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Detection of Cuts to improve performance in Wireless Sensor Networks

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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.We propose 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. 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.

INTRODUCTION

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.

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. 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. By "approximate location" of a cut we mean the location of one or more active nodes that lie at the boundary of the cut and that are connected to the source. Nodes that detect the occurrence and approximate locations of the cuts can then alert the source node or the base station.

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.

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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 onboard 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.

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. 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.

The DOS detection part of the algorithm is applicable to arbitrary networks; a node only needs to communicate a scalar variable to its neighbors. The CCOS detection part of the algorithm is limited to networks that are deployed in 2D Euclidean spaces, and nodes need to know their own positions. The position information need not be highly accurate. The proposed algorithm is an extension of our previous work [5], which partially examined the DOS detection problem.

OVERVIEW

The survey is the most important step in software development process. Before developing the tool it is necessary to determine the time factor, economy n company strength. Once these things r satisfied, ten next steps are to determine which operating system and language can be used for developing the tool. Once the programmers start building the tool the programmers need lot of external support. This support can be obtained from senior programmers, from book or from websites. Before building the system the above consideration are taken into account for developing the proposed system.

Although many randomized asynchronous protocols have been designed throughout the years , only recently one implementation of a stack of randomized multicast and agreement protocols has been reported, SINTRA. These protocols are built on top of a binary consensus protocol that follows a Rabin-style approach, and in practice terminates in one or two communication steps. The protocols, however, depend heavily on public-key cryptography primitives like digital and threshold signatures. The implementation of the stack is in Java and uses several threads. RITAS uses a different approach, Ben-Or-style, and resorts only to fast cryptographic operations such as hash functions.
Randomization is only one of the techniques that can be used to circumvent the FLP impossibility result.

Other techniques include failure detectors, partial synchrony and distributed wormholes. Some of these techniques have been employed in the past to build other intrusion-tolerant protocol suites

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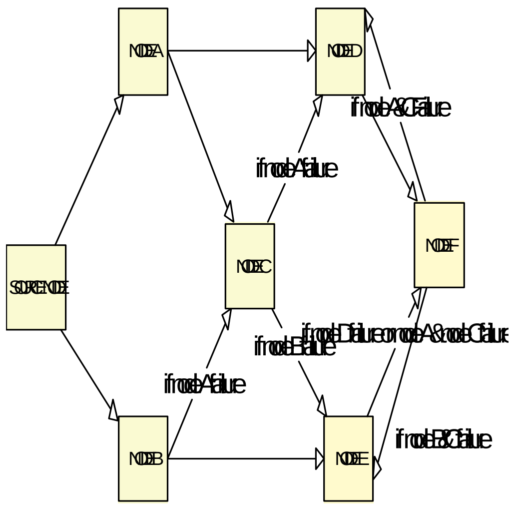
2.1 Architecture

The system can be used to present a system in terms of the input data to the system, various processing carried out on these data, and the output data is generated by the system.



2.2 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.

2.3 Disadvantages in Existing System

1. Unsuitable for dynamic network reconfiguration.
2. Single path routing approach.

2.4 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.

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MODULE DESCRIPTION

3.1 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.

3.2 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.

3.3 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.

3.4 NETWORK SEPERATION

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”. Because of cut, some nodes may separated from the network, that results the separated nodes can’t receive the data from the source node.

CONCLUSION

The DCD algorithm we propose here enables every node of a wireless sensor network to detect DOS (Disconnected frOm Source) events if they occur. Second, 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. Numerical simulations, as well as experimental evaluation on a real WSN system consisting of micaZ motes, show that the algorithm works effectively with a large classes of graphs of varying size and structure, without requiring changes in the parameters. For certain scenarios, the algorithm is assured to detect connection and

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disconnection to the source node without error. A key strength of the DCD algorithm is that 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. Application of the DCD algorithm to detect node separation and reconnection to the source in mobile networks is a topic of ongoing research.

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