ReDAST: A Complete Elimination of Transfaulty Nodes from the Wireless Sensor Network Operation

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Abstract **- Wireless Sensor Network (WSN) with distributed nodes collaboratively sense physical phenomena of surroundings and send sense information to the sink node through single-hop or multi-hop paths. In this study, the performance of the ReDAST (Reliable and efficient data acquisition in a stationary WSN in the presence of transfaulty nodes) was compared with the performance of a network fully constructed by sensor nodes, which can communicate in acoustic and Radio frequency (RF) communication mode to prevent loss of information and to get redundant coverage in the radiation affected area where in all the sensor nodes in that area become activated and switch to the acoustic communication mode after detecting radiation affected area. The results revealed that the present work, ReDAST, achieves better energy, efficiency and complete elimination of transfaulty nodes in WSN to reduced average end-to-end delay than sensor nodes having only acoustic mode of communication.**

Index Terms—Wireless Sensor Networks, Transfaulty Nodes, Data Acquisition, Acoustic Communication.

INTRODUCTION

Advent of wireless sensor technology pleads many prominent technological inventions to the use of public domain in recent dates [1]. The WSN technology has large application domain including security, surveillance, health care, environment monitoring, and object tracking. Further more autonomy, energy-constrained, resource constrained nodes, and dynamic topology are the key characteristics of a WSN. Sensor nodes detect physical phenomena like temperature, pressure, and humidity from the surroundings and then send sense information from source place to sink through single-hop or multi-hop collectively with the help of sensor nodes. Cooperation and collaboration among nodes is one of the important factor which aiming the successful operation of a WSN [2 and 7]. In contrary, misbehaviors, faults, and attacks of sensor nodes are major challenges in the wireless sensor network.

EXISTING SYSTEM

In existing system misbehavior and faulty are the major problems in WSNs. When sensor nodes misbehaves as transfaulty, though it sense physical surrounding correctly, but it fails to communicate with its neighbours due to the temporary failure in communication by electro-magnetic or nuclear radiation exposure [3]. The presence of electro-magnetic or nuclear radiation is temporary phenomena. A sensor node exhibiting such temporary behavior phenomena is termed as a transfaulty node [Fig.1]. Transfaulty nodes become temporarily isolated which creates dynamic holes in the network. Such holes form and disappears, later their size increase or decrease with time which is further results in loss of information. Complete elimination of transfaulty nodes from the network operation for their remaining lifetime is not desirable, because resources and services of these nodes can be used in network operation, which can improve the lifetime of the network.

Proposed System

Therefore, in this work, we propose Reliable and Efficient Data Acquisition in Wireless Sensor Networks in the Presence of Transfaulty Nodes (ReDAST) compared with network fully constructed by sensor nodes, which can communicate in acoustic and RF communication mode to gather and re-establish the temporarily lost information and get more coverage and connectivity to correct the sensed information through switching on and switching off activation of nodes to the acoustic mode of communication to gain better energy, efficiency and complete elimination of transfaulty nodes in WSN in radiation affected area [2].

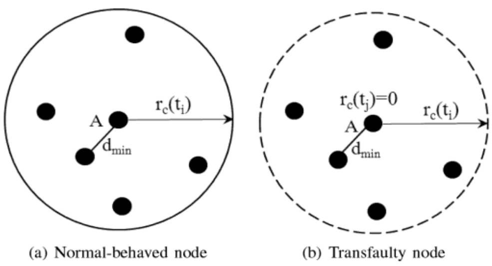

Fig.1. Normal and Transfaulty nodes

Steps:

System Model

We have constructed a WSN with GPS enabled homogeneous sensor nodes, each of the sensor nodes have the same capability of sensing, transmitting, and receiving and each node to know their position by GPS or any location services. The dual mode (radio frequency (RF) and acoustic) of communication was used to work in radiation affected area to continue communication between sensor nodes. A sensor node communicates using the RF communication mode which is usually gets affected by [redacted], later which disables the sensor nodes from communication. Therefore, the effect of radiation helps the sensor nodes to switch over to the acoustic mode which is not gets affected by radiation. Therefore the sensor nodes continue their communication in the presence of radiations using the acoustic communication mode. In the presence of radiations, the sensor nodes communicate in three different ways [4].

