Node Failure Detection Mechanisms in Wireless Sensor Networks

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Abstract : Wireless Sensor Network (WSN) comprises of loads of sensor nodes. The majority of them are controlled by battery and working condition is typically very poor. With the expanding of working time, the battery limit of system nodes will be depleted step by step. At that point the nodes will be faulty and causes mal functioning of the System . For such issues, it will gives essential data for resulting medicinal measures, for example, organize re-topology and directing fixing, if faulty nodes can be found what's more, be situated as quickly as time permits. In this manner, expanding consideration has paid on relative works about faulty node identification. In this Paper, we provide a overview on Node detection Algorithms like Boundary Node Detection (BND), Check Point Recovery Algorithm (CPRA), Maximum Cost Forwarding Protocol based Algorithm (MFCPA) Node Encoding Verification Method (NEVM), Clustering Based Algorithms like Table Fault Detection (TFD) and Low Energy Adaptive Clustering Hierarchy (LEACH) Protocol.

Keywords : WSN, BND, CPRA, MFCPA, NEVM, Clustering, TFD, LEACH .

I.   Introduction

WSN consists of Tiny Nodes. Detecting component inside the WSN are utilized to find the adjustments in the encompassing environment like temperature, sound, weight and this sensor node send the tangible data to the spectator for physical procedure and investigating. Handling, stockpiling and retribution like capacities are performed by sensor node [3] . On the off chance that any sensor inside the system got flawed, at that point generally activity of WSN will experienced incorrect consequence of broken sensor hub this will expand traffic and wastage of constrained vitality[4] [22] . In the event that any sensor inside the WSN is getting flawed at that point separation between the nodes is expanded as we probably am aware, for proficient transmission of information in the system required briefest course between the

generator and goal. Normal of all accessible of most limited course gives a worldwide proportion of the best availability over the entire system . On the off chance that a node inside the most limited course has become broken then eventually that the most limited course is harmed and this will influence the generally speaking nature of the system [16] . In military application WSN is most broadly utilized for observing fierce minute in remote territories and power insurance. In natural recognition application sensor hub inside the system are utilized to discover the earth space to assess calamities before they happen [17] . In clinical application WSN used to see the obsessive person's condition   what's more, give that information to the specialist who is accessible at the un accessible spot, such a framework is generally helpful for the individual who is remaining forlorn at home. On the off chance that there is blunder in the yield of the sensor may bring about the misconception of the every day surviving exercises of the individual being checked.   In industry for checking working of machines, machines are furnished with temperature, weight and vibration sensors[3] [10] . Flawed checking sensors may not permit the framework to trigger the caution which may cause to finish misfortune and thus affordable weights on business. For following an objective, sensors are fitted on moving focuses to follow them, for instance sensors are fitted on vehicle for confirmation of the safe and amazing that may perilous for human life .

Types of failure Nodes in WSN:

1) Crash Node: Fault in Node emerges due to the battery issue, a Node is damaged because of equipment issue . Due to such a flaw, defective node won't do any system movement. This kind of disappointment emerges as a result of normal cause without human movement.

2) Omission Node: In this sensor node doesn't send message or information in given specific time. This sort of shortcomings is presented by the assailant for upsetting whole movement of system.

3) Packet dropper Node: In this, sensor Node doesn't transmit all parcels in the WSN such a Node drops a few bundles in the WSN. This deficiency is additionally presented by the aggressor for upsetting whole execution of system. institutionalization blunder, equipment issue like Short circuit or on the other hand harm in any electronic segment, cruel condition, low battery and harm accessible connection are the principle reason of the sensor issues.

