

Automatic routing and fault detection in mobile adhoc networks

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Abstract—In order to monitor distributed environments which are remote in nature, wireless sensor network (WSN) is a very important tool. Detecting and creating routes of faulty nodes is something we cannot ignore, and it is also an important technology involved in sensor network of wireless nodes. The well-known fact is that with the help of interchange of the data in the close by nodes from network, the distributed fault detection aka DFD mechanism checks the validity of the nodes. But this does not always work. The accuracy of detecting a fault by a DFD system decreases significantly in 2 implementations. 1st being when there are very less number of nodes which are to be detected and corrected, 2nd being the high ratio of failure of the nodes. By structuring and defining a new detection criteria, in this paper we propose a new and advanced distributed fault detection aka DFD scheme.

Keywords—Wireless sensor network, node fault detection, improved DFD scheme

I. INTRODUCTION

In the most basic implementation, a wireless sensor network, aka a WSN, could consist of sensor nodes (which could be of very less cost, smaller in size and massive in numbers). These nodes will definitely be placed in a monitored/deployment region and they tend to form a self-organized and multi-hopping network system with the help of wireless communication. The main aim for this system is to sense the information of the entities present in the given area (aka monitoring/coverage area), collect the information in efficient form and finally deliver it to the observing end for further processing or analyzing. The system handles multiple functions at a time with very low consumption of energy. [1-4]

The quality of the wireless sensor network is deeply affected by the volume of failed nodes in it. Hence this becomes a necessary requirement to understand and analyze the fault detection methodologies for wireless network systems. Following are the reasons for the same [5-6]:

- Generally high number of low-cost mobile sensor nodes are planted in environments which are very hostile or the conditions are very uncontrollable. Hence, because of such reasons, these nodes are more prone to get damaged.
- As an application example, these nodes may also be deployed at a nuclear power plant. Hence due to security reasons it becomes very important for them to function at their peak performance.
- It is nearly impossible to manually go and check the functionality of the nodes, because they are usually deployed in the very large area. Checking each and every node could be a troublesome task.
- Because of node failure, there may be times when base stations receive incorrect information from the

failed nodes. If the case is serious, it may also lead to network collapse.

- Battery depletion could also be a reason for node failure.

Hence to sum everything up, we can say that following points are responsible for wireless sensor network node faults:

- Communication or sensor module failure which might be due to manufacturing process problems.
- Factors concerning the environment of the node
- External attacks
- Batter power depletion
- Communication range problem

A wireless sensor network node can exhibit 2 statuses [7-8]: faulty and normal. Also, fault in a node can be of the type permanent or static (temporary). The definition of these would be as follows: if the fault is of the nature “static” then it means it is stop the generation of new faults while the process of fault detection occurs, if the fault is of the nature “permanent” then it means the node that has failed will remain in the status of failed until unless it is replaced by a new node. In the paper [7, 9] the author has divided the faults in the nodes as “hard” and “soft”. The “hard” fault occurs when there is some issue of communication between the sensor nodes due to issue with some other module. The “soft” fault that the sensor node will still be functional but the data that is sensed or transmit is faulty.

The paper is organized as follows. In the next section, we have discussed the preliminary requirements that has been covered so far in this area. We describe the final scheme for distributed fault detection along with the theory in section 3. We have also shed light on the goods and bads of the schemes that we have work upon. The paper is concluded in the final section.

II. LITERATURE SURVEY

This is the part where we briefly review the work that is related to our topic and that has been done so far. It is very much possible that due to some faulty sensor measurements, it may be the cause of quality of service degradation. It may also result in using huge energy in the process. In the paper [10], the author has detected the fault in wireless sensor networks by spatial correlation of sensor measurements. This method could be used as an approach to get weights of the measurement of sensor neighbor's. This further helps to differentiate between the measurements.

