Detection of Fault in WSN and MANET

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***Abstract* - Faults occurring in sensor nodes are familiar due to the sensor device itself and the harsh environment where the sensor nodes are deploy .In this Paper, the problem of adaptive Distributed diagnosis in mobile ad hoc networks (MANETs) using clustering is considered.. In fact, fault-diagnosis becomes an important building block to establish dependability in MANET. An important problem in MANET is the distributed system-level diagnosis problem whose purpose is to have each fault-free mobile node to determine the state of all the mobile nodes in the system. The parameters such as diagnostic latency and message complexity are used for evaluating the performance of proposed diagnosis algorithm**

***Keywords* - WSN, Fault Model , MANET, Fault Model**

I. Introduction

Wireless Network

A mobile Ad hoc network (MANET) is a self-configuring network that does not require any pre-existent (fixed) Infrastructure, which reduce their deployment time and cost also. As each node in this network is free to move which makes the network to change its topology continuously. The infrastructure-less mobile nodes in ad hoc networks dynamically form routes among themselves to create own wireless network on that moment as shown in Fig 1.3 Mobile Ad-Hoc Network (MANET) is one of the most active research topics during the last ten years. With the advances in wireless technologies and development of mobile devices, ad hoc networks will play an important role in enabling present and future communication. For both video and data communication, mobile radio technologies has experienced a rapid growth. A MANET is a dynamic wireless network formed by a set of mobile hosts which communicate among themselves by means of the air without any pre-existing infrastructure. Each node in the MANET can act as a router as well as host. In order to maintain connectivity in a mobile ad-hoc network all participating nodes have to perform routing of network traffic. The success of communication highly depends on other nodes cooperation. So, MANET has the property of quick infrastructure-less deployment and no centralized controller which makes it convenient to people and vehicles can thus be internet-worked in areas without a pre-existing communication infrastructure or when the use of such infrastructure requires wireless extension. By extending range of mobile nodes ad hoc networks supports multi-hop routing by which they can extend the range of wireless networks. Range depends upon the concentration of wireless users[9]

II. RELATED WORK

Barborak *et al.* [1] surveyed the first comparison based diagnosis models. This was a key paper in which diagnosis was treated in a unifying framework together with other distributed problems and algorithms, including consensus and the Byzantine Generals problem. The authors presented, a detailed fault classification, including the specification of the incorrect computation fault model, which best defined the faults that can be handled by comparison-based diagnosis. This was relevant because several early diagnosis papers only implicitly presented the assumed fault model, by specifying how faults were detected. The survey also argued that if the frequency in which two units became faulty was low, then there was a low probability that they would be faulty at the same time. Thus two units executing the same tasks should produce identical results unless one, or both, had become faulty.

Kozlowski and Krawczyk [2] diagnosis model for hybrid fault situations. A hybrid fault situation was defined to be t/m-restricted if the number of faulty units did not exceed t and the number of misleading comparison outcomes was less than m. A misleading comparison outcome was supposed to be occurred when a fault-free unit would evaluate a faulty unit as fault free. The authors also presented an $O(N|C|)$ algorithm for comparison-based diagnosis under a hybrid fault situation.

Chen *et al.* [3] presented an extension to the MM model. Their model considered both processor and comparator faults separately. Therefore, a processor would either execute tasks or performed comparisons. It was also shown that the system diagnosability was $t \leq \lfloor \delta/2 \rfloor$, where δ was the minimum degree of nodes in the system. Though, they also showed that if the number of faulty comparators was less than the number of faulty processors, the diagnosability would reach $t \leq \delta$. The authors also presented an optimal $O(|E^*|)$ algorithm for the diagnosability $t \leq \lfloor \delta/2 \rfloor$, and an $(|E^*|2)$algorithm for the diagnosability $t \leq \delta$, where E^* was the set of comparators.

III.EXCITING FAULT NODE RECOVERY ALGORTHIM

Directed Diffusion Algorithm

The goal of the DD algorithm[2] is to reduce the data relay transmission counts for power administration. The DD algorithm is a query-driven communication protocol. The collected data is transmitted only if it matches the query from the sink node. In DD algorithm, the sink node provide the queries in the form of attribute-value pairs to the other sensor nodes by broadcasting the query packets to the whole network. then, the sensor nodes send the data back to the sink node only when it fits the queries.