The Organization of the Paper is as Follows the First section is about the Introduction, section two, three, four, five, six , seven deals with various Node detection Algorithms and section eight is the Conclusion.
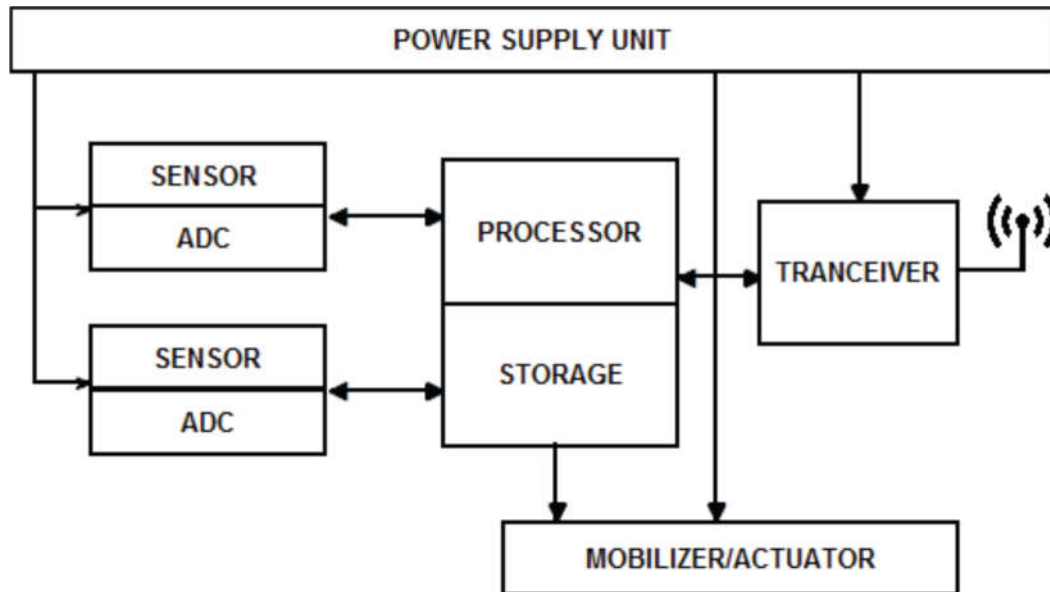
Figure 1 : Functional Block Diagram of Basic Sensor Node.

