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Recovering From a Node Failure in Wireless Sensor Actor Networks with Minimal Topology Changes

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Abstract: A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to one or more sinks, generally via multi-hop communication. The sensor nodes are typically expected to operate with batteries and are often deployed to not-easily-accessible or hostile environment, sometimes in large quantities. It can be difficult or impossible to replace the batteries of the sensor nodes. On the other hand, the sink is typically rich in energy. Since the sensor energy is the most precious resource in the WSN, efficient utilization of the energy to prolong the network lifetime has been the focus of much of the research on the WSN. The communications in the WSN has the many-to-one property in that data from a large number of sensor nodes tend to be concentrated into a few sinks. Since multi-hop routing is generally needed for distant sensor nodes from the sinks to save energy, the nodes near a sink can be burdened with relaying a large amount of traffic from other nodes.

Keywords: Wireless Sensor Network (WSN), wireless transceivers, Wireless Sensor Actor Networks.

I. INTRODUCTION

It is important to guarantee that information can be successfully received to the base station the first time instead of being retransmitted.. In wireless sensor network data gathering and routing are challenging tasks due to their dynamic and unique properties. Many routing protocols are developed, but among those protocols cluster based routing protocols are energy efficient, scalable and prolong the network lifetime .In the event detection environment nodes are idle most of the time and active at the time when the event occur. Sensor nodes periodically send the gather information to the base station. Routing is an important issue in data gathering sensor network, while on the other hand sleep-wake synchronization is the key issues for event detection sensor networks.

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created.

The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding

II. PROJECT OUTLINE

In this project, we present a Least-Disruptive topology Repair (LeDiR) algorithm. LeDiR relies on the local view of a node about the network to devise a recovery plan that relocates the least number of nodes and ensures that no path between any pair of nodes is extended. LeDiR is a localized and distributed algorithm that leverages existing route discovery activities in the network and imposes no additional pre-failure communication overhead. The performance of LeDiR is simulated using NS2 simulator.

Advantages goe like this where It is almost insensitive to the variation in the communication range.
LeDiR also works very well in dense networks and yields close to optimal performance even when nodes are partially aware of the network topology.

III. SYSTEM DESGIN DVELOPMENT

Fact Finding is the methods of gathering the information required about the existing system. Some of them are as follows. Observation of the current work situation will provide clues to problems and atmosphere. Record searching, special purpose records and sampling will give quantitative information about the system which facilitates sizing of the proposed system and may also point the areas of difficulties which are being experienced. Questionnaires can be used to collect the quantifiable data about the system. All of the techniques need to be supplemented by more detailed discussion of the interview situation. The identification of the user requirements, decision areas, objectives. And responsibilities for certain procedures can only be achieved for interviewing. Based on the above fact finding techniques, it is observed the current situation of the existing system. It is very helpful to finding the areas of difficulties, which are being experienced in the existing system. Thus it helps to develop the proposed system with the quantifiable data.

B. Input Design

Input Design is part of overall system design, which requires very careful attention. If the data going into the system is incorrect then the processing and output will magnify these errors.

The inputs in the system are of three types:

- External : which are prime inputs for the system
- Internal: which are user communication with the system
- Interactive: which are inputs entered during a dialog with the computer

The above input types enrich the proposed system with numerous facilities that make it more advantageous in comparison with the exiting normal system. All the inputs entered are completely raw, initially, before being entered into a database, each of them available processing. The input format in this system has been designed with the following objectives in mind.

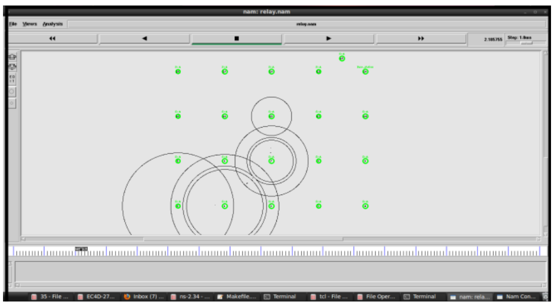

Fig 1.shortest path

IV. FEASIBILITY TEST

All projects are feasible, given unlimited resources and infinite time. Before going further in to the steps of software development, the system analyst has to analyze whether the proposed system will be feasible for the organization and must identify the customer needs. The main purpose of feasibility study is to determine whether the problem is worth solving. The success of a system is also lies in the amount of feasibility study done on it. Many feasibility studies have to be done on any system. But there are three main feasibility tests to be performed.

A. Operational Feasibility

During feasibility analysis operational feasibility study is a must. This is because; according to software engineering principles operational feasibility or in other words usability should be very high. A thorough analysis is done and found that the system is operational.

B. Technical Feasibility

System analyst to check the technical feasibility of proposed system. Taking account of the hardware it is used for the system development, data storage, processing and output, makes the technical feasibility assessment. The system analyst has to check whether the company or user who is implementing the system has enough resource available for the smooth running of the application. Actually the requirements for this application is very less and thus it is technically feasible.

C. Economical Feasibility

Before going further in to the development of the proposed system. The system analyst has to check the economic feasibility of the proposed system and the cost for running the system is composed with the cost benefit that can achieve by implementing the system. As in the case of Crypto Media development cost is not high, as it doesn't need anyextra hardware and software. Thus the system is economically feasible. System design is process of planning a new system to document or altogether replace the old system. The purpose of the design phase is to plan a solution for the problem. The phase is the first step in moving from the problem domain to the solution domain. The design of the system is the critical aspect that affects the quality of the software. System design is also called top-level design. The design phase translates the logical aspects of the system into physical aspects of the system.