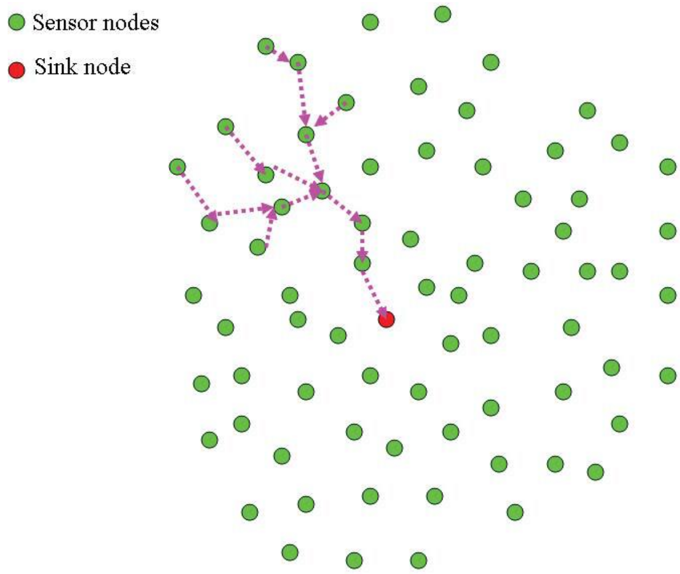

Fig.3. 1. Wireless sensor node routing.

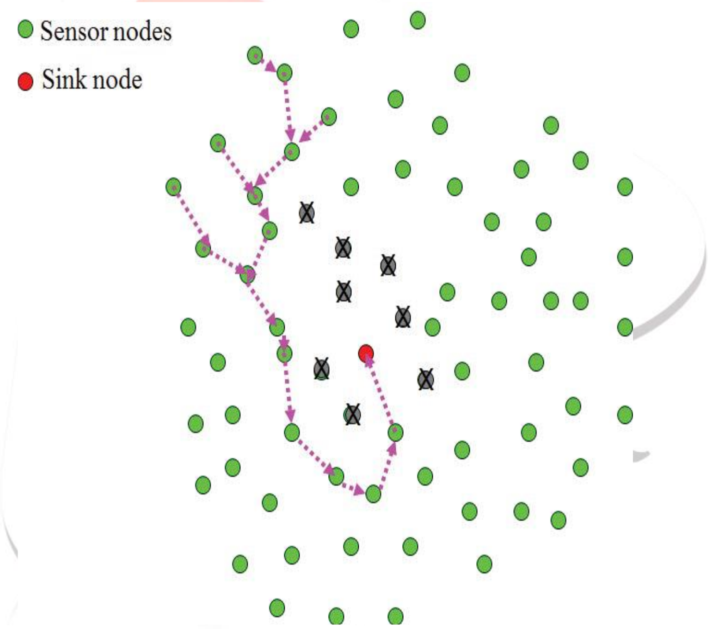

Fig. 3.2. Wireless sensor node routing path when some nodes are not functioning.

Grade Diffusion Algorithm

The GD algorithm not only creates the routing for each sensor node but also identifies a set of nodes to reduce the transmission loading. Each sensor node can select a sensor node from the set of neighbor nodes when its grade table lacks a node able to perform the relay. The GD algorithm can also record some information the data relay. Then, a sensor node can select a node with a lighter loading or more available energy than the other nodes to perform the extra relay operation. That is, the GD algorithm updates the routing path in real time, and the event data is thus sent to the sink node quickly and correctly.. Whether the DD or the GD algorithm is applied, the grade creating packages or concerned query packets must first be broadcast. Then, the sensor nodes move the event data to the sink node, according to the algorithm, when appropriate events take place. The sensor routing paths are shown in Fig. 3.1

The WSN may fail due to a range of causes, including the following: the routing path might experience a break; the WSN sensing area might experience a leak; the batteries of some sensor nodes might be depleted, requiring more transmit nodes; or the nodes wear out after the WSN has been in use a long period of time. In Fig. 3.2, the situation in which the outside nodes transfer event data to the sink node via the inside nodes (the sensor nodes near the sink node) in a WSN illustrate the accommodation measures for non-working nodes. The surrounded by nodes thus have the largest data communication loading, consuming energy at a faster rate. If all the surrounded by nodes deplete their energy or otherwise cease to function, the happening data can no longer be sent to the sink node, and the WSN will no longer task

IV.NETWORK MODEL AND FAULTMODEL

We assume sensors are randomly deployed in the interested area and all sensors have a common transmission range. The area is assumed to be completely covered by the sensors. As shown in Figure 4.1, the shady circles represent faulty sensors and the light gray circles are good sensors. There could be a failure taking place in a certain area as illustrated in the figure. All sensors in the area go out of service. Since we are depending on majority voting, we assume that each sensor has at least 3 neighboring nodes. Because a large amount of sensors are cast into the interested area to form a wireless network, this condition can be simply obtain. Each sensor node is able to locate the neighbors within its transmission range through a broadcast/acknowledge protocol.

