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RESEARCH ARTICLE

An Algorithm for Mobile Ad-hoc Networks to Reducing Cut Vertices

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Abstract: ***A wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut". In this article we consider the problem of detecting cuts by the remaining nodes of a wireless sensor network. In this paper, we propose an efficient algorithm to detect vertices. The neighbor node gets failure intimation from the cut vertex so that the information can be passed to source and destination so that the source can initiate data transmission through alternate path before the cut vertices get breakdown completely. In this way, data loss can be minimized and the cut can be detected truly. The algorithm is distributed and asynchronous so that every node needs to communicate with only those nodes that are within their communication range. The most important advantage is that this method can be used to reduce the time delay needed in detecting cut. The algorithm is distributed and asynchronous: every node needs to communicate with only those nodes that are within its communication range. The algorithm is based on the iterative computation of a fictitious "electrical potential" of the nodes. The convergence rate of the underlying iterative scheme is independent of the size and structure of the network. We demonstrate the effectiveness of the proposed algorithm through simulations and a real hardware implementation.***

Index Terms— alternate path, cut vertex, disconnected paths, detection and estimation, iterative computation

1. Introduction

A wireless sensor network is a collection of nodes organized into a network such that each node having sensing and processing capabilities. Each node has an RF transceiver, sensor, memory, powered by battery. Nowadays sensors are widely employed in various research fields since they can monitor temperature and hence whether forecasting can be made easier. They are randomly deployed in areas with sensors attached according to the applications for which they are being used. Since they are being powered up by batteries, energy consumption should be minimized in order to prolong the life of sensor nodes. In a network, sensor nodes communicate with each other so that results are obtained as part of their cooperatively combined work. Since each node needs to communicate with all the other nodes, wireless links are established between them. A cut is defined as the failure of node. It can separate

the network into disconnected paths incapable of communicating with each other. Since they are randomly deployed, loss of connectivity can be quite disastrous as they will lead to the breakdown of entire network. This paper focuses on cut detection of cut vertices. Although there have been methods to detect cut vertices, previous approaches are either difficult or impossible because they consume large amount of energy which limits the energy of the nodes, which is a limiting factor or spend a lot of time which can be otherwise used for fruitful applications. A previous approach CVD employs interval coded spanning tree to find out cut vertices. Therefore challenge is to reduce the time delay incurred in the previous algorithms.

2. Existing System

Wireless Multimedia Sensor Networks (WMSNs) has many challenges such as nature of wireless media and multimedia information transmission. Consequently traditional mechanisms for network layers are no longer acceptable or applicable for these networks. Wireless sensor network can get separated into multiple connected components due to the failure of some of its nodes, which is called a "cut". Existing cut detection system deployed only for wired networks.

To see the benefits of a cut detection capability, imagine that a sensor that wants to send data to the source node has been disconnected from the source node. Without the knowledge of the network's disconnected state, it may simply forward the data to the next node in the routing tree, which will do the same to its next node, and so on. However, this message passing merely wastes precious energy of the nodes; the cut prevents the data from reaching the destination. Therefore, on one hand, if a node were able to detect the occurrence of a cut, it could simply wait for the network to be repaired and eventually reconnected, which saves on-board energy of multiple nodes and prolongs their lives. On the other hand, the ability of the source node to detect the occurrence and location of a cut will allow it to undertake network repair. Thus, the ability to detect cuts by both the disconnected nodes and the source node will lead to the increase in the operational lifetime of the network as a whole. A method of repairing a disconnected network by using mobile nodes has been proposed in [1]. Algorithms for detecting cuts, as the one proposed here, can serve as useful tools for such network repairing methods. A review of prior work on cut detection in sensor networks, e.g., [2], [3], [4] and others, is included in the Supplementary Material, which can be found on the Computer Society Digital Library at http://doi.ieeecomputersociety.org/ 10.1109/TPDS.2011.178.