II. Boundary Node Detection Algorithm

The Boundary Node detection Algorithm is based on the Characteristic that every Boundary Node knows its corresponding neighboring node. The Boundary nodes sends signals/ Messages like " Are you able to receive " to its Corresponding neighboring nodes at definite intervals and the neighbor nodes should respond with a message " Yes, I am ! " in a definite time interval [5]. There will be a Triggering Alarm if the neighbor node does not respond on time and Network re-structure begins to select a new Node. The detection of node failure is very high for Boundary detection Algorithm which is its main advantage.
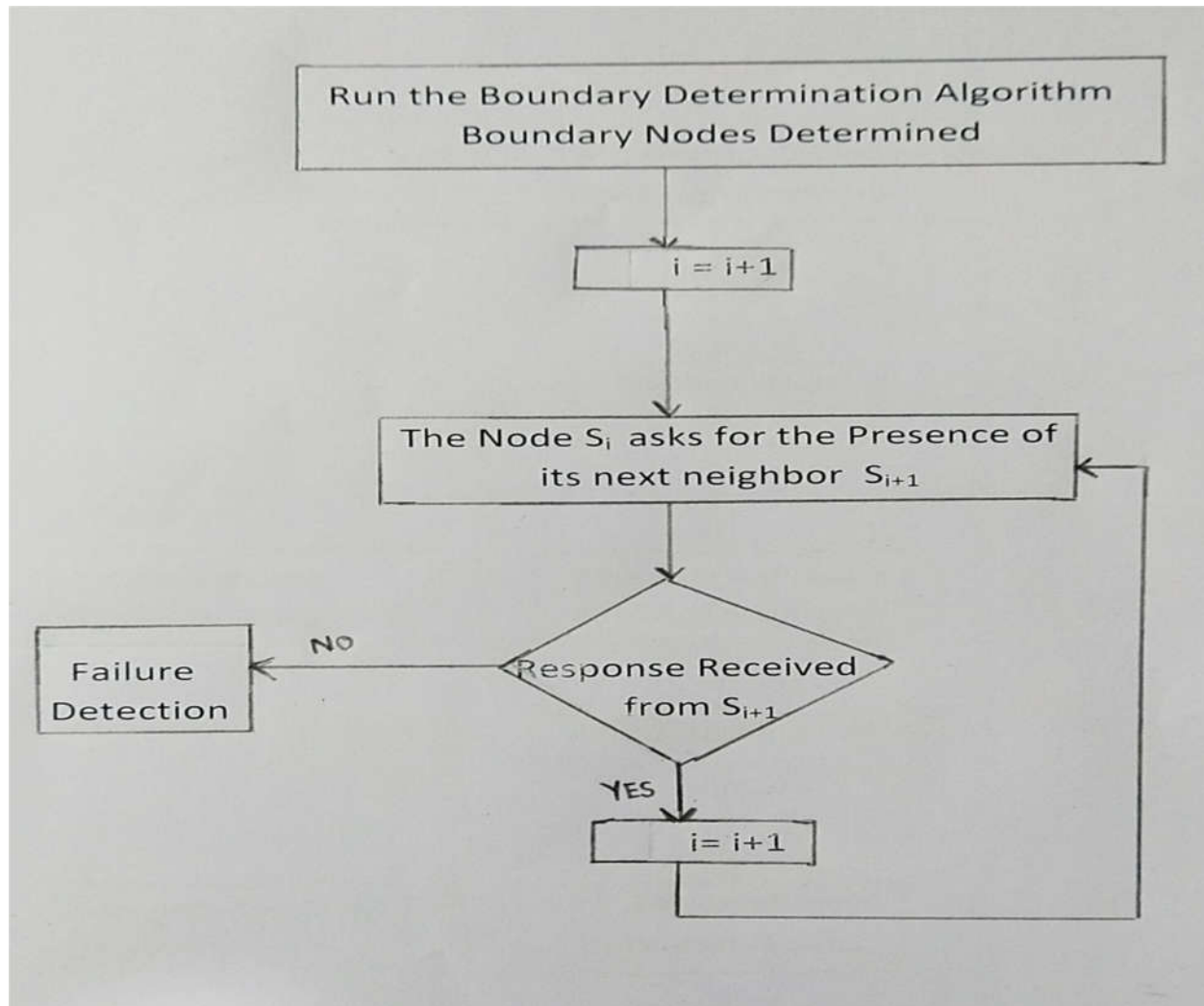
Figure 2 . Flow Chart for Boundary Node detection Algorithm

III. Check Point Recover Algorithm

The Check Point Recovery algorithm detects the Faulty nodes in the network by calculating energy levels of the nodes called as based on Heart beat [6] . If the Node responds in time then its Heart beat is greater than the Predefined Threshold Value and if the Node does not respond with in the stipulated time , then its heart beat is less than the Threshold and can be termed as a faulty node or the Energy level of the node is low [21] [26] . When such a low energy level Node is detected , it is dynamically replaced by another Healthy node and all the information is passed on to the new Node and the data is passed on to the new node and is not lost.