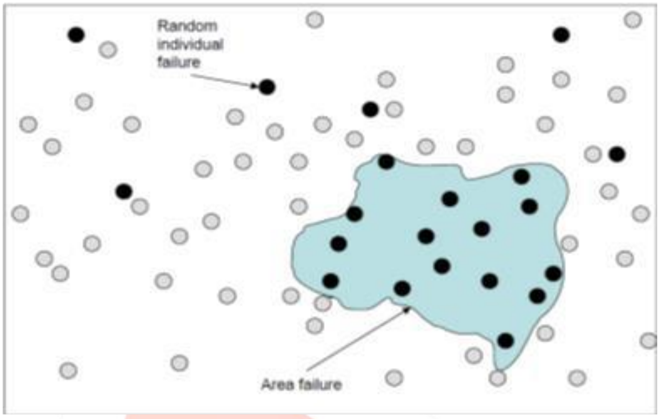

Figure 4.1: Sensor nodes randomly deployed over an area

V. PURPOSED WORK

Adaptive Destributed Algorithm

Notations used in the diagnosis algorithm are shown below in the table:

Table5.1: notations used in algorithm

Symbols	Description
F	Number of faulty nodes
Ff	Number of fault free nodes
Status_table[node-id]	Status of all the nodes in the network maintained by every node
$D_{node\text{-}id}$	Diagnostic value of the node
init_hb_msg	Initiator heartbeat message
res_hb_msg	Response heartbeat message
T_{out}	Maximum waiting time by the initiator nodes to a faulty or fault free node

ALGORITHM STEPS

Step 1: Create a cluster having N number of nodes using the formula $C_{m,k}$.

For all m=0,1,2……N-1

K=1,2,……...logN

Step2: Assume that all the nodes in the network can initiate the diagnosis and all the nodes are fault free at the initial stage of algorithm execution.

Step 3: Start the Diagnosis process:

Repeat
for K=1 to log N Do
Send i_hb(p, q , Dq, init_hb_msg)
Set_Timeout (Tout)

Step4: Find out response time and tested node response r_hb (q, p, D'q ,res_hb_msg)

if Dq = D'q, // then the testee node is fault free.
Status_Table[p] =fault free
ff = ff U [q]
else
// the node that replied an incorrect message are diagnosed as faulty node.
f=N (initnode_id)-ff
if (f=N (initnode_id)) Then
//if its entire neighboring nodes is faulty then the diagnosis is complete
Terminate=True
End if

Step5: Timeout:

//the testee node that did not reply to tester or initiator node within time Tout are diagnosed as faulty.

f=N (initnode_id)-ff
if (f=N (initnode_id)) Then
//if all its neighboring nodes are faulty then the diagnosis is complete
Terminate=True
End if
Update the entry in the Status_table[p]
Step 6: Receive_local_diag_msg (p, fp)
//when all initiator receives a local diagnostic message then,
f=f U fp;
D= D U {p}
D= N (init_node_id)-f
Step 7: Now at this instant, all initiator node will exchange local diagnostic message with each other and send it to every other nodes in the network.
Step 8: Make the global diagnostic message for storing the information.
Step 9: Calculate the threshold for each node and compare with the predefined threshold.
//to get the percentage of faulty and fault free nodes

1) For $C_{p,k}$: First of all a system having 8 nodes is grouped to create a cluster $C_{p,k}$ as shown in the figure below from figure:6.1.a to figure:6.1.d. It performs test sequentially until it finds a fault free node or all other nodes are faulty .If a fault free node is found, from this fault free node, node m copies diagnostic information of all nodes in $C_{p,k}$.

Figure5.1: $C_{p,k}$ for the system

2) .Array: Show the size of $C_{p,k}$ with fields xd , yd, type ,D(Diagnosis),ST(Status Table).