V. DESIGN FLOW

A. Create Network Topology (Physical Layer)

The Physical Layer is the first and lowest layer in the seven-layer OSI model of computer networking. The implementation of this layer is often termed PHY.
The Physical Layer consists of the basic hardware transmission technologies of a network. It is a fundamental layer underlying the logical data structures of the higher level functions in a network. Due to the plethora of

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available hardware technologies with widely varying characteristics, this is perhaps the most complex layer in the OSI architecture. The Physical Layer defines means of transmitting raw bits rather than logical data packets over a physical link connecting networking nodes. The bit stream may be grouped into code words or symbols and converted to a physical that is transmitted over hardware.

B. Transport Connection (Transport Layer)

Transport layers are contained in both the TCP/IP. which is the foundation of the INTERNET. and the OSI model of general networking. The definitions of the Transport Layer are slightly different in these two models. This article primarily refers to the TCP/IP model, in which TCP is largely for a convenient application programming interface to internet hosts, as opposed to the osi model of definition interface. The most well-known transport protocol is the (TCP). It lent its name to the title of the entire internet protocol suite TCP/IP. It is used for connection-oriented transmissions, whereas the connectionless user datagram suite(UDP) is used for simpler messaging transmissions. TCP is the more complex protocol, due to its stateful design incorporating reliable transmission and data stream services.

C. Generate Traffic (Application Layer)

In TCP/IP, the Application Layer contains all protocols and methods that fall into the realm of process-to-process communications via an Internet Protocol (IP) network using the Transport layer protocols to establish underlying host-to-host connections.
In the OSI model, the definition of its Application Layer is narrower in scope, explicitly distinguishing additional functionality above the Transport Layer at two additional levels: session layer and presentation layer OSI specifies strict modular separation of functionality at these layers and provides protocol for each layer.

VI. MODULES

A. Failure Detection

Actors will periodically send heartbeat messages to their neighbours to ensure that they are functional, and also report changes to the one-hop neighbours. Missing heartbeat messages can be used to detect the failure of actors. After that it's just check whether failed node is critical node or not.Critical node means if that node failed it form disjoint block in the network.

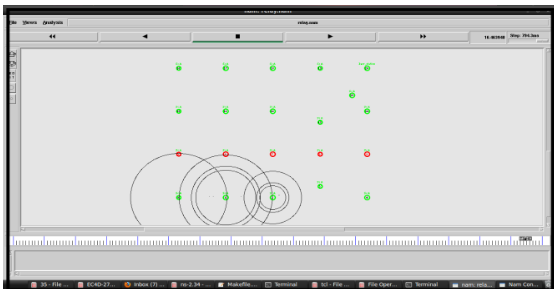

Fig 2. Movement The Backup Sensor Find Out The Route

B. Smallest Block Identification

In this step we have to find smallest disjoint block. If it is small then it will reduce the recovery overhead in the network.
The smallest block is the one with the least number of nodes
By finding the reachable set of nodes for every direct neighbour of the failed node and then picking the set with the fewest nodes.

C. Replacing Faulty Node

If node J is the neighbour of the failed node that belongs to the smallest block J is considered the BC to replace the faulty node
Since node J is considered the gateway node of the block to the failed critical node (and the rest of the network)
We refer to it as "parent." A node is a "child" if it is two hops
Away from the failed node, "grandchild" if three hops. Away from the failed node
In case more than one actor fits the characteristics of a BC (Best Candidate), the closest actor to the faulty node would be picked as a BC.
Any further ties will be resolved by selecting the actor with the least node degree.At last the node ID would be used to resolve the tie

D. Children movement

When node J moves to replace the faulty node, possibly some of its children will lose direct links to it.
We do not want this to happen since some data paths may be extended.
This algorithm don't want to extend the link.if a child receives a message that the parent P is moving, the child then notifies its neighbours (grandchildren of node P) and travels directly toward the new location of P until it reconnects with its parent again.

VII. CONCLUSION

Wireless sensor and actor networks (WSANs) additionally employ actor nodes within the wireless sensor network (WSN) which can process the sensed data and perform certain actions based on this collected data.

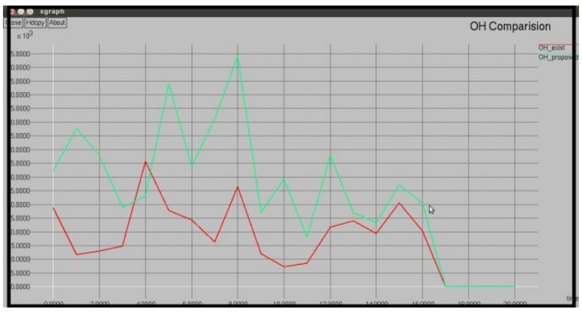

Fig 3.Comparision Between Xgraph

In most applications, inter-actor coordination is required to provide the best response. This suggests that the employed

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actors should form and maintain a connected inter-actor network at all times. However, WSANs often operate unattended in harsh environments where actors can easily fail or get damaged. Such failures can partition the inter-actor network and thus eventually make the network useless. In order to handle such failures, we present a connected dominating set (CDS) based partition detection and recovery algorithm.
The idea is to identify whether the failure of a node causes partitioning or not in advance. If a partitioning is to occur, the algorithm designates one of the neighboring nodes to initiate the connectivity restoration process. This process involves repositioning of a set of actors in order to restore the connectivity. The overall goal in this restoration process is to localize the scope of the recovery and minimize the movement overhead imposed on the involved actors. The effectiveness of the approach is validated through simulation experiments.

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