The Check Point Recovery Algorithm is associated with Ad-Hoc on Demand Distance Vector Protocol and Network Topology Management to determine the Shortest path between the two nodes and for maintaining the links of the replaced Failure Nodes [26]. The ID's of the replaced Faulty nodes will be broadcasted to all the nodes which are neighbors in the Corresponding Network. The data loss in the system is minimal thereby increasing the efficiency .
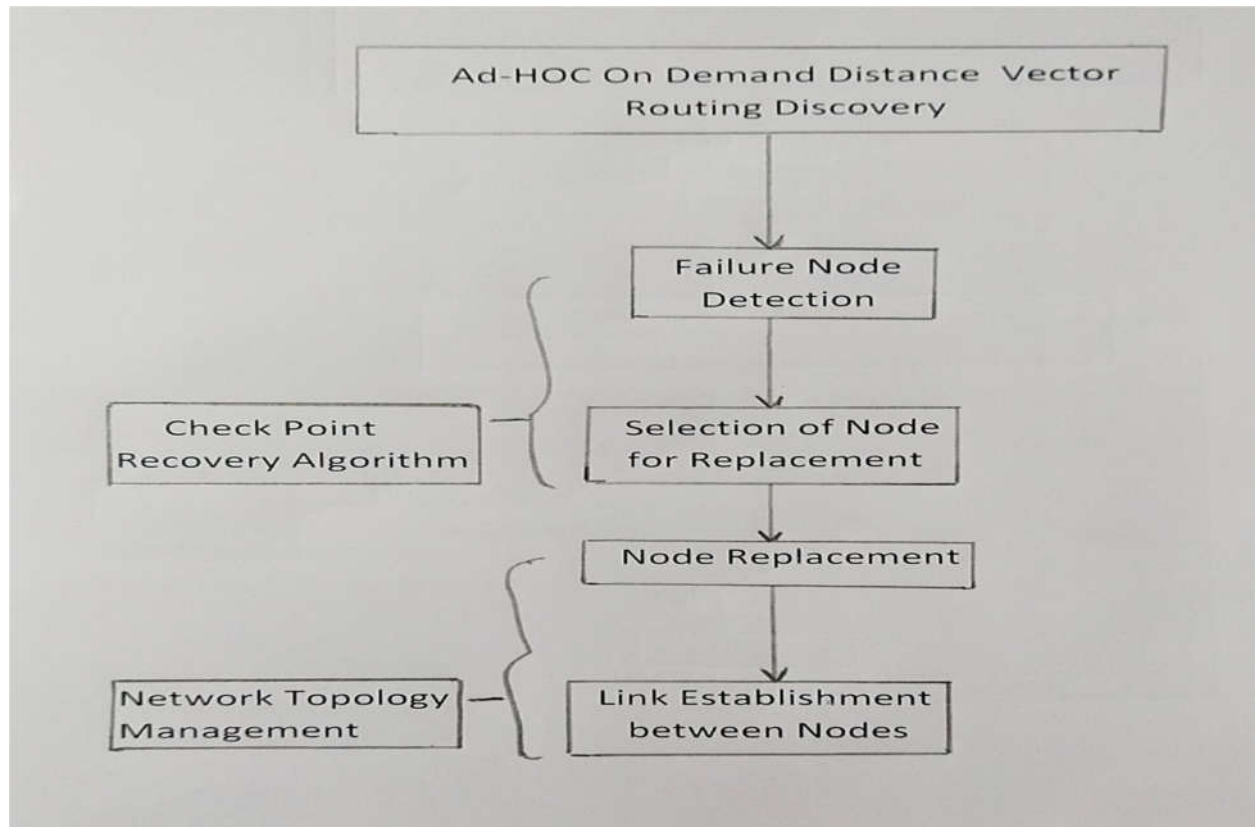
Figure 3 . Flow Chart for Check Point Recovery Algorithm

IV. Node Encoding Verification Method

The Node Encoding Verification Method (NEVM) involves listing out all faulty nodes with binary coding; creating different verification paths based on Coding of Nodes ; sending data packages through the verified paths, getting the codes for faulty nodes; determining a particular faulty nodes of failure route [20] . The binary node encoding is used in NEVM. After coding, different verification paths are generated based on the sequence of node coding. The length of each node's pattern is the number of paths that are need to be cross checked . If

there are *Nn* nodes in the failure route, the number of paths that are needed to be verified *Np* (number_ path) is $N_P = \log_2 N_n$. For example if there 8 Nodes then the number of Verification Paths are 3. The number of virtual nodes *Nv* is given by $N_v = 2^{N_P} - N_n$; if the Nodes in the Failure Route are not of Radix 2 Coding is done according to the arrival of data packages . The code value is set to Binary '0' if the package reaches the destination and the code value is set to Binary '1' if package is lost [15] [25] . The purpose of implementing NEVM verification method is for verifying the failure Nodes quickly and effectively and its Computations are very simple. Whenever the Faulty node is replaced by a perfect node necessary action is taken on faulty nodes, by isolating the faulty nodes from effective path in the Network. NEVM method is very efficient in detecting single failure node in the route and can not detect more than one failure nodes on single path [25] .