The paper number [11] addresses the designing of distributed decision fusion which is also fault tolerant. This will be designed in the presence of faulted sensors while the sensors are sending the decisions to a fusion center

sequentially. Hence while performing the distributed decision fusion a scheme is proposed which is known as collaborative sensor fault detection in order to eliminate local decisions which are unreliable. The author has created a threshold on the probability of upper bound which is based on multiple criteria such as fault free environment, fusion rule which is designed previously and assumption of having similar rules for local decisions. Hence using this boundary for error, author proposes a criteria to look out for fault nodes. This process identifies the faulty nodes, all the decisions which are corresponding to these nodes are removed from the process's computation, and the final decisions are made without them.

Paper number [12] proposed a method which happens to be used for identification of environmental events which are interesting in nature also known as canonical tasks in WSN. The possibility of measurements faults of a sensor is taken into account. To detect and correct such faults, the author then develops a distributed Bayesian scheme.

In [6], a new methodology for classification of faults in WSNs were introduced. It is also the first online technique based on model. Every sensor generates some readings, whose impact is considered by this technique, on how consistent the multi sensor fusion is. If eliminating a sensor improves the overall consistency of the result, then the sensor is deemed to be faulty. Bayesian approaches or maximum likelihood can be utilized over the multi sensor fusion requirements which can be used a way to differentiate the random noise. Some amount of random noise is expected if the final result's accuracy of multi sensor fusion is improved after running these processes. The author states that we need to combine measurements of so many different sensors into a model in order to get a consistent and constant mapping of the phenomena sensed. A broader set of faulty models become eligible for this cross validation based technique. The technique is so generic that it can easily be applied to any arbitrary system/placement of sensors. Information of all the nodes must be collected at the base station where the system will perform the on line fault detection.

Article number [13] is based on finding node failures for head of clusters in underwater sensor networks. The fault status of a cluster header is responsibility of the other nodes of the cluster. A cluster member will detect the fault in its cluster head. Once the fault is detected in a cluster head, it reaches to an agreement with respect to the other member of the cluster, the author has called this an agreement protocol. The mechanism of detection runs periodically in the network and for each of the cluster. And the period at which the detection takes place is decided by the data that is sent by the cluster head to the base station.

Another scheme for fault tolerance, which is also energy efficient was discussed in [14-17]. This paper is responsible to introduce the probability of a sensor fault into an optimal detection process of the event. It was also observed that the error in detection was improved to a greater extent when the size of neighborhood was increased. The author attempted to differentiate the events fault sensors and also from measurement error which was noise related. This also helped in limit the overall effect of a faulty sensor node on only the event detection accuracy.

III. IMPROVED DISTRIBUTED FAULT DETECTION SCHEME

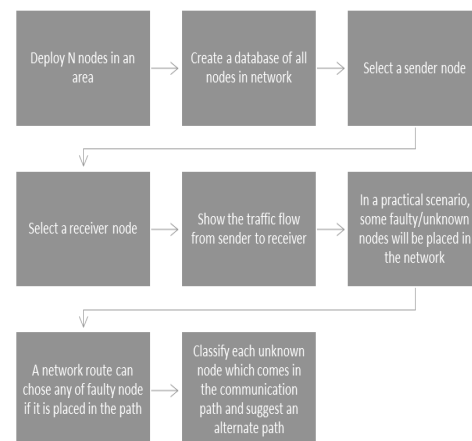
We need to propose a novel approach for traffic classification, which can improve the classification performance effectively. The problem at hand is that we have to detect the malicious traffic flow in our network and then work out a new route which is free from the faulty nodes. Also, we have to keep in mind that the new route should be the shortest route from sender to receiver. Thus we have to detect classify and detect the faulty nodes causing illegal traffic in the network and get this done with keeping minimal nodes involved

Following are the set of objectives we need to meet

- Successful node deployment over a described area.
- Simulate traffic from 1 node (source) to another (destination), i.e. 1 correlated flow
- Counter the network nodes which tries to alter traffic path. Create a perfect route from source to destination. The correlated path should be able to reroute itself in case of a malicious node.

Following process will be used to detect and identify the faults in a wireless sensor network.

