the data could be collected by finding alternative paths and by redundancy property of nodes in a region.

But when critical nodes that are near to the base station get failed, partitions will occur where a group of nodes cannot be able to pass the information to the base station. In such cases the network needs some alternative to bridge the communication. In this article, such situations where there occurs more number of partitions have been dealt. To bridge the communication, we have deployed mobile nodes to replace the failure nodes.

The main subtasks in the problem: (i) determining what damage has occurred (i.e. which nodes have failed and what radio links have been blocked); (ii) determining what changes, if any, have happened to the accessibility of the environment (i.e. what positions can be reached, and what
routes are possible between those positions); (iii) deciding on the positions for the new radio nodes; and (iv) planning and following a route through the environment to place those nodes. The problem thus involves both exploration and optimization, and may require the placement of nodes before the changes to connectivity and accessibility have been fully mapped.

The main objective is to improve the lifetime of the sensor network and we use mobile radio nodes to replace the failure nodes. Mobile nodes are expensive, and so solutions which require fewer nodes are preferred. In addition, the users of the WSN may require data to be transmitted from the sensors quickly, to allow a timely response, and so there will be limits on the number of radio hops allowed between the sensors and the wider network. Mobile nodes have to move through the network, monitor the environment and have to find appropriate location to sense the environment. Thus, the requirements are safety to avoid collisions in the network and scalability.

But when critical nodes that are near to the base station get failed, partitions will occur where a group of nodes could not be able to pass the information to the base station. In such cases the network needs some alternative to bridge the communication. In this paper we have dealt such situation where there occurs more number of partitions. To bridge the communication, we have deployed mobile nodes to replace the failure nodes.

**RELATED WORK**

Barooah (2008), addressed the DCD algorithm where every node of a wireless sensor network detects Disconnected from Source events if they occur. A subset of nodes that experience CCOS events to detect them and estimate the approximate location of the cut in the form of a list of active nodes that lies at the boundary of the cut/hole. The DOS and CCOS events are defined with respect to a specially designated source node. The algorithm is based on ideas from electrical network theory and parallel iterative solution of linear equations. The algorithm works with large classes of graphs of varying size and structure, without changes in the parameters. For certain scenarios, the algorithm detects connection and disconnection to the source node. The convergence rate of the underlying iterative scheme is quite fast and independent of the size and structure of the network, which makes detection using this algorithm quite fast. (Navneet N Tewani, 2013) addressed an algorithm that allows (i) every node to detect when the connectivity to a specially designated node has been lost, and (ii) one or more nodes (that are connected to the special node after the cut) to detect the occurrence of the cut. The algorithm is distributed and asynchronous.

Every node needs to communicate with only those nodes that are within its communication range, (Prima Kristalina, Wirawan, 2013). The algorithm is based on the iterative computation of the nodes. The convergence rate of the iterative scheme is independent of the size and structure of the network. The algorithm devised a way to solve the problem of redundant information at the destination which arises due to availability of information at every node that is initially sent from the source node. Mingxin Yang (2015) proposes to use a small number of mobile robots to replace failed sensor nodes for a large-scale static sensor network, and study algorithms for detecting and reporting sensor failures and coordinating the movement of robots that minimize the motion energy of mobile robots and the messaging overhead incurred to the sensor network.

Chong (2003) raised the problem of partitions with a focus on security. Barooah (2009) proposed a low overhead scheme to detect network partitioning, “cuts”. They developed an algorithm for detecting linear cuts, which is a linear separation of n number of nodes from the base station. The reason for the restriction to linear cuts is that their algorithm relies critically on a certain duality between straight line segments and points in 2D, which also restricts the algorithm in to sensor networks deployed in the 2D plane. The algorithm developed in needs a few nodes called sentinels that communicate with a base station either directly or through multi-hop paths. The base station detects n-cuts by monitoring whether it can receive messages from the sentinels. They do not propose any method to repair them. Dini (2008) proposed a method to repair network partitions by using mobile nodes. By reasoning
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