V. Modified Cost Forwarding Protocol

Modified Cost Forwarding Protocol is best Suitable for Wireless sensor systems which gangs constrained assets and doesn't require any capacity of routing tables at the sensor nodes building up ideal routing Paths with barely any message trades . It is versatile and easy to execute. The protocol depends on the way that the course of routing is constantly known and it depends on cost field approach [18] . The base expense from that node to the sink on the ideal way is known as the Cost Field Approach [14] [24]. Each immediate node transmits the message just if the expended cost in addition to the node cost is equivalent to the source's expense. The expense of communicating something specific is the main data required by a node to actualize this MMCF convention . The channel ought to be error free and should gives solid information delivery , have zero inactivity (With a reasonable back off coefficient (γ), the accomplishment of this convention is autonomous of transmission and handling delays) [13] [24] .

The usage of Minimum cost forwarding Algorithm includes two modes The initialization mode includes the setting up of the cost estimation everything being equal and the operational mode-includes the directing of information. The parameter considered for Minimum cost forwarding Algorithm is carried out by considering the connection cost dependent on the distance and the structure depends on Energy and delay Constraints. The encoded data contains all the data identified with Source Node while broadcasting. Encoding is possible any number of

times and at any node and Network coding idea is utilized at the Intermediate Nodes to improve the Energy Efficiency.

VI. Clustering based TFD Algorithm

Clustering Methods are generally used systems in WSNs to expand the lifetime of the Sensor hubs by diminishing the utilization of Energy and giving security, versatility and effectiveness in a greatly improved way [7] [8] . In Clustering Techniques the Sensor systems are divided into group of systems with little nodes, called Clusters [19] [23] . The groups are then overseen by an uncommon sensor node called as Cluster Head (CH). In this way, each gathering of Network group comprises of two kinds of node to be specific Sensor Node (SN) and CH. This calculation gives a propelled approach to perceive flawed sensors dependent on deciding typical CHs and using them as references to derive the ' status of the Neighbors . This calculation is viable in recognizing shortcomings in huge group subordinate WSNs that have high disappointment proportion and low thickness of hubs. It is made out of two system levels [12] . Level one is completed locally inside sensor hubs, while the other level is acted in the entryway or bunch heads [9] [23] . In this way, this work offers a propelled deficiency location approach named Table Fault Detection (TFD) calculation to tackle a portion of these issues, for example, the discovery of defective sensors with the nearness of numerous sensors and items, which impart together without considering the sensor nodes failure probability, with lessening the Energy Consumption by these nodes and upgrading the system lifetime [11] .

VII. LEACH Protocol

Low Energy Adaptive Clustering Hierarchy (LEACH) is a TDMA Based MAC Protocol. The Leach Protocol is divided mainly into three Sub sections like The Set-up Phase, the steady state Phase [1] [2] . The Set up phase involves the following steps like selecting the Cluster Head , forming a Cluster and Scheduling TDMA and CDMA In the Steady state phase the sensor node sends the data to CH in the allotted TDMA Slot , the CH receives data from all members , it compress and data fuses and then sends it to base station and the process starts from the step 1 .

Detection of Malicious Nodes : It involves the following steps, the first step is the authentication check . The authentication check is done by a pre shared secret Check key. If the MAC Values

are matched then the data is forwarded to the base station else it is sent back. The detection Phase includes the following steps, blacklist, flooding, suspicion level [1] [2] .