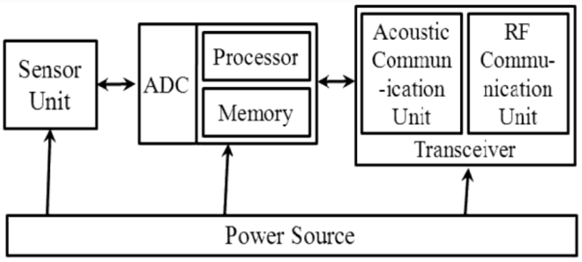

Fig.2. Sensor node architecture having dual mode communication.

GRID BASED APPROACH

In the present work, ReDAST is necessary to identify the boundary nodes which form dynamic holes for selecting the appropriate mode of communication [5]. The existing hole boundary identification method was completely lack to work with dynamic holes formed from radiation effects. Therefore, we performed a centralized boundary node detection scheme by the sink. After the deployment of network, a minimum subset of sensor nodes remain activated to cover the entire region optimally. In this work, we consider a grid based approach to find out minimum subset of nodes. In this approach, we divide the entire terrain into a grid having width and height of each cell equal to the sensing radius of a node. We select a node as a member of minimum subset, which is nearest to the center of a grid. There are many of such minimum subsets which cover the entire area optimally.

Hardware Requirements	Software Requirements
System : Intel Core i3 2.8 GHz.	Coding Language : TCL
Hard Disk : 250 GB	Software : NS2
Monitor : 15" VGA Colour	
Mouse : Logitech	
Ram : 1 GB	

Signal to Noise Ratio (SINR) value approach and switch over to the acoustic mode

The sensor nodes affected by radiation was detected based on SINR value. If the SINR value becomes less than threshold in communication due to the affect of radiation then the sensor node cannot communicate with other nodes and become isolated from the network then these affected sensor nodes switch to the acoustic mode and activate the neighbor node to sleep by sending the ACTIVATION message which remain activated for the next trpt time, where trpt is the time for repeating the broadcast of HELLO message [5]. The activation of sleep nodes leads them to switching over to the acoustic mode and additional activated sensor nodes gives redundant coverage to the affected area. The sink node sends the SETMODE message to boundary nodes after identifying the boundary nodes to work in dual modes of communication. Thus, the boundary nodes communicate both in the RF and acoustic modes then appear packet format of the ACTIVATION and the SETMODE control messages. The boundary nodes continue to be communicating with the affected nodes in the acoustic mode and with the other nodes in the RF communication mode. The unaffected nodes continue to communicate using the RF communication mode.

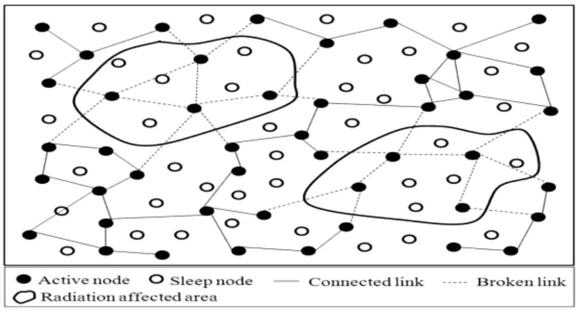

Fig.3. Radiation affected area

SIMULATION DESIGN

We performed a simulation-based study, used Mat lab simulation engine to simulate the proposed WSN. We considered a 500 m _ 500 m simulation area and deploy 200 – 400 homogeneous sensor nodes randomly over the area. Among sensor nodes, a sink node is placed randomly and all the sensor nodes are assumed to know their individual positions. A subset of sensor nodes remains activated for covering the entire terrain optimally after the deployment and rest of the nodes remain in the sleep state. All the sensor nodes have the capability of dual mode of communication, i.e., each sensor node can communicate using both RF and acoustic modes of communication and can switch between them, whenever required. The sensing range of the nodes considered as 30 m. The communication range of the sensor nodes in the RF mode are considered as 90 m. Acoustic signal has higher propagation delay and attenuation than RF signal [6].