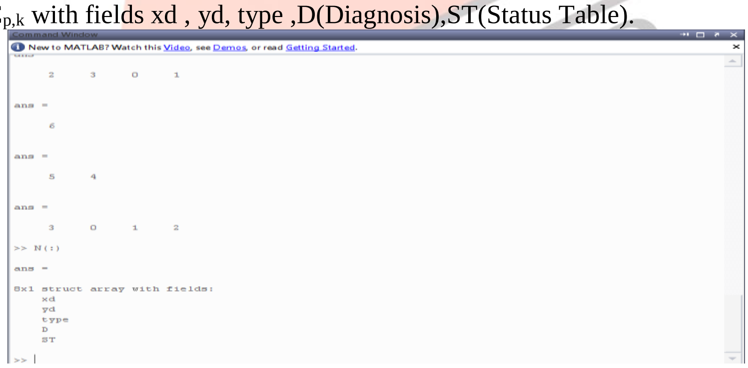

Figure5.2: Array for $C_{p,k}$.

3). Diagnosis information

Diagnosis process is started by the initiator node by sending the request heartbeat message to the tested node. An initiator node maintains a time out value after sending a heartbeat message to the tested node. The diagnostic information of our algorithm depends on number of messages such as initiation heartbeat message, response heartbeat message, local diagnostic message and global diagnostic message and the message size

Figure5.3.:Diagnosis information

4) Status table: To maintain the status of nodes about the entire network each initiator node maintains a vector called as Status Table[p] which stores the status that is local diagnostic information of each node m in the network. Actually each initiator node is a cluster head

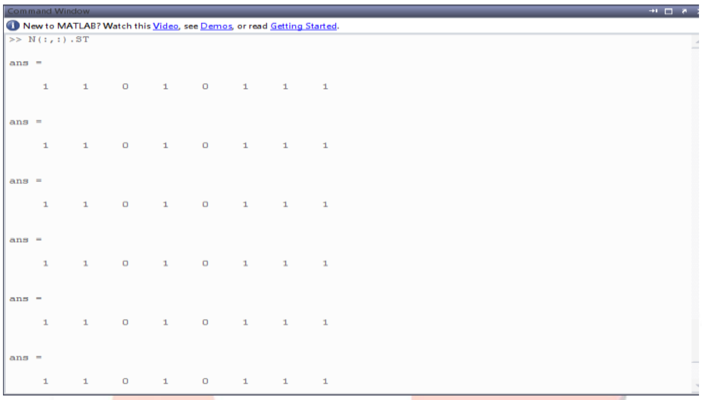

Figure5.4: Status Table For each node.

5) Global diagnosis message

Every initiator node prepares a global diagnostic message using local diagnostic message and further disseminates the diagnosis information throughout all the nodes to provide a global and consistent diagnostic view by every fault free node of the entire WSN.

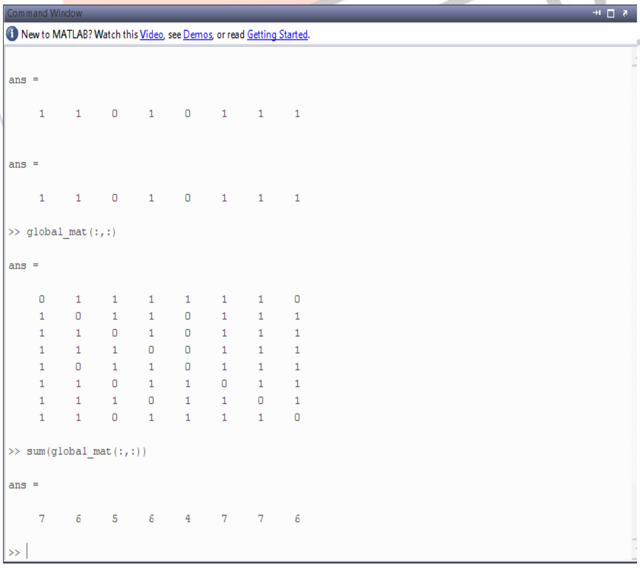

Figure5.5: Global Diagnostic Information

VI.CONCLUSION

.In real wireless sensor networks, the sensor nodes use battery influence supplies and thus have incomplete energy resources. In adding to the routing, it is important to research the optimization of sensor node substitution, reducing the substitution cost, and reusing the most routing paths when some sensor nodes are nonfunctional. In this paper we provided a detailed study of faults that occured in real WSN deployments.

VII. References

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