3. Related Works

The involved only local communication between neighboring nodes and is robust to temporary communication failure between node pairs. So here the detection of cuts takes place. But when the cut detected is of cut vertex, and then it can lead to the reconstruction of the damaged network by informing it to the source. A distributed algorithm CVD [1] scans the nodes of WSN parallel and edges are colored on the interval coded spanning tree for cut vertex detection. Here only the cut vertices are detected. It can be modified to include network reconstruction by informing source about the failure. A BFS based algorithm for cut edge detection is proposed in [5] but the cut edge detection is different from cut vertex detection. It should be noted that if a node is a cut vertex, then none of the edges incident on it is a cut edge and reversely if an edge incident on a node is a cut edge, that node is not a cut vertex. DDFS [6] is a tree based approach in which each time the message visits a node, a counter is incremented. Each leaf node sends it to parent node and parent node collects all indices received from its children. If the indices received by parent node are smaller than that of parent node, then that parent is called cut vertex. Time delay is much larger since DDFS has to traverse the edges serially. DDFS is sensitive to link/node fails due to serial nature. Previously an algorithm [4] was developed to repair network partitions. They have employed mobile nodes to replace the position of the failed nodes to establish network connectivity. They have considered wireless sensor network partition into two types-safe partition and isolated partition.

4. Proposed System

Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution .Failure of a set of nodes will reduce the number of multi-hop paths in the network. Such failures can cause a subset of nodes – that have not failed – to become disconnected from the rest, resulting in a "cut". Two nodes are said to be disconnected if there is no path between them. We consider the problem of detecting cuts by the nodes of a wireless network. We assume that there is a specially designated node in the network, which we call the source node Since a cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node. When a node u is disconnected from the source, we say that a DOS (Disconnected from Source) event has occurred for u. When a cut occurs in the network that does not separate a node u from the source node, we say that CCOS (Connected, but a Cut Occurred Somewhere) event has occurred for u. By cut detection we mean (i) detection by each node of a DOS event when it occurs, and (ii) detection of CCOS events by the nodes close to a cut, and the approximate location of the cut. In this article we propose a distributed algorithm to detect cuts, named the Distributed Cut Detection (DCD) algorithm. The algorithm allows each node to detect DOS events and a subset of nodes to detect CCOS events. The algorithm we propose is distributed and asynchronous: it involves only local communication between neighboring nodes, and is robust to temporary communication failure between node pairs The convergence rate of the computation is independent of the size and structure of the network.

MODULES:

- DISTRIBUTED CUT DETECTION
- CUT
- SOURCE NODE
- CCOS AND DOS
- NETWORK SEPERATION

DISTRIBUTED CUT DETECTION:

The algorithm allows each node to detect DOS events and a subset of nodes to detect CCOS events. The algorithm we propose is distributed and asynchronous: it involves only local communication between neighboring nodes, and is robust to temporary communication failure between node pairs. A key component of the DCD algorithm is a distributed iterative computational step through which the nodes compute their (fictitious) electrical potentials. The convergence rate of the computation is independent of the size and structure of the network.

CUT:

Wireless sensor networks (WSNs) are a promising technology for monitoring large regions at high spatial and temporal resolution. In fact, node failure is expected to be quite common due to the typically limited energy budget of the nodes that are powered by small batteries. Failure of a set of nodes will reduce the number of multi-hop paths in the network. Such failures can cause a subset of nodes – that have not failed – to become disconnected from the rest, resulting in a "cut". Two nodes are said to be disconnected if there is no path between them.

SOURCE NODE:

We consider the problem of detecting cuts by the nodes of a wireless network. We assume that there is a specially designated node in the network, which we call the source node. The source node may be a base station that serves as an interface between the network and its users. Since a cut may or may not separate a node from the source node, we distinguish between two distinct outcomes of a cut for a particular node.

CCOS AND DOS:

When a node u is disconnected from the source, we say that a DOS (Disconnected from Source) event has occurred for u. When a cut occurs in the network that does not separate a node u from the source node, we say that CCOS (Connected, but a Cut Occurred Somewhere) event has occurred for u. By cut detection we mean (i) detection by each node of a DOS event when it occurs, and (ii) detection of CCOS events by the nodes close to a cut, and the approximate location of the cut.

5. Conclusions

It has been found out that this method can be implemented in less time and cut vertices can be found out using less iteration compared with the former method. This method can be optimized to improve the efficiency and time management in the future. The main drawback of this method is that it can be applied to only immobile nodes

The Asynchronous and Distributed algorithm we propose here enables every node of a wireless sensor network to detect DOS (Disconnected from Source) events if they occur and it enables a subset of nodes that experience CCOS (Connected, but Cut Occurred Somewhere) events to detect them and estimate the approximate location of the cut in the form of a list of active nodes that lie 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.

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