System Requirements:

Results of Performance Evaluation

In this study, the performance of the ReDAST was compared with the performance of a network fully constructed by sensor nodes, which can communicate in both acoustic and RF communication mode which disables the sensor nodes from communication. Then the sensor node cannot communicate with other nodes which become isolated from the network then these affected sensor nodes switch to the acoustic mode and activate the neighbor node to sleep. The activation of sleep nodes leads them to switching over to the acoustic mode and additional activated sensor nodes gives redundant coverage to the affected area [Fig.3 and Fig.4]. The unaffected nodes continue to communicate using the RF communication mode. Therefore, the effect of radiation helps the sensor nodes to switch over to the acoustic mode which is not gets affected by radiation. Therefore the sensor nodes continue their communication in the presence of radiations using the acoustic communication mode.

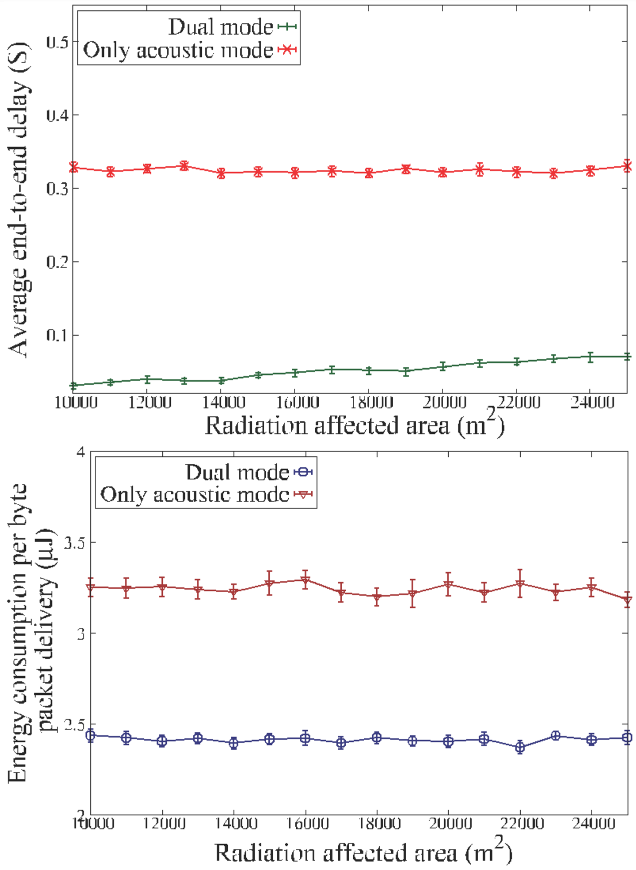

Fig.4. End to end delay in dual mode of communications

CONCLUSION

The transfaulty behavior of sensor nodes is due to temporary fault and interference in communication attributed to radiation effects. The sensing activities of nodes get affected due to environmental radiations. To prevent the information loss and to improve the reliability of data acquisition, we proposed ReDAST, which reliably gathers information from the temporarily isolated node in WSN. The simulation results showed that the proposed scheme, ReDAST, achieves better energy efficiency and reduced average end-to-end delay compared to the case in which all the sensor nodes have only the acoustic mode of communication. A node may take decision about the next switch of communication mode, depending on the information it has learnt from its interactions with other nodes. Depending on this idea, in the future, we plan to incorporate the learning concept into the proposed data acquisition algorithm. We also have a future plan to develop a real WSN to increase energy efficiency, reduced average end-to-end delay and complete elimination of transfaulty nodes to prevent information loss from the radiation affected area.

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