The last phase is the isolation level. In this phase the cluster-head node sends a message in encrypted form to all the nodes in the network except the node which is blocked . The message contains information to delete the blocked node from their neighborhood list and hence the blocked node id is completely isolated and eliminated from the network.
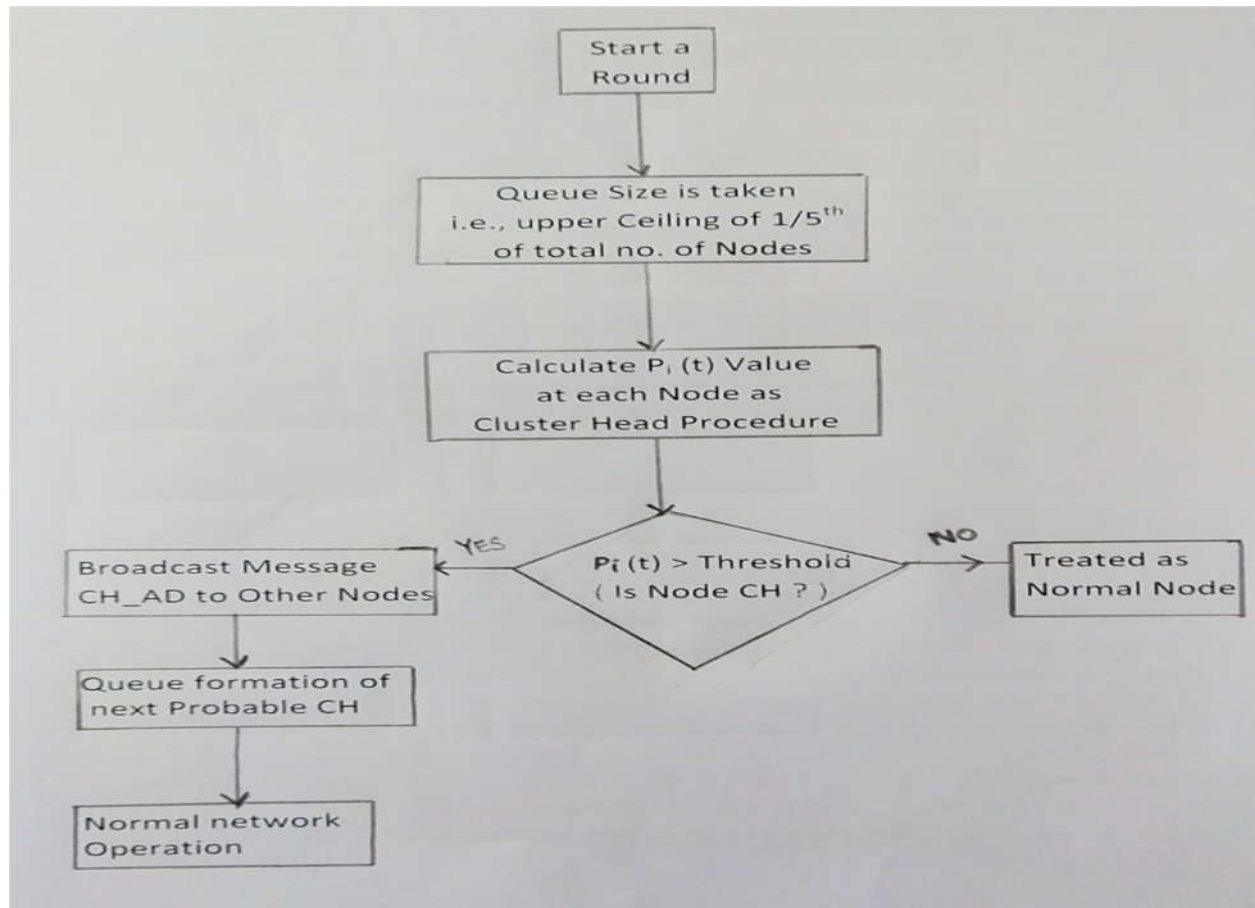

Figure 3 : Flow Chart for LEACH Protocol

VIII. Conclusion

The Node Failure is a critical issue in wireless Sensor networks which need to be detected and rectified as early as possible. The detection mechanisms described in this Paper gives us some unique solutions for the detection of Faulty nodes. The Algorithms and Techniques can be verified by Network Simulator Tool (NS-2) , OMnet ++, Qual Net . The techniques provide simple and very efficient solutions for the detection of Faulty nodes.

However they have some disadvantages which need to be addressed and research is going on to overcome those disadvantages.

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