- We start with selecting total number of nodes to be deployed in a given area
- Nodes are deployed randomly in a given area
- We then select a sender and a receiver for information transfer
- Information start from the sender towards the receiver, through the shortest path formation
- Information transfer occurs using a hop by hop mechanism
- Every node will switch on only the next node which lies in the route
- This way, only the concerned nodes will be used while complete transfer
- Hence, energy could be consumed with strategically switching the nodes on and off



IV. RESULTS AND DISCUSSION

Following are the implementation results for the scenario. We took the implementation for 100 sensor nodes and using

this implementation, we were able to work out the result as shown in the below section.

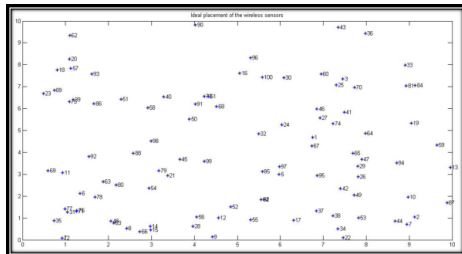


Fig1. Ideal placement of the WSN

This figure shows how the sensors are placed in a given area. These sensors are placed in a random fashion in the area. Also, every sensor placed in the area has got an ID using which it can be tagged.

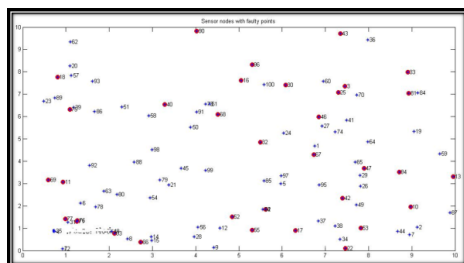


Fig2. Fault detected in the scenario

Once all the sensors are deployed, the processing will move on to make path from sender node to receiver node. The user will select a sender and receiver from the placement using node IDs. Sender node thus selected will also become the master node. This master node will send an acknowledgement signal to the left over nodes in the network, in order to find the fault and non-faulty nodes.

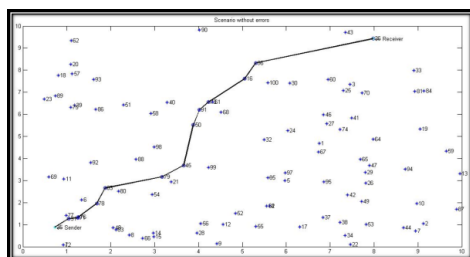


Fig3. Scenario 1: No error

This is the ideal scenario. Here, we assume that there are no faulty nodes. The nodes of the network are all authentic without any kind of faults. Transfer of information is completed without any kind of error. We have selected the shortest path from sender to receiver.

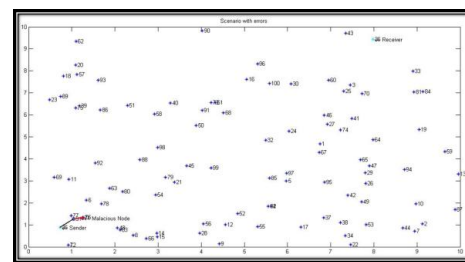


Fig4. Scenario 2: with error

This is one of the practical scenarios. The faults that were detected earlier are now into play in this scenario. The information starts from the sender, but as soon as an error occurs, the information flow stops and data is lost. This is the case of the faulty nodes.

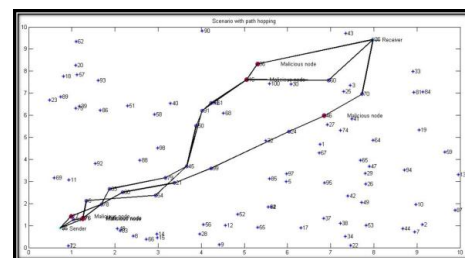


Fig5. Scenario 3: Path hopping

This is the scenario when the sender finds more than 1 route to the receiver. And even after occurrence of a faulty node, the information loss does not intervene in the route formation. The route is still completed even after a faulty node occurs. This scenario is meant to show the path hopping between sender and receiver. Information can be transferred from more than 1 route also.

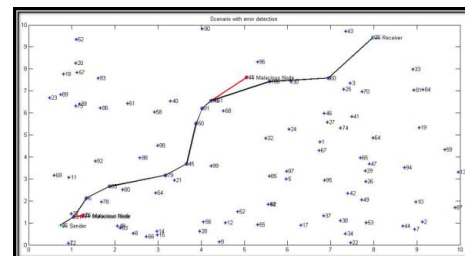


Fig6. Fault detection

This is the final scenario. Here, the faults are detected and the route will change accordingly. The system will find the shortest path between sender and receiver despite of fault occurrence.

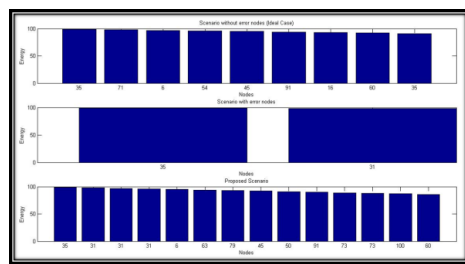


Fig7. Energy distribution

This figure shows how the energy is being depleted in the above scenarios when information is transferred from 1 node to other.

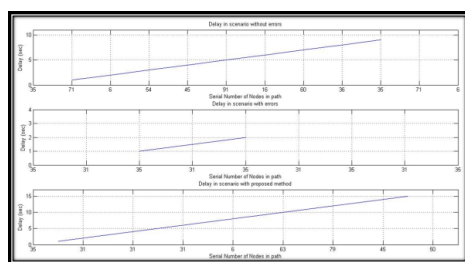


Fig8. Delays in the scenario

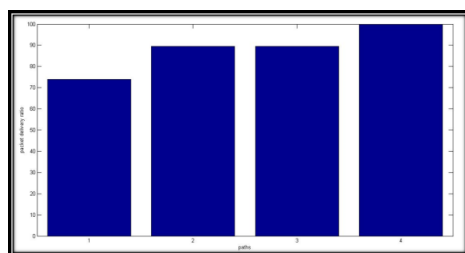


Fig9. Packet delivery ratio

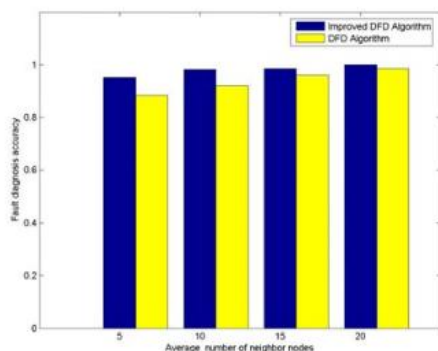


Fig10. The trend of node fault detection accuracy with various average numbers of neighbor nodes when 200 nodes are deployed and the node's failure ratio is 0.3.

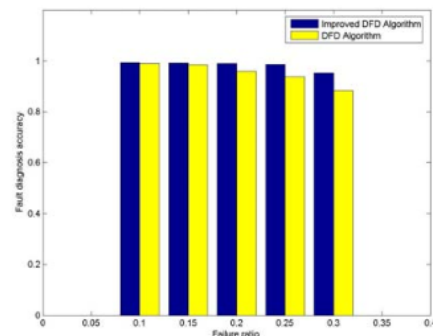


Fig11. The trend of node fault detection accuracy with various node failure ratios when 200 nodes are randomly deployed and the average numbers of neighbor nodes is 5.

V. CONCLUSION AND FUTURE WORK

In this paper, we have proposed a technique for detecting the faults in a wireless sensor network. We have also proposed a rerouting mechanism with the help of which the communication path will take a new path if the original path encounters an error. This helps to complete the communication in the most efficient way possible. As a future task, we may test the scenario on a bigger network model which includes more number of nodes or more number of faulty nodes.

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